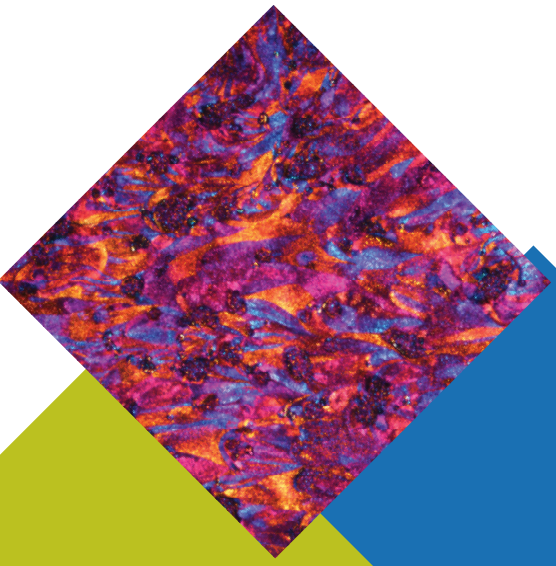
NC STATE UNIVERSITY

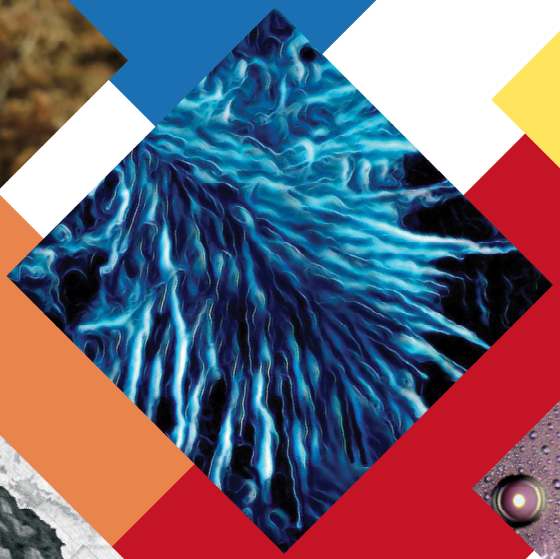
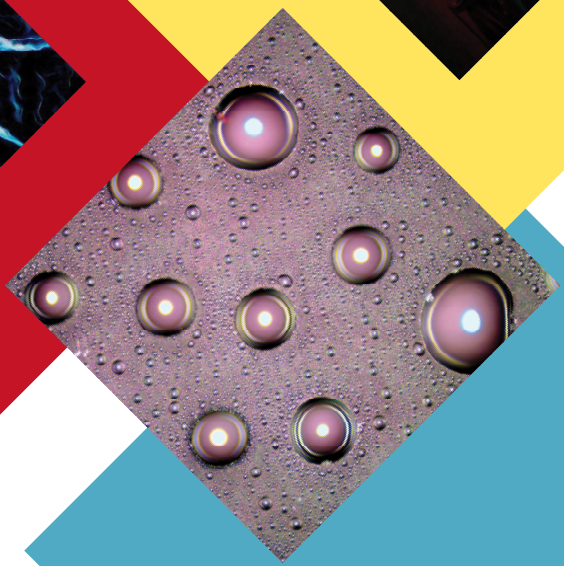
15th Annual
Graduate Student Research Symposium

ABSTRACTS

Wednesday
April 6, 2022
1:00 to 5:30 pm
McKimmon Center






Fifteenth Annual
Graduate Student Research Symposium
North Carolina State University

SYMPOSIUM ORGANIZERS

Graduate School

Dr. David Shafer, Assistant Dean
Bridget Foy, Administrative Assistant
Todd Marcks, Fellowships and Grants Administrator
Darren White, Webmaster

Graduate Student Association

Kuncheng Song - Bioinformatics (Symposium Lead)
Deveshwar Hariharan - Electrical and Computer Engineering (GSA President)
Salvador Cruz Matus - Plant and Microbial Biology
Pavel Koprov - Industrial and Systems Engineering
Peter Oppenheimer - Plant Pathology
Sarah Orr - Toxicology
Echo Pan - Functional Genomics
Bren Potter - International Studies
Alex Sohn - Chemistry
Adam Schmidt - Civil, Construction, and Environmental Engineering

AGENDA

12:00 pm - 1:00 pm	Poster Set Up (All set up their posters).....	Area 1
1:15 pm - 1:30 pm	Welcoming Remarks and Symposium Overview	Area 1
	Mr. Deveshwar Hariharan, GSA President	
	Dr. David Shafer, Assistant Dean of the Graduate School	
1:30 pm - 4:00 pm	Poster Session and Competition.....	Area 1
4:15 pm - 5:30 pm	Announcements of Awards and Reception	Room 2
	Dr. Peter Harries, Dean of the Graduate School	
	Dr. David Shafer, Assistant Dean of the Graduate School	

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ABSTRACTS

College of Agriculture and Life Sciences

Manveen Kaur Ahuja, Qingyang Wang, Deepti Salvi
Graduate Program: Food Science
Advisor: Deepti Salvi
Poster Number: 4

Comparison of inactivation efficacy of plasma-activated water against biofilms on two types of lettuce

Bacterial biofilms are multicellular layers of adherent bacteria, being surrounded by a matrix of extracellular polysaccharides. Biofilms are a primary source of contamination in food processing environments and their removal has been a major challenge as they are protected from varieties of environmental stresses such as antimicrobial compounds. Plasma-activated water (PAW), generated by exposing water to cold plasma, is a promising sanitizer for biofilm decontamination.

The aim of this study was to compare the decontamination efficacy of PAW against biofilms developed on romaine lettuce and iceberg lettuce. Lettuce samples of size 1" x 1" were dip inoculated with Listeria innocua or E. coli DH5 to grow biofilms for 24 hours at 4 °C. PAW was prepared by exposing deionized (DI) water to an atmospheric pressure air plasma jet for 15 minutes. The inoculated lettuce samples were incubated in PAW for 15 min for biofilm inactivation. The inactivation efficacy of PAW against biofilms was determined by plate count and analyzed using ANOVA. All experiments were performed in triplicate.

Reductions of E. coli biofilms by 1.7 ± 0.7 log CFU/ in2 and 2.5 ± 1.1 log CFU/ in2 were observed on romaine lettuce and iceberg lettuce, respectively. For L. innocua biofilms, PAW achieved a reduction of 2.0 ± 1.1 log CFU/ in2 on romaine lettuce while 2.5 ± 0.5 log CFU/ in2 reduction was observed on iceberg lettuce. Physical parameters of PAW including pH (2.3 ± 0.2), ORP (245 ± 13 mV), conductivity (185 ± 13 µS/cm), and temperature (33.9 ± 2.9 °C) were also observed. The results suggest that PAW is a promising sanitizer for fresh produce but the efficacy may vary based on the type of produce.

Rachelle Andreatta and Travis Park
Graduate Program: Agriculture and Extension Education
Advisor: Travis Park
Poster Number: 6

Relationship between Enrollments in Land-Grant Agricultural Education Majors by Year and State Participation in the Teach Ag STAR Program

Agricultural education has suffered a shortage of teachers for decades (Eck & Edwards, 2019). From 2010-2019, 729 new programs emerged, requiring 1,632 new teachers. In 2014, the State Teacher Ag Results (STAR) program was started and provided states with funds for recruitment and retention of agriculture teachers. This research purpose was to determine Teach Ag STAR effectiveness on enrollments in agricultural education in colleges of agriculture (COA). This relational study was based on Teach Ag STAR state participation data and land-grant agricultural education enrollment data collected from the Food and Agricultural Education Information System at Virginia Polytechnic State University (2021). Enrollment data were collected from COA from 2002-2019 and from STAR states between 2014-2019. Complete data were provided for 22 states. Data were based on enrollments from five years prior to participation in STAR compared with five years after the state began STAR or until 2019. Of the 22 states, 12 experienced their highest enrollment since 2002, after STAR. Seventeen states increased overall enrollment since STAR began in their state. Analysis of the 2014 cohort of eight states showed a loss of 97 students (x = -14.9 students, -10.7%) in the five years prior to STAR and an increase of 149 students (x = 18.6 students, 15.0%) in the 5 years following STAR. STAR appeared to elicit an overall increase in agricultural education student enrollment at land-grant universities following implementation. Based on these census data, a positive relationship exists between STAR implementation and agricultural education enrollments at land-grant universities. Researchers should analyze STAR's plan of action of the states with large increases in enrollment to determine what factors elicited positive enrollment increases.

Lindsey E. Becker and Marc A. Cubeta
Graduate Program: Plant Pathology
Advisor: Marc A. Cubeta
Poster Number: 14

Elucidating the seed mycobiome of four wheat cultivars: a culture-based approach

The occurrence of pathogenic fungal taxa associated with wheat (Triticum aestivum L.) seeds is well studied, but less is known about non-pathogenic taxa of the wheat seed mycobiome. The goal of our research is to characterize wheat seed fungal endophyte diversity via a culture-based approach. Four publicly available winter wheat cultivars developed in the southeastern United States with varying phenotypic and disease resistance traits were examined: Catawba, Hilliard, Shirley, and USG3640. These cultivars were grown in plots located at Midpines Research Station in Raleigh, North Carolina over a period of two years. We hypothesize that a small but critical group of fungal taxa will be present in all four cultivars across both years. To isolate endophytic fungi, asymptomatic wheat seeds were surface disinfested using sequential submersion in 95% v/v ethanol and 50% v/v bleach solutions. Post surface disinfestation, seeds were air dried, macerated, and sieved to obtain < 177 µm fragments. A 1:100 diluted suspension of macerated seeds was transferred to Malt Yeast Extract (MYE) agar amended with streptomycin and tetracycline (50 mg/L each), and cyclosporin (4 mg/L). Single hyphal tip isolates were grown in MYE broth and DNA was extracted. Molecular characterization of fungal isolates was accomplished using ITS primers and Sanger sequencing. By utilizing these methods, we are developing a catalog of fungal taxa associated with the wheat seed interior. Comparison of fungal taxa associated with each wheat cultivar will allow for greater understanding of the wheat seed mycobiome and diversity. We were able to compare the seed endophytic community over two years, providing insight into the core mycobiome of wheat seeds. The culture library generated by this study will help validate amplicon sequencing of wheat seeds and contribute to the design of synthetic microbial communities.

Eric Butoto and James B. Holland
Graduate Program: Crop Science
Advisor: James B. Holland
Poster Number: 24

A tale of two selection methods for resistance to Fusarium ear rot and fumonisin in maize

Fusarium verticillioides is a maize fungus that causes Fusarium ear rot (FER) and produces fumonisin (FUM), a mycotoxin associated with various diseases in humans and animals that consume contaminated grain. Phenotypic selection (PS; visually selecting resistance plants to use as parents for the next generation) is the traditional method for breeding resistance, but it is hindered by the cost and time required to obtain accurate evaluations of FER and FUM. Genomic selection (GS) is an alternative method that can speed up time and reduce the cost of obtaining accurate evaluations of FER and FUM content. Genomic selection uses existing field evaluation data plus dense genetic markers to train a prediction model that predicts FER and FUM content for new individuals that have not been evaluated in the field. This study empirically compares PS and GS ability for improving FER and FUM resistance over multiple generations (cycles). Plants sampled from PS and GS cycles were evaluated in three North Carolina environments in 2020. We found that both methods effectively improve resistance to FER and FUM content. Resistance to FER and FUM content was slightly higher in GS than PS; however, the final cycle of PS and GS did not differ significantly ($\alpha = 0.05$) for FER and FUM content. We observed a 20% decrease in genetic marker variation from PS and a 30% decrease from GS; balancing rapid genetic gain and loss of genetic variation will be important in GS. Our greatest challenge was our inability to quickly obtain dense and consistent set of marker genotypes across generations of GS; practical implementation of GS in individual public-sector breeding programs will require cheaper and faster dense genotyping methods.

Darien Campisi[1], Shannon Rhoads[2], and Todd Cohen[2]
Graduate Programs: Physiology[1]; Neurology, University of North Carolina at Chapel Hill[2]
Advisor: Todd Cohen
Poster Number: 25

Elucidating the Mechanisms Behind ALS Pathogenicity in Mutated Cytoskeletal Genes

Amyotrophic lateral sclerosis (ALS) is a rapidly progressing adult-onset neurodegenerative disease caused by motor neuron death in the brain and spinal cord. The patient's condition progressively worsens until death occurs only 2-5 years after diagnosis. There are currently no effective treatment methods for ALS. Found in post-mortem brain tissue, phosphorylated TAR DNA-Binding Protein 43 (TDP43) accumulates in the cytoplasm of affected motor neurons as a hallmark of disease. However, less than 5% of ALS cases are caused by mutations in the TDP43 gene itself. Because mutations in cytoskeletal genes are understudied, we are screening ALS-causative mutations across several genes of cytoskeletal proteins to better understand their pathological mechanisms. Based on previous results, we hypothesize that proteins with mutations in coiled-coiled domains or other known functional domains will show defects in their intended processes, leading to the aggregation of insoluble, phosphorylated TDP43 and other ALS phenotypes. We first screened for evidence of TDP43 aggregation and concurrent phosphorylation in HEK293 cells with ALS-causing mutations. We found that a subset of mutations significantly increased phosphorylated TDP43 levels, especially those within coiled-coil domains or other known functional domains. Currently, we are studying the effects of these mutations on protein stability and confirming that previously seen increases in phospho-TDP43 are present as insoluble aggregates in the cytoplasm. After confirming pathological mutants, they will be further investigated for autophagy defects, dysfunctional nuclear-cytoplasmic shuttling, and changes in organelle trafficking to determine the pathological cellular changes that occur with mutations in cytoskeletal genes.

Magdalina J. Cummings[1], Hongyao Yu[2], Guang Hu[2], Xiaoling Li[3], Myriam Hemberger[4] and Xiaoqiu Wang[1]
Graduate Programs: Animal Science[1]; Epigenetics and Stem Cell Biology Laboratory[2], and Signal Transduction Laboratory[3], National Institute of Environmental Health Sciences, Research Triangle Park; Departments of Biochemistry & Molecular Biology and Medical Genetics[4], Cumming School of Medicine, University of Calgary, AB, Canada
Advisor: Xiaoqiu Wang
Poster Number: 34

Uterine-specific ablation of Sirtuin 1 causes subfertility and accelerates reproductive aging

Sirtuin 1 (SIRT1) is a multifunctional NAD+-dependent deacetylase that regulates cell cycle, apoptosis, and aging. We hypothesize that SIRT1 plays a critical role in uterine function during pregnancy and uterine specific ablation of Sirt1 gene accelerates reproductive aging. RNA in situ hybridization analyses showed that Sirt1 mRNA was decreased in uterine decidua of aged female mice (45-48 weeks of age) at post-Decidual Day 2 [DD2; mimicking gestational day (GD) 6.5] as compared with young female mice (6-8 weeks of age). To investigate the functional role of SIRT1 in the uterus, mice carrying the Sirt1f/fallele were bred to Pgrcre/+ mice to generate Pgrcre/+Sirt1f/f (Sirt1d/d) mice. The 6-month breeding trial indicated a significant reduction ($P<0.0001$) in total live pups born to Sirt1d/d mothers (n=7; 40/89, 45%) compared to Sirt1f/f mothers (n=6; 223/245, 91%). These Sirt1d/d mothers showed decreases ($P<0.01$) in litter size from their 1st pregnancy and became sterile at 25.1±2.5 weeks of age. Sirt1d/d females exhibited decreases ($P<0.0001$) in decidual bulb weight and disoriented implantation sites at both GD 6.5 and 9.5. Immunohistochemical analyses of the uteri of GD 5.5 mice showed alteration in the expression patterns of PTGS2, FOXO1, and PGR and decreases in PGR and COUPTFII in the stromal cells and increases in Ki67 sporadically in the epithelial cells at GD 3.5. Investigation of downstream progesterone, estrogen, and Indian hedgehog factors using qPCR analyses revealed that Sirt1 ablation at GD 3.5 altered the integrity of these pathways. Transcriptomic data showed an increase in stress and senescence pathways and a decrease in IL-15, mTOR, Stat3 signaling pathways. Comparative analyses of Sirt1d/d and aged transcriptomes identified 1157 shared dysregulated genes. Young Sirt1d/dmice also had accelerated development of fibrous collagen. These novel results indicate a significant role for SIRT1 in governing decidualization and placentation, as well as aging.

Savannah Currens
Graduate Program: Agricultural Education
Advisors: Travis Park and Clint Stevenson
Poster Number: 35

Correlation between CASE Institutes for High School Food Science Educators and Food Science Major Enrollment at the Local Land-Grant University

Food science, like other agriculture degree programs at land-grant universities, has experienced a shortage of new talent in the workforce pipeline. Nationwide undergraduate food science enrollment has decreased by 32%. NC State University has mirrored this trend with a 27% decrease in enrollment since 2015 (Food and Agriculture Information System, 2020). Yet, demand for food scientists is greater now than ever before. Employment in food science careers was projected to increase by 6% from 2018 to 2021 (US Labor Statistics). The result is 100% job placement for food science graduates. However, there are not enough food science graduates to pace industry demands. The purpose of this study was to determine if a relationship exists between the number of Curriculum for Agricultural Science Education (CASE) Food Science and Safety (FSS) certified teachers in a state and food science enrollment at the state's land-grant university. Undergraduate enrollment data for food science from 2010-2020 were gathered from FAEIS at Virginia Polytechnic State University which categorizes majors by Classification of Instructional Programs (CIP) codes. CASE FSS teacher certification data from 2014-2021 were obtained directly from the CASE program director. The average number of teachers trained per state was 9.3. Since 2013, collegiate food science enrollment in these states decreased by 31.0%. Change in food science enrollment since each institution's highest enrollment was -39.1% overall. Correlation between CASE FSS teachers and change in enrollment since 2013 was -0.20 ($p = 0.36$). Change since highest enrollment was -0.24 ($p = 0.27$). Results indicated no significant correlation between CASE FSS teachers and food science enrollment at land-grant universities. Since CASE FSS alone does not appear to be correlated with student interest in food science, teacher professional development may need to be enhanced. Worthwhile research should explore continuous professional development for educators.

Kai Deng
Graduate Program: Food Science
Advisor: Gabriel K. Harris
Poster Number: 39

Herbs, Fruits, and Coffee: The Viability of Developing Infused Coffee Products

As one of the most popular drinks around the world, coffee did make significant progress in recent years with more than hundreds of billions of dollars in annual deals, and the production and consumption of coffee products will continue to rise worldwide in the future. The primary goal of this project is to create a coffee product infused with natural herbs or fruits, which can give this new product a distinctive fruity flavor and provide natural bioactive compounds that contribute health benefits to humans. The final form of this product would be a concentrated coffee solution that is highly customizable, it can be added into milk to make a Latte, or it can be added into water to make a regular coffee. Wolfberry is one of the ancient herbs used in China, and it will be represented in this project. Lutein and Zeaxanthin, two of the essential carotenoids in the wolfberry, have proven beneficial for human eyes. Besides that, wolfberries also contain other substances such as betaine, Lycium barbarum polysaccharides, iron, and selenium. On the other hand, as a representative of fruit, blueberries are known for their anti-inflammatory, anti-cancer, and antioxidant properties, which is a suitable candidate for this project. This newly developed coffee product will be evaluated by a series of techniques, including HPLC, Mass Spectrometry, and Colorimeter, to determine the composition and concentration of bioactive compounds present in the product. Then, natural extracts will be added for standardization if necessary. Aseptic packaging will be used for final products with an optimal shelf life of 6 months to a year. Since there is a lack of naturally infused coffee products on the market right now, this innovation could lead to a breakthrough in the coffee industry.

Ashley R. Deutsch, Lara L. Martens, Adam Hartstone-Rose
Graduate Program: Biological Sciences
Advisor: Adam Hartstone-Rose
Poster Number: 41

Osteological correlates of fascicle length and gape in Carnivora

Previously, our lab has studied the scaling and dietary correlates of masticatory muscle architecture separately in cats, weasels (and their close relatives; musteloids), dogs, and bears as well as across the carnivore order as a whole. In some of these lineages, particularly musteloids, fascicle lengths (FLs; a correlate of gape) scale with relative diet size. In the current investigation, we evaluate bony correlates of dissection-based FL measurements. In a preliminary analysis of 14 musteloids, we measured 13 origin-to-insertion distances to compare to the FLs of the masticatory adductors (jaw closing muscles) of these species. Residuals of bony distances relative to body mass and cranial size were regressed against residuals FL for each individual muscle as well as average FL. Some bony distances were found to be good proxies for certain jaw-closing muscle metrics, although proxies correlated better for some muscles than others. This may be because the attachment areas for some muscles are almost entirely influenced by masticatory function, while others are also affected by the neuro-protective and sensory functions of the cranium. Combining these findings with measures of jaw leverage (e.g., the lengths of the jaws at each bite point), it is possible to reconstruct the gape of extinct species. This will give new insight into relative diet sizes consumed by these carnivores. When we expand our methods across other members of the order, we will be able to evaluate gape in modern species for which data have not been systematically collected and also provide this new approach to gape estimation in extinct species including sabertooths.

Anna Dye[1], José Ascencio-Ibáñez[2], George Kennedy[3], Linda Hanley-Bowdoin[1]
Graduate Programs: Plant Biology[1], Biochemistry[2], Entomology[3]
Advisors: Linda Hanley-Bowdoin and George Kennedy
Poster Number: 48

Virus complementation enables transmission of partial mixed infection in tomato

Mixed viral infections in plants affect disease severity, viral diversity, and transmission by insect vectors. Co-infection in tomato of two begomoviruses, Tomato yellow leaf curl virus (TYLCV) and Tomato mottle virus (ToMoV), leads to a severe phenotype indicative of a synergistic interaction between the two viruses. TYLCV is a monopartite Old-World virus and ToMoV is a bipartite New-World virus. Both are transmitted by the silverleaf whitefly (Bemisia tabaci MEAM1). This work investigates the role of mixed infections on viral titers, virus localization, and whitefly transmission. We found that when transmitted by a whitefly vector, the mixed infection frequently loses the B component of ToMoV but maintains the A component. Both genome components are necessary for systemic infection in a single infection. However, we hypothesize that TYLCV is providing movement functions necessary for ToMoV A to systemically infect a tomato plant and thus to be transmitted by a whitefly vector. This result was confirmed with agroinoculation of a partial mixed infection with ToMoV A and TYLCV and omission of the ToMoV B component. The partial mixed infection, which results in a distinct phenotype, can be transmitted over multiple rounds of vector transmission. We examined localization of mixed and partial mixed infections in the host plant. This work is important to better understanding interactions among virus genomes in mixed infections.

Beth Edwards
Graduate Program: Youth, Family, and Community Sciences
Advisors: Annie Hardison-Moody and Sarah Kirby
Poster Number: 50

Pathways of Resilience in Low-Income Families: A Longitudinal Case Study Exploration of a Multilevel, Dynamic Process

Families play an important role in caring for and supporting the growth and development of their members as they progress through the family life cycle. When adversity arises, how do some families rise above their challenges and achieve positive adaptation in spite of difficult circumstances? The study of family resilience explores this process. Resilience is not a static trait that only occurs in some families. It is a dynamic process from which all families have the potential to benefit. A variety of promotive processes, protective processes, risks, and vulnerabilities interact at multiple levels of the ecosystem to shape a unique trajectory for each family. These pathways cannot be fully appreciated by merely noting the absence of psychopathology, viewing a single snapshot in time, or averaging the adaptive responses of multiple families. Using qualitative data from a large longitudinal analysis of interviews with 124 low-income families, this project takes a case study approach to examine in depth the trajectories of a few families from the study. Qualitative analysis of multiple interviews and observations of each family over an eight-year period provides an opportunity to explore the multilevel, interactive, and dynamic process of family resilience. Preliminary analysis suggests that a variety of resources such as family support, job stability, a positive attitude, creative problem-solving skills, and flexibility contribute to resilience and that being able to utilize an array of these resilient processes enhances a family's ability to survive and thrive.

Sophie Farlow
Graduate Program: Agricultural and Extension Education
Advisor: Joseph L. Donaldson
Poster Number: 57

A Study of Career Intentions and Career Adaptability among Extension Summer Internship Program Interns

Agriculture plays a vital role in our daily lives, and Cooperative Extension has an indelible mission in supporting food and agricultural systems. Internships provide opportunities to prepare the next generation of Extension professionals to provide vital education and technical assistance for farmers, consumers, and others. Limited research is available on Extension internship programs, specifically how the program influences, if at all, the interns' career choice and career adaptability. Career adaptability, broadly stated, is the ability to adapt and manage one's career. Career adaptability is a set of competencies that include career agency; occupational awareness; negative career outlook; support from family and friends in making career transitions; and work-life balance. As career adaptability may help individuals thrive in the workplace despite changing economic realities, it is important to research ways to enhance career adaptability among those entering the workforce. This research investigated career adaptability and career choice among NC State Extension Summer Internship Program interns (N=15). A descriptive quantitative approach was used to study the interns' perceptions, implementing the Career Futures Inventory-Revised in a one-group pretest-posttest design. Career choice and levels of interns' adaptability were measured both before and after the internship program. Analysis showed that interns increased their perceived career adaptability during the internship program with perceived improvements in career agency (29.3%), occupational awareness (15.5%), negative career outlook (20%), and work-life balance (28.3%). However, perceived support declined by 10%. Perhaps, this decrease was because the interns were college students pursuing internships away from their college campuses and friends. Approximately one-half of the interns were planning Extension careers prior to their internship, and the internship experience helped them identify specific Extension professional roles. The major implication of the study is that the Extension internship program enhanced most major constructs of interns' career adaptability and help them clarify Extension career intentions.

Kyle A. Freedman, Cristian Collado, Ricardo Hernández, Mark Hoffmann
Graduate Program: Horticultural Science
Advisor: Mark Hoffmann
Poster Number: 64

Precise Indoor Vine Conditioning: Impact of light intensity on the physiology of 'Traminette' and 'Concord' grapevines

Grape production in the United States is one of the most impactful horticultural crops. Perennial fruits such as grapes take up to 5 years to produce harvestable yields and require high up-front investment costs during establishment. High establishment costs combined with the challenges that climate change poses to viticulture makes grape growing a risky endeavor. Prior research has shown that high light intensity and temperature can increase grapevine flowering and thus potential yield. Advances in Controlled Environment Agriculture (CEA) and more efficient lighting technologies such as Light Emitting Diodes (LED) can be utilized to condition young grapevine transplants for increased yields. Such conditioned grapevine transplants could then be planted and cropped in the same year and potentially used as starter plants or in an annual system. A system like this could reduce establishment costs for growers, allow greater flexibility in site-specific cultivar selection, and reduce the risk of long-term systemic grapevine diseases. The objective of this study is to condition grapevines with supplemental light intensity for increased growth and development. 'Concord' and 'Traminette' grapevines were grown in a controlled environment greenhouse under three LED supplemental light intensities: 0 PPFD, 300 PPFD, and 600 PPFD. Results indicated that growth parameters such as stem diameter were greater at 600 PPFD across both cultivars. Other response variables including leaf area showed no significant difference between treatments. Photosynthetic rate was the highest for both cultivars at 300 PPFD. These results suggest that grapevines respond to supplemental light with increased growth and that these increases in growth lead to greater bud fruitfulness and yields. Our future research will focus on evaluating those characteristics.

Carly Graves
Graduate Program: Biological and Agricultural Engineering
Advisor: Madmoud Sharara
Poster Number: 74

Gaseous Emissions From In-House Broiler Litter

Broiler litter is a valuable fertilizer but can also be a source of odorous and GHG emissions during broiler production, storage, and land application phases. This study seeks to quantify the magnitude of emissions associated with in-house broiler litter, and estimate variability across farms. Finally, the study screens litter parameters, such as litter age and chemical composition, for gas emission predictors. A set of five active broiler houses in North Carolina were sampled to measure gaseous emissions (NH_3, H_2S, CH_4, N_2O, CO_2, and VOCs) using headspace flux measurement gas samples. Liquid extraction was used to quantify less volatile organic species that are associated with odorous emissions in the litter. H_2S emissions were very low (> 0.01 ppm) and did not produce statistically significant observations. There was a wide range of emissions from the litter samples for different gases: 146-555 ppm NH_3, 1.5-22 ppm N_2O, 4,077-50,835 ppm CO_2, and 9.1-43.3 ppm CH_4. The differences between farms accounted for 86%, 81%, 76%, and 84% of the variability in NH_3, N_2O, CO_2, CH_4 observations, respectively. Moisture content and age of the litter were the primary contributing to increased gaseous emissions from all samples. More specifically, NH_3 was largely impacted by pH ($p < 0.01$), while N_2O, CO_2, and CH_4 were largely impacted by C:N ($p < 0.01$). Additional findings related to VOCs from gaseous and liquid sampling analyses are forthcoming.

Rifat Hasan, Ashley E. Beck, Steven G. Hall
Graduate Program: Biological and Agricultural Engineering
Advisors: Ashley E. Beck and Steven G. Hall
Poster Number: 84

Re-framing waste as a valuable resource: A metabolic approach to value-added products via cyanobacterial cultivation

Wastewater treatment has been a major concern globally for decades. With the increasing demand for protein from a growing world population, fish and animal agricultures are growing rapidly over plant-based food sectors and becoming a major source of water pollution. While wastewater treatment in these sectors continues to improve, the development of environmentally sustainable techniques is still needed, especially cost-effective approaches with potential for downstream value-added production. Bioremediation of wastewater using microorganisms has a great prospective as a sustainable eco-friendly alternative to existing techniques. This study investigated the potential of one of the fastest-growing cyanobacterial species, Synechococcus elongatus UTEX 2973, for bioremediation of mixed wastewater (a combination of aquacultural and swine wastewater). This species can remediate wastewater by uptaking nutrients such as nitrates, ammonia, and phosphate to maintain its growth. The nutrient content of aquaculture wastewater is inadequate for the growth of this species. On the other hand, the nutrient concentration of swine wastewater can be excessive. This study investigated three different mixing ratios such as 25:75, 50:50, and 75:25 of these two types of wastewaters to find a suitable combination for the growth of S. elongatus. This species can also convert atmospheric carbon dioxide into complex cellular carbohydrates through carbon fixation during the bioremediation process. This study examined changes in carbohydrate accumulation with the end goal of using carbohydrate-enriched biomass as a feedstock to produce sugar and other derivatives. The carbohydrate accumulation in biomass during the bioremediation process was compared with the carbohydrate accumulation in biomass that was grown in synthetic growth media. Incorporating mixed wastewater in S. elongatus cultivation as a growth medium can reduce the cost of sugar production as it replaces costly growth media with a waste product. To complement the experiments, stoichiometric metabolic modeling of this strain was performed to predict the trend in the growth of this species and carbohydrate accumulation in biomass under different environmental conditions (by varying nutrients). Furthermore, the metabolic model of this strain was used to predict optimal nutrient levels in aquaculture wastewater for carbohydrate accumulation. Hence, by combining two important bioprocesses, this study addresses one of the most discussed issues of recent times, turning wastes into resources.

April Hausle
Graduate Program: Horticultural Science
Advisor: Julieta Sherk
Poster Number: 85

Middle School Educators' Descriptions of Outdoor Learning Environment Design

Outdoor learning environments (OLEs) are defined as any outdoor spaces within schools or informal educational settings where lessons occur. Examples of OLEs include, but are not limited to, school gardens and nature trails. Regular outdoor lessons have been shown to improve learning outcomes for middle school students (ages 11-14), as well as contribute to their mental, physical and emotional well-being. Although there is a large body of evidence to support the countless benefits of outdoor learning for adolescents, there is little research examining the design of OLEs in middle school settings. With the goal of improving the design quality of OLEs, 30 formal and informal middle school educators in the Southeast United States were surveyed to determine their views on which design elements are most effective for demonstrating NC Essential Science Standards and other scientific concepts to their students. This study also compared and contrasted OLEs in formal versus informal educational settings and examined educators' attitudes toward teaching outdoors. Results from this survey suggest that educators consider outdoor classrooms to be the most effective design element within OLEs for demonstrating scientific concepts to middle school students, and OLEs are most useful to educators when they contain a wide variety of design elements. Furthermore, OLE design element preference differs between formal and informal educators. Formal educators prefer garden-centric OLEs with elements such as compost areas, raised beds, vegetable plots and greenhouses, while informal educators prefer nature-centric OLEs with elements such as water features, trails, pollinator gardens and pathways. Finally, the majority of middle school educators find that their students have an improved understanding of North Carolina Essential Science Standards after lessons in OLEs.

Nitesh Kasera, Praveen Kolar, Steven Hall
Graduate Program: Biological and Agricultural Engineering
Advisors: Praveen Kolar and Steven Hall
Poster Number: 94

Effect of surface modification by nitrogen-containing chemicals on morphology and surface characteristics of N-doped pine bark biochars

In this study, pine bark-derived biochar was modified with melamine, urea, ammonium chloride, and ammonium nitrate to synthesize nitrogen-doped biochars. The effect of chemical modification on the extent of N-doping and surface properties were investigated. The elemental analysis suggested that melamine modified biochar samples had 4.75% nitrogen, higher than nitrogen in other modified biochars. The surface morphology and surface profile were studied with scanning electron microscopy and confocal laser scanning microscopy. X-ray photoelectron spectra showed that N-doped samples' surface nitrogen content increased to 8.3%, 3.9%, 2.3%, and 2.9% for melamine, ammonium chloride, ammonium nitrate, and urea, respectively. X-ray photoelectron spectroscopy results also revealed that among the nitrogen fractions in the N-doped biochars, melamine modified biochar has the highest percentage of pyrrolic and pyridinic nitrogen (35.2% and 36.8%, respectively) compared to others. Urea modified biochar had the highest percentage of graphitic nitrogen (26.6%). Our results suggest that application-specific nitrogen-enriched biochar can be prepared by understanding how different nitrogen precursors interact with carbon surfaces.

Imani Madison[1], Eli Buckner[2], Maria Angels de Luis Balaguer[1], Jina Song[1], Jing Ding[3], Alice Kimbell[3], Devarshi Selote[1], Aitch Hunt[1], Eduardo Bueso[4], Ross Sozzani[1], Cranos Williams[2], Terri Long[1]
Graduate Programs: Plant and Microbial Biology[1]; Electrical and Computer Engineering[2]; Statistics [3] , Institute of Molecular and Cellular Biology of Plants, Universitat Politècnica de València-Consejo Superior de Investigaciones Científicas[4]
Advisor: Terri Long
Poster Number: 106

Iron deficiency changes the mechanisms governing sieve element cell differentiation

Abiotic stress severely affects plant development, from the molecular level to the cellular and organismal level. Iron deficiency, in particular, results in stunted primary root elongation and shoot chlorosis. In response to iron deficiency, the epidermal-specific responses to iron deficiency are well-known. However, iron deficiency affects other organ and tissue systems as well, contributing to overall stunted plant development. Sieve elements are phloem cells that transport photosynthates from source tissues, such as mature leaves, to sink tissues, such as fruits, developing leaves, and roots. Sieve elements in Arabidopsis roots differentiate along a gradient of cells from progressively undifferentiated "stem" cells to differentiated sieve elements. Root phloem serves as a useful model system in which we can study sieve element differentiation in response to stress. As a result, we have inferred the gene regulatory networks associated with the progression of sieve element differentiation under either iron deficient (-Fe) or iron sufficient (+Fe) conditions to identify the molecular mechanisms underlying iron deficiency-induced changes to sieve element differentiation. We also show that -Fe negatively regulates sieve element differentiation, particularly enucleation. We also identified putative key regulators of vascular differentiation. Here, we propose a molecular mechanism for the regulation of this developmental process under varying iron conditions. This reveals a need for more extensive tissue-specific stress studies, especially to inform broader applications such as tissue-specific stress responses.

Nassib Mugwanya
Graduate Program: Agricultural and Extension Education
Advisors: Jayaratne Koralalage, Dara Bloom, Joseph Donaldson, Jason Delborne
Poster Number: 120

Extension Agent Competencies and Training Needs on Public Issues Education: A Case of Genetically Engineered Crops in Uganda

Extension agents must possess unique competencies to conduct successful education programs on public issues in agriculture. This study assessed the important competencies Extension agents need to lead Extension and education programs on genetically engineered crops, a controversial public issue in Uganda. Specifically, the study objectives were to: describe the current extension programs on genetically engineered crops in Uganda; determine which competencies are important for Extension agents to conduct successful public issues education programs on genetically engineered crops; determine the self-reported proficiency levels of Extension agents involved in biotechnology education activities in eastern Uganda; identify training needs of Extension agents involved in education activities on genetically engineered crops; determine extension agents attitudes towards genetically engineered crops and public issues education programs. Using a descriptive survey research design, the study assessed Extension agents based on the Public Issues Education framework of core competencies for conducting extension programs on controversial issues in agricultural extension and education. The web-based survey instrument included 60 specific competency statements categorized into eight competency constructs. A total of 58 Extension agents participated in the study, drawn from the eastern agroecological zone of Uganda. All eight competency constructs were perceived to be important on a five-point Likert scale ranging from 1=not important to 5=very important. Self-reported proficiency levels for all eight constructs were perceived to be average, on a five-point scale ranging from 1 (very low), to 5, (very high).The development of a public issues education competency assessment tool based on the findings of this study will allow agents to determine and prioritize their professional development needs on conducting extension programs on genetically engineered crops. The findings of this study are limited to Extension agents with agricultural biotechnology extension responsibilities in the eastern agroecological zone of Uganda.

Mason Nelson[1], Sagi Enicole Gillera[2], William Marinello[2], Brian Horman[3], Genevieve St Armour[3], Heather B. Patisaul[4]
Graduate Programs: Physiology[1]; Toxicology[2]; Biological Sciences[3]; Center for Human Health and the Environment, North Carolina State University[4]
Advisor: Heather B. Patisaul
Poster Number: 124

Exploring the Lactational Window of Exposure as a Critical Period of Susceptibility to the Effects of Chemical Flame Retardant Exposure on Neurodevelopment

The rising incidence of neurodevelopmental disorders in children is raising concern that exposure to environmental contaminants may be contributory. Chemical flame retardants (FRs) have long been associated with behavioral and cognitive impairments in humans, including heightened risk of Autism Spectrum Disorders (ASD). Our lab has shown that developmental exposure to the commercial FR mixture Firemaster 550 (FM 550) adversely impacts sociability and anxiety-like behavior in prosocial prairie voles exposed to FM 550 during gestation and lactation. Because prairie voles form social bonds and partner preferences, behaviors that are not commonly observed in other laboratory animal models, they have unique value to assess the effect of chemical exposure on social neural networks. The mode of action and more specific age at which the brain may be vulnerable to exposure remain unknown. To address this gap in research, we tested the hypothesis that the brain is vulnerable to FM 550 exposure during the lactational period. Because the hippocampus and nucleus accumbens are key areas associated with social behavior and the hippocampus undergoes significant development during this time period, they were the brain regions of focus. In this study, dams were exposed to 0 or 1000 ug of FM 550 via dosed cookie treat from gestational day (GD 0) through weaning (PND 21). Experimental animals were exposed to FM 550 through the dam during this entire lactational period. Offspring's brains were then collected as adults and expression of genes associated with anxiety and social behavior were assessed using Nanostring. The observed changes were sex and region specific. This study provides insight into the sex-specific effects of FM 550 exposure on social brain regions during an important developmental period.

Cassondra Newman[1], Andrew Oakley[1], Ryan Andres[1], Katelyn Fritz[1], Brian Scheffler[2], Sharon Simpson[2], Jaqueline Campbell[3], Steven Cannon[3], Ramsey Youngblood[4], Amanda Hulse-Kemp[2], Jeffrey Dunne[1]
Graduate Programs: Crop Science[1]; Genomics and Bioinformatics Research Unit, USDA-ARS2[2]; Corn Insects and Crop Genetics Research Unit, USDA–ARS3[3]; Institute for Genomics, Biocomputing, and Biotechnology, Mississippi State University[4]
Advisors: Amanda Hulse-Kemp and Jeffrey Dunne
Poster Number: 125

The Generation and Analysis of Genomics Information Forms the Foundation for Efficient Virginia-Type Peanut Cultivar Development

The peanut breeding program at North Carolina State University (NCSU) has historically developed Virginia-type peanut cultivars using conventional, visual-based selection techniques. The field of genomics has been rapidly improving to where it is currently feasible to produce vast amounts of high-quality genetic data in a timely and cost-effective manner. This technology can be applied to plant breeding to enhance the accuracy and efficiency of selection. In this study, genomics data was generated and used to create the full representation of the genetics of Virginia-type peanut cultivar 'Bailey II', or a reference genome. In comparison to published peanut genomes, the Bailey II reference genome is highly continuous and complete. Additionally, whole genome profiling was conducted for 66 peanut lines of importance to the NCSU peanut breeding program. The genetic data were used to gain insight into relatedness between individuals, population composition, and the amount of variation present across the genome. Moreover, genetic data generated in this study were used to track a historical crossing event which brought desired traits from a wild species, Arachis cardenasii, into cultivated peanut. This event took place at NCSU over 50 years ago, and still has impacts on current cultivar performance. Specifically, the genetic data generated in this study aided in the detection of two large segments of DNA from A. cardenasii which are present across the individuals in the breeding population. These two segments were positively selected for through breeding activities. Moreover, sixteen additional DNA segments which were previously uncharacterized in our program were identified. In summary, the data and findings generated will allow for peanut breeders to better understand the program's population composition, make informed breeding decisions, and track important regions of the genome [like those from A. cardenasii], which will ultimately lead to improved cultivar releases and superior peanuts for consumers.

Meichen Pan[1], Wesley Morovicb, Claudio Hidalgo-Cantabranaa, Avery Robertsa[2], Yong Jun Goha
Graduate Programs: Food Science[1]; IFF Health and Biosciences, International Flavors and Fragrances, Inc., Madison, WI[2]; Genomic Sciences[3]
Advisor: Rodolphe Barrangou
Poster Number: 131

Genomic and Epigenomic Landscapes Impact CRISPR-based Genome Editing in Bifidobacterium

Bifidobacterium is a ubiquitous commensal in the human gastrointestinal tract, associated with a range of health benefits. Despite the abundance of studies on Bifidobacterium physiology, there is a lack of genetic tools that enable the investigation of relevant functions and attributes. In the last decade, the advent of CRISPR-based technologies has revolutionized genome editing across the tree of life. Although CRISPR-based engineering has been deployed in select bacteria species, it has yet to be reported in Bifidobacterium. Here, we applied CRISPR-based editing in B. animalis subsp. lactis and demonstrated that editing outcomes hinge on both genomic and epigenomic context at a strain-level resolution. We repurposed the endogenous type I-G system to screen for naturally-occurring large deletion variants in length up to 27 kb, as well as to generate a 500-bp-deletion in tetW gene, abolishing the native tetracycline resistance. A CRISPR-cytosine base editor was optimized to install C•G-to-T•A mutation in multiple B. lactis strains, effectively inactivating the tetW via a premature stop codon insertion. Remarkably, we uncovered new epigenetic patterns that are distributed unevenly among the B. lactis strains, despite their genomic homogeneity, that may contribute to the various editing efficiencies. This study highlights the need to develop individualized CRISPR-based genome engineering approaches for Bifidobacterium and opens new avenues for the engineering of next-generation probiotics.

Camilo H. Parada-Rojas[1], Kenneth Pecota[2], Christie Almeyda[3], G. Craig Yencho[2], Kevin L. Childs[4], and Lina M. Quesada-Ocampo[1]
Graduate Programs: Plant Pathology[1]; Horticultural Science[2]; Micropropagation and Repository Unit, North Carolina State University, Raleigh, NC[3]; Department of Plant Biology, Michigan State University, East Lansing, MI[4]
Advisor: Lina M. Quesada-Ocampo
Poster Number: 133

Advancing our knowledge of sweetpotato disease resistance: one NLRome at a time

Cultivated for its nutritious storage roots, sweetpotato (Ipomoea batatas) is an important staple crop in the tropics, especially in Sub-Saharan Africa, Central America and New Guinea. Sweetpotatoes are highly susceptible to diverse pathogens in the field and postharvest. Breeding sweetpotatoes for resistance remains challenging due to limited knowledge of the genetic basis of resistance and the hexaploid nature of the crop. Plant intracellular immune receptors known as nucleotide-binding domain leucine-rich repeat receptors (NLR) represent a key component of the plant immune system by mediating plant immune responses to pathogen threats. Here, we aimed to catalog NLR diversity in historical (Apache) and contemporary (Covington) sweetpotato cultivars. We used resistance gene enrichment sequencing (RenSeq), a genome reduction approach, to capture and sequence full NLRs. A custom designed NLR bait-library of 2,034 targets allowed us to enrich NLR genes with 97% target capture rate. Using PacBio sequencing after RenSeq on genomic DNA, we identified between 649 to 833 complete NLRs for both cultivars. To uncover the diversity of NLRs in sweetpotato, we employed a curated database of cloned and functionally characterized NLRs (RefPlantNLR) to assign sequenced sweetpotato NLRs to functional phylogenetic clades. Our study provides a catalog of NLR genes that can be used to accelerate breeding and improve our understanding of evolutionary dynamics of NLRs in sweetpotato.

W. C. Rivero[1], Qingyang Wang[1], Ricardo Hernandez[2], Deepti Salvi[1]
Graduate Programs: Food Science[1]; Horticultural Science[2]
Advisor: Deepti Salvi
Poster Number: 144

Enhancing growth of hydroponic sweet basil using cold plasma technology

Hydroponic farming utilizes a water solution enriched with nutrients (NS), instead of soil, to optimize yield. Plasma, the fourth state of matter, is composed of reactive oxygen and nitrogen species. Plasma-activated nutrient solution (PANS) is generated when plasma is exposed to a nutrient solution. Cold plasma-based hydroponic technologies including PANS have been shown to enhance plant growth, but their effect on food quality is unexplored. The objective of this study was to compare the yield, morphology, and quality of sweet basil plants grown in an ebb-and-flow hydroponic system with either NS or PANS. Yield (fresh and dry weight), morphology (nodes and branches, plant height and width, root length, and leaf area) and quality (color, texture, relative aroma profile, and mineral composition) of PANS or NS treated basil plants were analyzed. Although the chemical characterization of PANS showed higher concentrations of nitrate, total nitrogen, and zinc, there was no significant difference in terms of plant yield ($p<0.05$) as compared to NS grown plants. However, the plants grown in PANS had a significantly higher number of nodes (24%), taller plants (32 %), longer root length (61%), more branches (43%), wider plants (33%), and higher concentration of essential oils (13%). These results suggest that PANS improves plant morphology without decreasing product quality or yield. Plasma could benefit the hydroponic industry by speeding up harvest dates based on the increase in plant height of sweet basil, thus increasing the productivity of the overall plant factory. Plasma treatment is a more sustainable approach to plant growth enhancement in comparison to synthetic fertilizers without usage of fossil fuel raw materials.

Je'toya Robinson
Graduate Program: Youth, Family, and Community Sciences
Advisor: Annie Hardison-Moody
Poster Number: 146

Impacts of co-curricular student success programs on recent graduates of the College of Agriculture and Life Sciences

It is understood that co-curricular programs are purposed to assist college students with being successful during and post college. However, literature has not shared if the co-curricular programs offered by The College of Agriculture and Life Sciences at North Carolina State University are impacting success upon their graduates. The co-curricular programs that are offered in the college are: Undergraduate Research, Study Abroad, Internships, CALS honors, CALS ambassadors, CALS Scholar, and Thomas Jefferson Scholar. This research project will provide specific data to the CALS department of North Carolina State University that will inform the quality of their co-curricular programs and the amount of impact the programs have on their graduates' career success. Career success has been measured using the 'Career Success Measurement Tool'. The measurement tool along with other questions centered around career success and co-curricular participation together created a survey. The survey was conducted with over 300 alumni who graduated during the years of 2014-2019 from North Carolina State University's College of Agriculture and Life Sciences, "CALS" and participated in at least one co-curricular program during their undergrad years. In addition to the survey, a voice recorded interview was completed with ten of the 3oo participants, to provide a more in-depth sharing of their experiences with the co-curricular programs of The College of Agriculture and Life Sciences at North Carolina State University and the impacts the programs have made on their career success. To draw a conclusion on the impacts of the CALS' co-curricular programs at NCSU, a data analysis was conducted. The data received from the surveys and interviews provided the relationship of NCSU's CALS' co-curricular programs and its impact of career success amongst their graduates.

Mikayla Roth and Julieta Sherk
Graduate Program: Horticultural Science
Advisor: Julieta Sherk
Poster Number: 151

Green Roof Strategies for Substrate-based Food Production in Urban Areas

Green roofs are used to introduce green space to cities by growing plants, especially in dense urban areas. They have both function and beauty, and often use space that is otherwise unoccupied. Many cities have vast amounts of roof space, with much belonging to unused and flat roofs. Potential benefits span from economic to environmental impacts. To add even more function to green roofs, fruits and vegetables can be grown on roofs for consumption. Methods of design, potential community engagement, irrigation practices, growing substrate, and other strategies of 15 green roof gardens were examined. For sites where data was available, like in New York City, Geographic Information Systems (GIS) software was used to identify some of the local institutions that could impact community-wide benefits from the rooftop farms and gardens. Many trends that were highlighted by the survey were expected, such as almost all rooftops providing additional irrigation and receiving at least 6 hours of sunlight each day. There was also a large variety of plants that were reported to do well, suggesting that rooftop farms and gardens can successfully grow a number of different crops. One unexpected discovery was the common use of rooftop farms and gardens for restaurants and the unique culinary production associated. Overall, the surveyed roofs generally followed very similar designs, with a few distinct aspects that made them unique. In the future, more of these food-producing green roofs could further promote locally sourced healthy food within communities. The evidence obtained from the survey results of this study define the strategies and feasibility of urban agricultural practices on green roofs, which improve local food systems and provide a template to design rooftop gardens.

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Graduate Programs: Bioinformatics[1], Crop and Soil Sciences, North Carolina State University[2], Forage and Range Research Unit, USDA-ARS[3], Horticultural Science, North Carolina State University[4], Genomics and Bioinformatics Research Unit, USDA-ARS[5]
Advisors: Amanda Hulse-Kemp and Susana Milla-Lewis
Poster Number: 158

Creation of Genomic Resources for Saint Augustinegrass to Support Breeding Programs and Analysis of Gray Leaf Spot Resistance

In the past couple of decades, St. Augustinegrass has become extremely popular in southern states due to some cultivars' ability to thrive in sandy soils and across many environments in warm climate regions. Prior to this project there was little data on the genetic makeup of the grass despite its popularity and the vast knowledge of physical and breeding aspects of the species. Like most grasses, St. Augustinegrass is extremely heterozygous making it difficult to create genome assemblies, and to date no genome reference sequence exists. Raleigh, a cultivar noted for being more cold-tolerant than other St. Augustinegrass genotypes, is a diploid cultivar developed by the North Carolina State University breeding program. However, it is susceptible to fungal diseases found in warm, humid regions including Gray Leaf Spot (GLS), which is caused by Magnaporthe grisea and other fungal species. A germplasm collection line, PI410353, was previously discovered to be more resistant to the pathogen causing GLS. Therefore, both Raleigh and PI410353 were sequenced using PacBio Circular Consensus Sequencing (CCS) technology to develop two reference genomes for St. Augustinegrass containing full representation of both haplotypes creating a complete set of 4 haplotype sequences. An experiment was developed to identify and characterize possible regions containing or closely linked to genes for gray leaf spot resistance and ana analysis conducted to compare RNA-Seq data from the susceptible cultivar Raleigh to a resistant cultivar PI 410353.

Tanner R. Schwarz
Graduate Program: Plant Pathology
Advisor: Adrienne M. Gorny
Poster Number: 159

Improving Agricultural Disease Management of the Highly Aggressive Root-Knot Nematode, Meloidogyne enterolobii, Through Resistant Sweetpotato and Soybean Plant Genotypes

Meloidogyne enterolobii is an aggressive root-knot nematode species that has been detected in North Carolina within the last decade. This species is regarded as one of the most damaging root-knot nematode species, threatening agricultural production worldwide. Sweet potato and soybean are important crops that are susceptible to M. enterolobii. The United States produced a total of $726 million of sweetpotato and $46.1 billion of soybean in 2020, which are important for both domestic and export markets. Regions that produce sweet potato and/or soybean are facing a major hurdle to keep crop production safe from M. enterolobii infection. Management options for controlling M. enterolobii are limited and pesticide options are declining due to environmental concerns. Plant genotype resistance is an effective, environmentally sustainable, and economical management strategy that inhibits nematode reproduction, resulting in a decline in nematode populations while crop yield is maintained. It is vital to improve management of M. enterolobii by identifying sources of plant resistance in important crops. Potential sources of resistance to M. enterolobii were screened for in 100 selected sweetpotato (Ipomoea batatas) genotypes and 100 selected soybean (Glycine max and G. soja) genotypes in the greenhouse. Results showed that resistance to M. enterolobii was found in both sweetpotato (12 out of 100) and soybean (5 out of 100) genotypes tested. This knowledge can be used to incorporate the resistant plant genotypes directly into the field as a management tool to reduce nematode populations, and can also be incorporated into plant breeding programs to develop new plant genotypes with resistance to M. enterolobii. In addition, all farmers, including organic and low-income farmers, can utilize the resistant plant genotypes as this management tactic is environmentally sustainable and cost efficient. The results from the research will help to improve management of M. enterolobii in soybean and sweetpotato production systems.

Urvi Shah, Qingyang Wang, Sophia Kathariou, Deepti Salvi
Graduate Program: Food Science
Advisor: Deepti Salvi
Poster Number: 162

Plasma-activated Water as a Novel Sanitizer: Process Optimization for Inactivation of Salmonella Typhimurium

Plasma-activated water (PAW) is generated by exposing water to nonthermal air plasma (fourth state of matter) and is effective for pathogen inactivation on various food surfaces due to reactive nitrogen and oxygen species. The generation approach of PAW affects the concentration of reactive species in PAW and thereby microbial inactivation efficacy. The purpose of this study was to optimize the processing conditions of PAW for its inactivation efficiency against Salmonella Typhimurium using response surface methodology.

A Box-Behnken design(BBD) was used with 3 independent factors: volume of water, time for plasma activation, and the distance between the water surface and nozzle of the plasma jet. A total of 15 BBD experiments were performed in duplicate to evaluate the effects of the 3 parameters on physicochemical properties of PAW (pH, electrical conductivity (EC), oxidation-reduction potential (ORP), nitrate and nitrite concentration) and on microbial reduction of planktonic S. Typhimurium incubated in PAW for 3 min. Statistical significance was determined at $p < 0.05$.

The ORP value was significantly affected by the volume, time, and time*distance. The pH, nitrite, and nitrate concentrations in PAW were significantly affected by time, distance, and the quadratic terms of volume, time, and distance. EC values and microbial reduction were significantly affected by time, volume*time, and volume*distance. An increase in time predicted a reduction in pH, increase in ORP, EC, nitrite, nitrate, and microbial reduction. A decrease in distance predicted an increase in EC, nitrite, and nitrate values. Two optimized conditions were obtained with an average of more than 6 log10 cfu/mL of reduction for S. Typhimurium.

The findings identify optimum processing conditions that can be useful for future research studies and in scaling up this technology for industrial applications. PAW can provide a chemical-residue free sanitizer to replace the existing chemical sanitizers used in food industry.

Katelyn Sheehan-Lust[1], Gina Fernandez[1], Hamid Ashrafi[1], Cherie Oschenfeld[2], Abraham Corrales[3], Margaret Worthington[4], Erika Henderson[4], Courtney Weber[5], Jill Bushakra[6], Michael Dossett[7]
Graduate Programs: Horticultural Science[1]; Department of Horticulture, University of Arkansas[4]; Department of Horticulture, Cornell University[5]
Other supporting organizations: Pairwise, Durham, NC[2]; Plant Sciences Inc., Watsonville, CA[3]; USDA, Corvallis, OR[6]; BC Berry Cultivars, Agassiz, British Colombia, Canada[7]
Advisor: Gina Fernandez
Poster Number: 163

A public-private partnership to uncover genetic treasures in Rubus

North Carolina State University, Cornell University, University of Arkansas, University of British Columbia/BC Berry Cultivar Development Inc., and the United States Department of Agriculture (USDA) have joined in a collaborative effort with Pairwise, and Plant Sciences Inc to uncover the genetic potential in the genus Rubus. The research at NCSU has two main components. The first experiment is an environmental effect study. This “traditional” breeding study encompasses the phenotyping of a set of traits on the same 5 cultivars in 5-6 geographically distinct locations over two years. The range of locations include the primary public Rubus breeding programs in North America. The genotypes being evaluated include seminal raspberry, blackberry, and a black raspberry cultivars. The aim of this study is to provide information on the effects of genotype, environment, and their interactions on economically significant traits. The second component at NC State University is a SNP validation study including the 5 genotypes in the above experiment as well as 25 other Rubus species.

Maggie Short
Graduate Program: Crop Science
Advisor: Matthew Vann
Poster Number: 166

Developing Nitrogen and Potassium Fertilizer Recommendations for Cigar Wrapper Tobacco in North Carolina

Cigar wrapper tobacco is a new crop to North Carolina, and research-based production recommendations are needed to assist farmers in growing this new crop. An immediate need in this area is fertilizer rate recommendations. Nitrogen (N) and potassium (K) rate trials were conducted in four locations across North Carolina in 2021. Rates 0, 80, 160, 240, 320, and 400 lbs N/acre were split-applied as 28% UAN, and the effects of these variable rates on yield and quality were evaluated. In a separate trial, rates 0, 50, 100, 150, 200, 250, and 300 lbs K2O/acre were applied as potassium sulfate, and the effects of these variable rates on yield and quality were evaluated. Multiple dependent parameters were also studied in both trials during the growing season to increase understanding of the effects of the variable fertilizer rates. Data from the 2021 field trials will be presented

Bhavana Uppili[1], Lisa LaFountain[2], and Suzanne D. Johanninsgmeier[2]
Graduate Programs: Food Science[1]; USDA-ARS, Raleigh, NC[2]
Advisor: Suzanne Johanningsmeier
Poster Number: 174

Characterizing the quality of fresh and processed peppers by their aroma, flavor, and texture

Pepper fruits (Capsicum annuum) are economically important commodities due to their unique sensory profiles and rich antioxidant properties. North Carolina is among the top 7 states with 2,400 acres of land dedicated to producing 54 billion pounds of bell peppers as of 2020. Breeders and processors are seeking technologies to improve quality retention to extend shelf life and availability of fresh and processed peppers. The objective of this work was to develop a standardized vocabulary, known as a lexicon, to help characterize the sensory quality of fresh and processed peppers. A panel of 10 volunteers was recruited and trained in characterizing sensory attributes qualitatively and quantitatively. These sensory attributes encompassed the aroma, flavor, and texture of commercially available fresh, pickled, and roasted peppers. Through 37 hours of such training, definitions, methods of evaluation, and reference materials were established for each unique attribute, and a scale ranging from 0 to 15 was used for scoring intensities of attributes. Thus, a lexicon with 45 clearly defined attributes was developed. It is comprised of 14 aroma, 19 flavor, 8 texture, and 4 chemesthetic attributes. Commercially available fresh and processed pepper samples (n=22) were evaluated by the panel in duplicate to validate the lexicon in being comprehensive, non-redundant, and capable of capturing all product differences. Principal Component Analysis (PCA) was used to visualize differences among the products and attribute redundancies identified through analysis of correlations. Attributes such as smoky and burnt were found exclusively in roasted peppers. While the floral attribute was characteristic of fresh red bell peppers, attributes such as vinegar, pungency, and spicy characterized pickled banana and jalapeño peppers. The lexicon enables reliable characterization of a wide range of pepper products and can be used as a tool for evaluating various strategies towards quality improvement, such as novel processing of pepper products.

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Advisor: Steven D. Frank
Poster Number: 187

Tree species richness around urban red maples reduces pest abundance but does not enhance biological control

Urban trees often host greater insect pest densities than forest trees. This discrepancy may be due in part to differences in tree diversity and canopy cover between these settings. In cities, trees are often planted in isolation or monoculture which favors pest accumulation. Gloomy scale—Melanaspis tenebricosa (Comstock)—is a pest of urban red maples that is abundant where impervious surfaces are extensive. We investigated the effect that surrounding tree species richness and tree canopy cover had on gloomy scale abundance, natural enemy abundance, and biological control in red maple trees in Raleigh, NC. USA. We collected scales and natural enemies from 95 and 90 red maples respectively that spanned a gradient of tree species richness, canopy cover, and impervious surface values. We measured gloomy scale parasitism in 27 red maples and removal and predation of sentinel prey in 30 red maples. Tree species richness and canopy cover interacted to lower gloomy scale abundance. Parasitoids were less common in maples in diverse settings, but generalist predator abundance was unaffected by tree diversity. Finally, tree species richness and canopy cover did not strengthen biological control of scales or sentinel prey. Our findings suggest that tree diversity and canopy cover may reduce gloomy scale abundance but do not necessarily support biological control.

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Advisor: Brian M. Wiegmann
Poster Number: 190

Phylogeny, divergence times, and diversification patterns in leaf-mining flies (Diptera: Agromyzidae) from anchored phylogenomics

Leaf-mining flies (Diptera: Agromyzidae) are a diverse clade of phytophagous Diptera well known largely for their economic impacts as leaf- or stem-miners on vegetable and horticultural crops. Higher-level phylogenetic relationships of Agromyzidae have remained uncertain because of challenges in sampling of both taxa and characters for morphology and PCR-based, Sanger-era, molecular systematics. Here, we provide a comprehensive phylogenomic treatment of the family Agromyzidae. We use hundreds to thousands of loci obtained from anchored hybrid enrichment (AHE) to reconstruct phylogenetic relationships among leaf-mining flies and to estimate the timeframe of their diversification. In the present study, we have discovered that trees are well-supported except for a few deep nodes using differing molecular data types or partitions and phylogenetic approaches. Based on relaxed clock divergence time estimates and model-based historical biogeographic analysis, Agromyzidae is found to have originated in the Nearctic region in the early Paleocene approximately 64.47 million years ago. Diversification rates in Agromyzidae rapidly increased in the Miocene, congruent with estimates for the timing of vicariance events from the disjunction of North American and Eurasian plates, with numerous host plant shifts, and rapid adaptative radiations within multiple agromyzid lineages. Our study provides a new framework phylogeny for Agromyzidae using phylogenomic data, and this tree is used to develop a macroevolutionary context to begin a more thorough survey of their biogeographic distributions, the patterns and rate of their lineage diversification, and the history of host plant use within this family of plant feeding flies.

College of Design

Rebecca Asser[1], Wendy Moore[2]
Graduate Programs: Landscape Architecture[1]; Agricultural and Natural Resources Committee Chair, Lumbee Tribal Council[2]
Advisor: Andy Fox
Poster Number: 8

Reimaging Maxton/Hayes Pond: Collaboration and Investigation of a Lumbee Landscape

The research initiative explores landscape architecture, community engagement, and resilience as it relates to the history and sovereignty of the Lumbee people at Maxton/Hayes Pond. After Hurricane Florence broke the dam that held back Shoe Heel Creek, the 312-acre site has seen many changes, including an increase in invasive species as well as a tragic accident. As a designated North Carolina Natural Heritage Program area it was historically home to the federally endangered American Alligator and still includes many other unique plant and animal species. The Lumbee Tribal Council seeks ecologically responsible solutions to restore the site. Additionally, in January 1958, the Lumbee and other indigenous groups of the area took a stand against the KKK at The Battle of Hayes Pond. It is considered one of the first successful confrontations against white supremacy at the dawn of the Civil Rights Movement. As a culturally significant site, the Council seeks design interventions that allow community members to gather, commemorate, and enjoy the beauty and history of Maxton/Hayes Pond. In over a year of collaboration, the research project has participated in informal interviews with community members, gathered data from local Lumbee scholars, conducted rigorous ethnobotanical and ecological research, put forth surveys and preliminary feedback booklets using a design game, and engaged in community-organized Clean Up Days. This multi-pronged research project will result in a co-produced design solution that celebrates the historic and ecological significance of Maxton/Hayes Pond. The success of this endeavor is symbolic of the resilience of the Lumbee people who have encountered many storms in their existence but survive and thrive much like Mother Earth.

Courtney J. Barron
Graduate Program: Art and Design
Advisor: Marc Russo
Poster Number: 12

Shift: An Animated Speculative Exploration of Social Polarization

This poster documents the research, development, and creation of the interactive animated film titled Shift. Using digital 2D animation software as well as 3D programs and game development software, Shift takes a look at how social polarization can affect our personal lives. Using the genre of speculative fiction as a vessel, this project pushes polarization to the extreme in a future setting and follows two individuals and their experiences in this polarized world. To accurately explore the issue of social polarization and present it in a compelling and effective interactive narrative, Shift has three main points of research. The first point of research is to investigate the current state of polarization, its causes and history, and related concepts like group polarization and confirmation bias. The second point is exploring speculative fiction, its precedents, and how it can be used to address issues in today's world. The final point of research involves the methods for creation, exploring precedents who have implemented similar aesthetic, narrative, or interactive elements and how this implementation has succeeded or failed. This research provides the foundation for Shift's narrative development and structure, as well as its visual development and overall aesthetic. Shift ultimately prompts the user to critically think about their own relationship with polarization and how they might change the way they interact with others to create a brighter, less polarized future.

Lauren Burnham
Graduate Program: Graphic Design
Advisor: Matthew Peterson
Poster Number: 22

Thinking Statistically: Enhancing Statistical Learning through Mixed Reality Informal Experiences

Statistical literacy, or the ability to understand and interpret data, has become increasingly important to navigating our data-driven society. While many efforts have focused on improving formal learning experiences in statistics, research points towards informal learning outside of the classroom as a crucial component of the general public's understanding of science and mathematics. This presents a rich opportunity to enhance statistical learning for young students through the design of compelling informal learning experiences. Drawing from the framework for statistics and data science education from the National Council of Teachers of Mathematics, this investigation explores the ways in which a mixed reality museum experience can engage middle school-age learners with the stages of the statistical problem-solving process. The resulting studies consider how the affordances of this environment, such as movement, immersion, and learner-driven experimentation, could encourage statistical question-asking and offer supplements to traditional learning approaches. Experiences which lay a foundation of curiosity towards statistical problem solving hold the potential for enriching the learning process for students beginning to engage with the subject.

Carla Delcambre
Graduate Program: Design
Advisor: Elen Deming
Poster Number: 37

How does Virtual Reality (VR) enhance learning outcomes in a Landscape Architecture Design + Build studio at North Carolina State University?

Drawing a two-dimensional line and a three-dimensional object is challenging for first-professional landscape architecture students. Many of these graduate students do not have design training, nor do they have experience in building three-dimensional design objects. During the introductory studios in the Department of Landscape Architecture and Environmental Planning at North Carolina State University, graduate students are taught to sketch, draw, model, and design. Computer visualizations are used to broaden design thinking strategies by introducing AutoCAD, SketchUp, Lumion, and Photoshop. In the second year, MLA students in the Design + Build studio are immersed in the construction process by creating prototypes in the College of Design Materials Lab. Students quickly move from a sketch to a design, then into ideation, and fabrication within a 16-week studio. This poster will discuss how VR Oculus Rift is integrated into a Design + Build studio to evaluate designs solutions before transitioning into fabrication. This quasi-experimental approach uses mixed methods through surveys and observations. Findings reveal the need for integrating VR in the studio environment for visualization and perception benefits. The design process in higher education is evolving due to the advancement of immersive technologies using VR.

Todd J. Elia-Warnken
Graduate Program: Landscape Architecture
Advisors: Meg Calkins and M.E. Deming
Poster Number: 52

Re-envisioning Design Education through the Lens of Virtual Reality

This paper reveals student outcomes integrating Virtual Reality (VR) as a design tool to teach construction, materials, and methods in the Department of Landscape Architecture and Environmental Planning at North Carolina State University. The research examines the design process from virtual explorations to immersive landscape architecture details and renders. The study discusses key learning opportunities using VR Sketch to conceptualize design ideations in three dimensions. This paper seeks to identify design decisions, design obstacles, the efficacy of design solutions, and the VR interactive mechanism used during the design process. Data collected through surveys and observations provide evidence of enhanced learning opportunities for integrating VR in landscape architecture design studios and seminars. Recently, research has focused specifically on the integration of commercially available VR technologies within a broader built environment curriculum (Hamza and Horne, 2006). This raises concern relating to the effective integration and application in landscape architecture design classes. In academic settings, VR is being integrated into educational research, forming highly immersive visualizations and experiences during the construction process.

Genevieve Gholizadeh
Graduate Program: Industrial Design
Advisors: Kathryn Wozniak, Kelly Umstead, Bryan Laffitte
Poster Number: 73

Combatting Ocean Plastic Pollution Through Debris Collection, Material Development, and the Design and Creation of Closed-Loop Shoes

Today, approximately 380 million tonnes of plastic are produced annually, and approximately 8 million tonnes enter our waterways. This builds upon an assumed 200 million tonnes already in our oceans. It is estimated that 80% of this plastic waste comes from land-based sources, like litter and debris in runoff, while the remaining 20% comes from water-based sources, such as discarded fishing gear. While the long-term impacts of plastic pollution within our oceans are still largely unknown, it is believed that ocean plastic is a contributor to climate change. It is also damaging to marine ecosystems. My project reduces plastic pollution in the ocean by intercepting discarded monofilament fishing nets and line, converting this plastic into pellet form, and reincorporating these pellets into the footwear industry as a material source. My project culminates in the design and creation of a sustainable shoe. To design a sustainable product, the material, production process, and product end-of-life must be considered. My shoe leverages recycled fishing nets and line over virgin plastic. The shoe upper is knit, and the shoe sole is 3D printed. These practices eliminate the material waste generally incurred during shoe production. Lastly, my shoe is designed to be recycled. The footwear industry is one of the largest contributors to plastic pollution. Over 20 billion shoes are produced annually, most of which cannot be recycled due to the use of toxic glue and the various plastics used in shoe production. Without the use of glue and with far fewer components, my shoe can be easily disassembled and recycled, keeping this plastic out of our waterways and within a closed loop.

Masoome Haghani
Graduate Program: Design
Advisor: Wayne Place
Poster Number: 79

Human-Centric Daylighting System Design: Prismatic Vertical Louver

Natural light admitted through windows in buildings can provide interior illumination, reducing lighting electricity consumption. It can also enhance life quality for the building occupants by providing a sense of connection to the cycles of nature, stimulating alertness, and enhancing circadian rhythm.

The downside of natural light is that beam sunlight can cause thermal discomfort and glare for the occupants and can increase electricity consumption for cooling the building. The negative thermal impacts are particularly intense for windows with significant east or west exposure, where the heat content of the sunlight is much greater during the hot months than during the cold months. Also, for those exposures, the sun angles are particularly challenging for causing glare for the occupants.

For centuries, architects and daylighting designers have struggled to invent window management systems, such as overhangs, louvres, or other optical treatments, to control the negative impacts of beam sunlight on these challenging window exposures. All the previous methods for regulating these negative impacts of beam sunlight have also reduced diffuse light from the sky, which negatively impacts both interior illumination and the view through the window.

The research reported here is focused on an invention currently being patented by North Carolina State University, which is an optical treatment for windows that reflects away 99% of the beam sunlight while admitting most of the diffuse light from the sky. In this manner, all the positive impacts of natural light are retained, while the negative thermal and glare impacts are eliminated. The potential energy and life-quality implications for buildings around the world are huge.

The research reported here is focusing on a version of the invention embodied as prismatic, vertical slats that rotate about their vertical axes one time over the course of a day. The mechanism for supporting and rotating the prismatic slats is similar to those used with standard vertical blinds, differing primarily in the algorithm governing the tracking mechanism and in the nature of the material making up the slats. The research report will include optical analysis of the basic material; computer simulations and experimental measurements of the system performance in an office space; and testing of human subjects in three office spaces outfitted with three window treatments: the new prismatic vertical slats, conventional vertical slats, and conventional mesh shading material

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Advisor: Jeremiah X. Johnson
Poster Number: 92

Unsupervised Residential Load Disaggregation Based on Low-Resolution Smart Meter Data and Surveys in a Developing Country Context

System monitoring and demand forecasting have become important aspects of power planning. Although load monitoring using smart meters data has been extensively studied in developed countries, it remains a serious challenge in developing countries. Despite the significant amount of work in non-intrusive load monitoring (NILM) methods in North America and Europe, the aspects such as cost and difficulty of access to high-resolution smart meters and sub-metering data remain a challenge for NILM algorithms in developing countries. Also, the pattern of use, number, and type of appliances in a house, and available data of residents in an economically developing country are quite different from a developed one. In this study, we have access to a unique data set of smart meter recordings (15-minute resolution) and a related survey, containing information about the appliances in each house and building materials, conducted in a neighborhood in Karakol, Kyrgyzstan. It provides a unique opportunity to develop a co-simulation NILM algorithm to disaggregate the electricity consumption into predefined categories of end-use consumptions (e.g., space heating, appliances). In the proposed method, Hidden Markov Model algorithm and a building energy simulation program, EnergyPlus, are coupled to exchange their output. HMM obtains the most probable activity chains of household members in each house based on 15-minute resolution electricity metering and EnergyPlus simulates the energy consumption of each house based on provided HMM activity chains and survey data. By reproducing the electricity profile of each house, the algorithm can report the end-use level electricity consumptions. In this study, our algorithm breaks down the aggregated energy use profile of residential buildings into categories of appliances without having access to labeled data. The presented method can provide a forecasting model for power system planning in developing countries as appliance adoption grows over time, changing total consumption and increasing peak demand.

Maryam Nadali
Graduate Program: Graphic Design
Advisor: Helen Armstrong
Poster Number: 122

Let's Learn French with Smart Tangible Objects

For many years researchers have worked to improve the second language acquisition learning process. Immersion and interactivity, essential approaches to language acquisition, provide key learning opportunities in formal classroom settings. Immersion coupled with interactive activities can engage and challenge students by moving them away from mechanical drills. However, such activities seldom are personalized or consider individual learners' specific needs and levels. In this research, I am investigating the design of a tangible interaction to support and supplement second language acquisition in college-level classroom settings. During a tangible interaction, a person interacts with digital information by directly manipulating it through physical objects with their hands and perceiving the feedback through their peripheral senses. A tangible user interface (TUI) can enhance the learning process as well as provide a user framework for collaborative learning. This research explores the design benefit of a TUI powered by artificial intelligence to supplement second language acquisition in three aspects: (1) improving the learning performance by providing immediate feedback, (2) boosting the student confidence through personalization, and (3) reducing the cognitive load of learning by simulating and moderating collaborative learning between the learner and the AI system.

Vaikunth Raghavan
Graduate Program: Art and Design
Advisors: Patrick FitzGerald, Justin Johnson, Marc Russo
Poster Number: 137

Snow Seeker

Climate change is transforming our planet, drowning ecosystems with the polar meltdown and pushing many species into their extinction. This project explores the predictions of climate science through the conceptualization and design of a role-playing game experience, Snow Seeker, which visualizes a future Earth adversely affected by climate change, depicting the likely transformations to the Antarctic and other ecosystems from multiple perspectives and see how such transformations affect every species on the planet. Using the latest theories framed by the scientific community to explain climate change and combining them with game engines and procedural 3D tools, the game environments created for Snow Seeker are designed to represent how the world will look in the future if the South Pole completely melts and global temperature goes above 4°C.

Through storytelling and gamification, the players will embark on a journey for survival, looking for basic supplies as they travel across the globe over harsh and volatile ecosystems, witnessing how the lands change and realizing what could happen if we fail to control global temperature rise and climate change. Players can choose to play as different species and experience the landscapes as such and gauge how each is affected differently. Through speculation of such a future, the hope is to change people's attitude and encourage them to work together and solve the climate crisis.

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Advisors: Kelly Umstead and Matt Penny
Poster Number: 156

Cancer and Dyspareunia: Decreasing Pain with Intercourse for Women

Fifty percent of female cancer survivors report significant pain with intercourse (dyspareunia) that negatively impacts their personal relationships, body image and self-esteem. Dyspareunia is the result of cancer treatments such as surgery, radiation, and chemotherapy, even affecting women who have non-gynecologic cancers. Cancer survivors may struggle with dyspareunia management for the remainder of their lives. The reported barriers for women seeking dyspareunia treatment include embarrassment, privacy concerns, long commutes/wait times, the burden of numerous medical appointments, financial cost, and inadequate solutions not meeting the needs of women. Current device inadequacies include (i) targeting singular therapy needs which require patients to purchase each device individually (ii) lack of ergonomic considerations (iii) not mitigating the challenges of therapy adherence.

This research investigates the current pelvic floor physical therapy experience for female cancer survivors. Device design intimately affects the available therapy modalities, ergonomics, and treatment adherence and impacts patient outcomes. The research study participants include physicians, pelvic floor physical therapists, and female cancer survivors suffering from dyspareunia. Inclusion criteria for cancer patients include cancer history, age, and experience with pelvic floor physical therapy. Interviews and surveys provide an in-depth understanding of systemic and device-related problems. Think aloud protocols have provided insights into participants' thoughts and feelings within this sensitive subject matter. Early stage prototypes have been shipped across the United States to participants. Both preference and A/B testing have been employed for prototype feedback throughout the design process. The preliminary design has taken therapy requirements, ergonomics, and human factors psychology into account to improve the overall patient experience. The home-based intravaginal device paired with the app improves patients' abilities to perform and progress through their pelvic floor physical therapy and is anticipated to therefore improve clinical outcomes.

Byeongmo Seo
Graduate Program: Design
Advisor: Soolyeon Cho
Poster Number: 161

Development of an HVAC Optimal Control Algorithm for Cooling Energy Efficiency Improvement in Commercial Buildings Using Machine Learning and Digital Twin Technologies

As human civilization develops, the use of fossil energy rapidly increases. Similarly, the amount of greenhouse gas emissions, one of the main contributors to global warming, also increases. “The Future of Cooling,” published by the International Energy Agency (IEA), affirmed that electricity energy consumption for space cooling accounts for about 20% of the total building energy (IEA, 2019). If space cooling remains inefficient, cooling energy consumption will be three times higher in 2050 than in 2016. High-efficiency cooling systems or optimal control of cooling systems should be considered to increase cooling system efficiency. High-efficiency cooling systems are suitable for newly built buildings, but they are difficult to apply in existing buildings due to the cost and time required for system replacement. Commercial buildings already use building automation system. An advantage of BAS is that it can be controlled manually by the building manager or controlled automatically according to a set schedule. In the case of automatic control, only simple on/off control or time-based control can be performed, and such is difficult to apply to a building with continuously changing internal and external environments. In addition, even if the building manager can control the system manually, it is difficult to expect efficiency improvement through BAS unless an experienced manager resides in the building itself because the building is controlled using subjective judgment instead of analyzing and evaluating building performance. The goal of this study is to develop and evaluate a Machine Learning-based optimal control algorithm for cooling systems to minimize the cooling energy consumption of commercial buildings using the digital twin technology. Through ML technology, building and meteorological data collected in BAS are analyzed automatically to identify patterns and develop an optimal control algorithm suitable for real-time building behavior and external environment. Due to the use of past and current building data in ML-based optimal control algorithms, it is also possible to compensate for the weaknesses of BAS and ensure optimal control based on the internal and external environments of a building.

Casey Stanek Walsh
Graduate Program: Graphic Design
Advisor: Deborah Littlejohn
Poster Number: 170

Restoring Elderly Independence: Extending Aging-in-Place Through Assistive Technology

The number of seniors aged 65 years and older is projected to grow ~150% over the next 40 years to 95 million and comprise nearly 25% of the U.S. population (National Science and Technology Council, 2019). Among the growing senior population, the desire to age-in-place has become more prominent and has gained visibility in healthcare policies and services. According to the Centers for Disease Control and Prevention (CDC), aging-in-place is the ability to live in one's own home and community safely, independently, and comfortably, regardless of age, income, or ability level (2009). Gerontechnologists suggest that smart technology is a viable tool for seniors who want to age-in-place, as it can give seniors more confidence in their ability to live alone and at a much lower cost than other alternatives. As society becomes ever more reliant on new technology however, the older population—less likely to know how to manage the technology themselves—is losing access to information and is being excluded from the design of technological advances.

Employing human-centered design methods, including personas, storyboarding, rapid visual iteration, and prototyping, this research investigates how the design of a system of assistive interfaces can support independence and address the negative implications of natural aging for aging-in-place individuals experiencing mild cognitive decline and social isolation. It explores scenarios where familiar social engagement strategies (Atchley, 1989), such as prompting shared experiences and observing routine and abnormal behaviors, are integrated into the design of in-home assistive technology. Participatory user workshops will ensure diverse user needs are met, and will closely assess and analyze human-interface interactions that facilitate individual well-being and improve user's confidence level in using assistive devices. The objective is to develop a set of design strategies and guidelines for the development of reciprocal and conversation-based assistive technologies that empower the aging-in-place user.

Arissa Wheeler
Graduate Program: Industrial Design
Advisor: Kelly Umstead
Poster Number: 182

The study addresses the growing public safety and environmental concerns with personal watercraft

The research identifies the design errors and leading factors that cause personal watercraft user injuries and fatalities. The research uses triangulation, a mixed methods approach, to corroborate the findings, including quantitative and qualitative data from the literature review, market analysis, survey, interviews, and observations to establish publicly known concerns, market trends, and user insights. Today reported accidents have totaled 62,190, with many going unreported. Of the reported accidents, 52% (32,430) resulted in injuries, and 2.7% (1,655) proved fatal. Accidents' leading factors include lack of maneuverability, axial load due to user's seated posture, and fall into the jet propulsion. Manufacturers claim that these accidents are a result of human error. However, as designers, we know that if many people do it, it is not human error but rather human behavior, especially since personal watercraft has a large rental market where users view their risks as minimal, and in some states, drivers can be as young as 12 years old. Rather than addressing these problems, manufacturers continue to minimize corporate exposure by shifting blame to the users through assumption of risk, indemnification, and release of liability agreements. The research drove the final design direction for a new type of personal watercraft that addresses these growing concerns.

Erin Willett
Graduate Program: Art and Design
Advisor: Tania Allen
Poster Number: 185

The Naturalist's Challenge: A Design Application for Climate Restoration

The Naturalist's Challenge, an online game application, educates participants about sustainable habits related to diet and consumption while giving structure to enable the successful integration of new habits into the player's everyday life. It leverages the innate sociability of games to create a community that expands the positive environmental impact and spreads through social networking to help combat the climate crisis.

Unlike others of its kind, The Naturalist's Challenge directly approaches issues within our global food system to educate users of actions that can be done at an individual level to help reverse global warming. A key aspect of the project is that it aims to inspire, create agency, and bring hope. Its precedents are carbon tracking apps, behavioral modification apps, and cooperative simulation games.

Climate change is an ever-impending issue that our world is in the midst of grappling with. The International Panel on Climate Change, which oversees the progress of global warming, just released a report on August 9th, 2021, that we have entered 'Code Red for Humanity' (McGrath). However, when talking about climate change, many people feel hopeless that any individual action can make a difference (Mark). The good news is that things can still change and understanding the options is the first step.

The food, agriculture, and land-use sector contribute a whopping 24% of greenhouse emissions. This is an area where individuals can make the most difference (Hawkins). The Naturalist's Challenge targets this sector and related consumer habits and combines it with the theories of learning through play and behavior modification through gamification to create an engaging, educational structure for individual and community change.

Jonathan Williams
Graduate Program: Design
Advisor: Derek Ham
Poster Number: 186

Learning Design Through Designerly Knotting

From sailors and surgeons, to casual users tying their shoes or preparing a fishing rod, many have succeeded in the intricate dance of skill and coordination needed to tie a knot. Knot tying is a childhood rite of passage, which functions as a familiar and approachable entry-point for learners to enter into the design discipline. When positioned within the design domain, designers have the ability to distinguish their own distinct form of knot tying — "designerly knotting" — that is different from other professional or common applications of knot tying. Designerly knots are knots that emphasize construction and physical soundness, functional use and appropriateness of use, and the qualities of aesthetics and beauty in the knot's existence.

This research explores the integration points of "designerly knotting" within beginning design education.When designerly knots are placed into a learning environment, designerly knots function as constructionist learning objects within beginning design education practice. Providing tangible learning and tactile instruction, designerly knots teach pattern recognition and computational thinking, build haptic vocabularies, all while providing room for improvisation by the learner as they explore what it means to create in the context of design.

College of Education

Grace Carroll
Graduate Program: Learning and Teaching in STEM
Advisor: Soonhye Park
Poster Number: 26

Development and Initial Validation of the Knowledge of Models and Modeling in Science Teaching (KMM-ST) Survey

The Next Generation Science Standards promote engaging students in Science and Engineering Practices (SEPs) as a way to support students' conceptual, procedural, and epistemological understandings in science. Developing and using models is one of the core SEPs. Effectively engaging students in scientific modeling requires science teachers to be equipped with a special body of knowledge related to models and modeling. This study reports the development and validation of the Knowledge of Models and Modeling in Science Teaching (KMM-ST) survey to measure teacher knowledge necessary to use models and modeling for promoting students' science learning. The KMM-ST survey was designed to measure: (1) Knowledge of models and modeling in science (14 Likert-scale items), and (2) Knowledge of models and modeling in science teaching (14 Likert-scale items). Subject-matter experts from the fields of science, engineering, and science education evaluated the face validity of the survey and resulted in an elimination of four survey items. The remaining 24 survey items were administered to science teachers across the US and 105 completed surveys were analyzed by exploratory factor analysis in RStudio. After an iterative process of item reduction, informed by parallel analysis and item total correlations, final EFA results indicated a two factor model matching the originally proposed sub-constructs but with poor reliability estimates (Chronbach's alpha of .51 for sub-construct one and .57 for sub-construct two). Currently, the survey is being revised based on the knowledge gained from the first round of validation, and will be readministered to a new participant group in Spring 2022 to collect reliability- and validity-related evidence. When the survey establishes sufficient evidence for reliability and validity, it will serve as a useful research tool for studies examining the links of teacher knowledge to teaching practices and student learning outcomes regarding models and modeling in science classrooms.

Karen Collier
Graduate Program: Science Education
Advisor: Meg Blanchard
Poster Number: 31

Investigating motivational supports for graduate students: Employing self-determination theory with structural equation modeling

Self-determination theory (SDT) assumes there is an inherent desire in individuals to be interested in learning and developing one's knowledge. As a mini-theory of SDT, basic needs theory posits that competence, autonomy, and relatedness are essential for an individual's well-being and contribute to positive life outcomes, such as academic success. These basic psychological needs are impacted by internal and external factors that influence people's intrinsic motivation to pursue goals and accomplish tasks. Social aspects that thwart these needs can be detrimental to an individual's function and wellness. Consequently, intrinsic and extrinsic motivation impact academic success through the components of the basic needs theory. The Graduate Student Support Survey (GSSS) was used to identify factors that support and inhibit the success of graduate students with a desire to discover differences between subgroups, especially underrepresented populations in science, technology, engineering, and mathematics (STEM). The GSSS is a 7-factor, 28-item survey with the subscales of microaffirmations, microaggressions, mentor relationships, financial concerns, imposter syndrome, sense of belonging, and access and opportunity. Using structural equation modeling (SEM), this study posited that the exogenous variables, microaffirmations, microaggressions, financial concerns, and mentor relationships, acted as extrinsic motivators that could thwart or support the basic needs components, as measured with imposter syndrome, sense of belonging, and access and opportunities. Recognizing these factors' impact on students' well-being can assist university administrators, advisors, and mentors to better support and facilitate graduate students' academic and personal growth while creating an inclusive climate for all graduate students.

Mariam Elias
Graduate Program: STEM Education
Advisor: Aaron Clark
Poster Number: 53

vSTEM: Teaching Self-Efficacy of Virtual STEM Outreach Program During the COVID-19 Pandemic

Outreach programs are mediums designed to expose and motivate students about potential STEM careers. Through such programs, a hands-on demonstration or experiment connected to real-world challenges can make textbook studies come alive with revived importance and possibility for students, plus define career paths not previously considered. When COVID-19 hit, those programs were greatly affected as they relied on hands-on activities and project-based learning. Although teaching self-efficacy is associated with many benefits for teachers and students, little is known about how teachers develop a sense of efficacy in the online teaching environment. As researchers have sought to understand factors influencing teacher effectiveness, many have explored teaching self-efficacy, defined as the teachers' beliefs about their capability to carry out the professional tasks of teaching (Tschannen-Moran and Hoy, 2001). Research conducted over several decades provides a growing body of evidence linking teachers' self-efficacy beliefs to the quality of instruction, student achievement, and student motivation (Klassen and Tze, 2014; Klassen et al., 2011; Zee and Kooman, 2016). This study examines outreach STEM program teachers' efficacy for teaching in a fully online teaching environment during the sudden transition to online teaching due to the COVID-19 pandemic. The study sought to identify how specific variables such as teaching experience and teaching supports associate with teachers' self-efficacy perceptions transitioning to online teaching during a pandemic. More specifically, we examined teachers' self-efficacy perceptions in the sphere of student engagement and instructional strategies. In a mixed-methods study, two groups of teachers at two outreach programs will receive the Teachers' Sense of Efficacy Teaching Scale (Tschannen-Moran and Hoy; 2001) to measure and compare the two groups' self-efficacy; one is teaching face-to-face, and the other group is teaching virtually. Furthermore, an interview will be conducted with teachers to examine the factors impacting them and seek what support they need to strengthen their teaching experience in online platforms.

Emily C. Elrod
Graduate Program: Learning and Teaching in STEM
Advisors: Cyndi Edgington and Temple Walkowiak
Poster Number: 54

Investigating Teacher Candidates' Teaching for Conceptual Understanding

Effective mathematics teaching practices include concept development as a cultivator of procedural flexibility and fluency. Fostering conceptual understanding requires that connections among ideas be made to create networks of knowledge (Hiebert & Lefevre, 1986). One way for these links to be built is the inclusion of representations within mathematics tasks and instruction. When representations are utilized with fidelity during instruction, teachers provide the foundation for students to be able to approach a problem from various angles. Making use of multiple representations as a tool to support students' reasoning lays the groundwork for development of procedural fluency and robust conceptualization. The enactment of teaching for conceptual understanding and flexibility with representations is not an easy feat, especially for novice teachers (Eisenhart et al., 1993; Lampert et al., 2013). Effective instructional practices learned within a conceptually oriented teacher preparation program have the potential to influence similar practices within classrooms. This study aims to understand how teacher candidates from multiple grade bands demonstrate the practice of teaching for conceptual understanding within their student teaching placement, as evidenced by edTPA artifacts. In this embedded multiple-case study, data were analyzed using an iterative coding process, utilizing both a priori and emergent codes. Within-case and cross-case analyses provide evidence to understand how the elementary and secondary case traverse through the cycle of effective teaching – planning, instruction, and assessment. Preliminary results show that similar teaching practices were enacted across cases; however, the opportunities for sophisticated conceptual development varied.

Aimee B. Fraulo
Graduate Program: Teacher Education and Learning Sciences
Advisor: Sarah J. Carrier
Poster Number: 63

Exploring Outdoor Educators' Positional Identities: Survey Development and Validation Using Structural Equation Modeling in a Mixed Methods Study Blending Quantitative Results with Phenomenological Analysis

Numerous studies have reported the myriad benefits of outdoor learning, but do not address the factors, contexts, and experiences that impact outdoor educator's (OE) identity formation and professional trajectory as educators. Through an embedded mixed methods approach, this study developed a quantitative survey instrument to measure OEs' positional identity while concurrently conducing a qualitative phenomenological study to uncover the unheard, authentic voices of OEs that have previously been filtered through the perspectives of researchers and formal educators. Results indicate that OEs have complex and varied approaches to their professional activities, yet they share similar personal and pedagogical goals of supporting learners' socio-emotional growth and development. The contribution of this study is to provide representation for this group of underrecognized educators and expose their professional contributions to assist educational researchers and practitioners in developing holistic, intentional whole child learning models that span beyond the four walls of the classroom.

Mwenda O. Kudumu
Graduate Program: Learning and Teaching in STEM
Advisor: K.C. Busch
Poster Number: 97

The Perceptions and Practices of Informal Science Educators regarding Culturally Relevant Education in Science Centers

The discourse in peer-reviewed literature between 2015 and 2020 on diversity, equity, and inclusion (DEI) in informal science education (ISE) institutions revolved closely around broadening the participation of communities of color. Culturally Relevant Education (CRE) has evolved to address these issues across formal education content areas. CRE describes educational opportunities designed with the whole person in mind that consider and preserve the culture and experiences of the learner while maintaining high levels of academic excellence and advanced skill transfer. Although very few research studies on CRE investigated ISE institutions, CRE has been useful in formal science settings and has potential usefulness in ISE settings. This research investigates what science center educators know about CRE, think about cultural relevancy in informal science contexts, and do to apply CRE in science centers. A basic qualitative methodology was employed by collecting, analyzing, and interpreting three sources of data: surveys, semi-structured interviews, and documents. A pool of informal educators working at science centers located within the USA was identified using snowball sampling. Twenty-five individuals representing a mixture of experience level, type and size of organization, race and ethnicity, gender, and organizational commitment to DEI agreed to participate in the study. Participants completed a self-administered survey providing demographical information about themselves and their organization. Semi-structured interviews were conducted with questions based on constructs from the CRE framework. In addition to transcribed interviews, the data set for this study consisted of survey responses as well as institutional and programmatic documents. The data analysis processes followed standard qualitative techniques involving several stages of open, a priori, categorical, and emergent coding; qualitative content analysis for the documents; and member checking to verify study findings. Preliminary data analysis showed that the science center educators studied are not often guided in their DEI efforts by conceptual and/or theoretical frameworks.

Erik Schettig
Graduate Program: Learning and Teaching in STEM
Advisor: Aaron Clark
Poster Number: 157

Electrifying Teacher Professional Development: A Conceptual Framework of a Hybrid Professional Development Model Utilizing Active Learning Modules to Teach about Microcontrollers Through Multiple Representations

Microcontrollers, small computers built on a semiconductor integrated circuit, are responsible for the smart devices that have become increasingly used around the world in both professional and personal applications. Their incorporation into the classroom supports a gain of content knowledge in Science, Technology, Engineering, and Mathematics (STEM) courses and demonstrates how such content can be applied to solving real-world problems. In order to equip in-service and pre-service teachers with the associated knowledge and skills of incorporating microcontrollers into the learning environment, a hybrid professional development model using active learning modules is being developed to instruct on the function and application of microcontrollers through abstract and concrete representations. Using a mixed-methods approach, impacts of the professional development model will be measured in the realms of content knowledge of electricity and microcontrollers, self-efficacy of using microcontrollers in an educational environment, spatial visualization skills related to using virtual and physical models, and the ability to apply problem-solving skills through microcontrollers. Traditionally, professional development opportunities for teachers are held entirely in person. Such a modality can place strain on a teacher's already packed schedule. A hybrid professional development model allows for course delivery to be provided online through active learning modules and then for teachers to come together to apply their gained knowledge in a collaborative hands-on problem-solving project where participants are tasked with designing and building a prototype model using a microcontroller system. Microcontrollers represented through abstract and concrete forms in the learning environment can resolve student misunderstandings of electricity in addition to providing students with an early STEM experience that can establish an interest in a variety of STEM careers including but not limited to automated manufacturing, embedded systems, electrical engineering, computer engineering, and similar fields where electronics can be used as a resource in solving problems.

David Stokes
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Advisor: Hollylynne Lee
Poster Number: 171

Examining Sociocritical and Agency Building Educational Experiences in STEM and Their Potential to Change Patterns in STEM Underrepresentation

The underrepresentation of minorities in STEM within the U.S. has led to a lack of diverse participation in discussions and decisions that influence policies, priorities, and other aspects of the scientific process related to quality of life. These disparities begin in pre-collegiate educational settings and sufficient solutions to this issue of social justice have yet to be found. At the same time sociocritical educational environments related to the work of Paulo Friere (e.g., Ladson-Billings' Culturally Relevant Pedagogy) have been effective in enhancing educational outcomes for minorities. Within these perspectives critical consciousness remains the least studied, but is arguably the most important component for engaging minorities in the STEM educational process. This study seeks to characterize educational experiences that can reduce structural barriers perpetuating STEM underrepresentation in America. This is achieved through specifying a multidimensional construct of students' pre-collegiate Sociocritical and Agency Building Educational Experiences in STEM (SABEES) derived from sociocritical frameworks and an empirical synthesis of pre-collegiate critical consciousness and agency building educational implementations. Measurement occurs through survey development and data is collected from college students to learn about their pre-collegiate SABEES via a retrospective design. STEM persistence likelihood (with respect to STEM career attainment), indicated through the students' intent to pursue a STEM major, is modeled as a function of their SABEES and demographics in order to understand the relationships between these factors. Methods include a systematic literature review based on the PRISMA guidelines; construct, content, and survey validation through expert feedback and cognitive interviews; and structural equation modeling and analysis. The quantitative findings are meshed with the qualitative synthesis of empirical investigations. The SABEES construct specification, survey results, and empirical synthesis is used to connect prior empirical outcomes with STEM persistence likelihood in order to build a framework for reducing and ultimately eliminating STEM underrepresentation.

Gary W. Wright III
Graduate Program: Science Education
Advisor: Cesar Delgado
Poster Number: 188

Queering science teacher education: Exploring changes in pre-service science teachers' attitudes and beliefs about gender and sexual diversity (GSD)-inclusive science teaching

Students who identify as LGBTQ continue to report feelings of being unsafe at school due to their sexual orientation, gender expression, and gender identity. Access to an inclusive curriculum and supportive teachers can have a significant positive impact on LGBTQ students' feelings of safety, academic performance, educational aspirations, and sense of school belonging and well-being. One response is to ensure that science teachers are prepared to integrate GSD- inclusive science teaching (GSDST) into their science classrooms. This research explored how pre-service science teachers' (PSSTs) attitudes and beliefs about GSDST changed after participating in an GSD-infused intervention implemented in a STEM teaching methods course. This study leverages three conceptual frameworks to inform the design and implementation of the intervention and in the data analysis: 1) GSDST, 2) effective teacher professional development (Desimone, 2009), and 3) Ambitious Science Teaching (Windschitl et al., 2018). Quantitative and qualitative data were collected to determine how this intervention affected PSSTs attitudes and beliefs about GSDST and to explore which design elements of the intervention contributed to changes in their attitudes and beliefs. The quantitative data shows that there was a medium positive effect on PSSTs' heteronormative attitudes and beliefs. The qualitative data indicates that the PSSTs' felt that the intervention provided them with concrete examples of GSDST that were coherent with Ambitious Science Teaching and multicultural education efforts and focused on science content. Results and related themes also suggest that PSSTs hold attitudes and beliefs that are consistent with an additive approach of GSDST (add- LGBT-and-stir) such as through inclusion of resources or showing LGBTQ scientists in the classroom. These findings will contribute to a more nuanced understanding of how to prepare science teachers to address GSDST and better meet the needs of all their students consistent with recent calls for gender equity reform in science education.

College of Engineering

Andrew Abney
Graduate Program: Mechanical Engineering
Advisor: Chris Vermillion
Poster Number: 3

Prediction of turbulence sensitivity in the non-linear closed-loop dynamics of marine hydrokinetic kites

Marine hydrokinetic (MHK) kites are energy-capture devices consisting of a lifting body tethered to a base station, which perform periodic flight paths approximately perpendicular to the prevailing flow. These dynamic flight maneuvers enable the kite to operate at flight speeds that far exceed the magnitude of the prevailing flow, enabling energy capture through on-board turbine rotors in a highly mass-efficient manner. An extensive body of literature demonstrates the flight performance of MHK kites in both steady and time-varying flow resources, including time scales associated with tidal variations and those associated with turbulent phenomena. Lacking from the current literature, however, is a method for predicting flight performance in a flow field with unknown turbulent frequency content. This work addresses that deficiency, presenting a method for evaluating a closed-loop MHK kite's sensitivity to turbulent flow over the full domain of feasible turbulent frequency content. As a first step, the closed-loop plant is simulated in a steady flow. Once steady-state tracking is achieved, the system states are captured at several discrete locations around the path. The plant is then linearized at these discrete points, and a frequency-domain analysis is conducted to determine the sensitivity of critical kite performance variables to disturbances in the flow. The results of this frequency domain analysis have been validated in two ways: First, the closed-loop system was re-simulated with a known sinusoidal flow disturbance superimposed on the base flow. The linearization analysis was used to predict the bounds of output errors, which were compared to the non-linear simulations, showing strong agreement. Second, a customized tow testing framework was used to experimentally characterize the kite's performance in the presence of prescribed sinusoidal variations in the tow speed. Results of these experiments demonstrate strong agreement between model predictions and observed performance.

Sanghyun Choo and Chang S. Nam
Graduate Program: Industrial Engineering
Advisor: Chang S. Nam
Poster Number: 29

Reinforcement Learning-assisted Multi-Task Learning for EEG-based Emotion Recognition with Contextual Information

This study aims at developing and validating a novel framework for electroencephalogram (EEG)-based emotion recognition using Multi-Task Learning (MTL) assisted by Reinforcement Learning (RL) to find optimal training strategy. Most EEG-based emotion recognition studies have focused on only mapping input neural features to the annotated emotion labels without considering other emotion factors like context. To consider the other emotion factor and the emotion labels, MTL can be used since its structure share parameters of neural network and include multiple classification tasks in terms of the same datasets. The joint optimization technique is usually applied to MTL when multiple labels for the datasets are available. However, this optimization technique considers weighted task-specific losses simultaneously so that the specific tasks' losses can be overestimated or underestimated. RL can be a solution to solve this training issue by utilizing dynamic training actions since it is powerful for adaptive learning involving sequential decision makings. To address an emotion factor with the emotion labels for emotion recognition and overcome the beforementioned issue of the joint optimization in MTL, we propose a novel framework for RL-assisted MTL to classify EEG emotion features with context information. We formulate the Markov Decision Process (MDP) to train MTL parameters adaptively. Then, the network architectures of MTL are customized. It is trained with the formulated MDP based on Deep RL algorithms, maximizing the cumulative rewards. To validate the proposed framework, we conducted an emotion experiment to collect context-related emotion labels of EEG signals and compare its classification performance compared to the Single-Task Learning (STL) model and the conventional MTL. The proposed method showed higher performances and derived a more generalized classifier than the others. The proposed framework can provide EEG emotion classifiers, including higher classification performance in Brain-Computer Interface domains, and be applied to diverse fields beyond EEG classification areas.

Archit Gajjar
Graduate Program: Computer Engineering
Advisors: Paul Franzon, Aydin Aysu
Poster Number: 66

XGBoost Accelerator for Real-Time Ransomware Detection

Advanced ensemble trees have proven quite effective in providing real-time predictions against ransomware detection, medical diagnosis, recommendation engines, fraud detection, failure predictions, crime risk, to name a few. Especially, XGBoost, one of the most prominent and widely used decision trees, has gained popularity due to various optimizations on gradient boosting framework that provides increased accuracy for classification and regression problems. XGBoost's ability to train relatively faster, handling missing values, flexibility and parallel processing make it a better candidate to handle data center workload. Today's data centers with enormous Input/Output Operations per Second (IOPS) demand a real-time accelerated inference with low latency and high throughput because of significant data processing due to applications such as ransomware detection or fraud detection This paper showcases an FPGA-based XGBoost accelerator designed with High-Level Synthesis (HLS) tools and design flow accelerating binary classification inference. We employ Alveo U50 and U200 to demonstrate the performance of the proposed design and compare it with existing state-of-the-art CPU (Intel Xeon E5-2686 v4) and GPU (Nvidia Tensor Core T4) implementations with relevant datasets. We show a latency speedup of our proposed design over state-of-art CPU and GPU implementations, including energy efficiency and cost-effectiveness. The proposed accelerator is up to 65.8x and 5.3x faster, in terms of latency than CPU and GPU, respectively. The Alveo U50 is a more cost-effective device, and the Alveo U200 stands out as more energy-efficient.

Vaibhav Garg, Jiaqing Yuan, Sherry Xi, Munindar P. Singh
Graduate Program: Computer Science
Advisor: Munindar P. Singh
Poster Number: 70

MINI-ME: Extracting Mini Stories from MeToo Experiences

On Reddit, victims share their experiences of sexual misconduct. While sharing such experiences, they reveal their feelings, emotions, and seek advice from other platform users. The victim's emotional state and the advice sought should be identified to provide them a helpful response. Traditional summarization techniques are domain dependent and may not extract these details from a MeToo post. We propose MINI-ME, an Artificial Intelligence (AI) based framework to extract mini stories that include sentences of (i) sexual misconduct, (ii) the victim's feelings or emotions, and (iii) advice sought. MINI-ME is trained on the annotated dataset containing 5947 MeToo sentences of these three categories. MINI-ME achieves an average F1 score of 81% and outperforms other baselines comprising keyword search, word embeddings, and sentence embeddings.

Paul Greback-Clarke
Graduate Program: Biomanufacturing
Advisors: Gary Gilleskie and Balaji Rao
Poster Number: 75

Quantification of rAAV particles using PEG modulated steric exclusion chromatography (SXC-HPLC) for gene therapy applications

The current development of a new class of medicine known as gene therapy has the potential to not just treat, but in many cases, cure patients affected by disease. Recombinant adeno-associated virus (rAAV or simply AAV) is a common delivery mechanism utilized by these gene therapy products. The biopharmaceutical industry is currently more suited to characterization of protein therapeutics such as monoclonal antibodies (mAbs), which are much less complex than the viral vectors used in gene therapy products (AAV is composed of a 60-subunit icosahedral protein shell with a payload of almost 5 kb of nucleic acid). Manufacturing technology for AAV in many ways has outpaced the development of analytical assays, and new methods are required that are capable of meeting analytical needs.

The work presented in this poster looks at a new way to quantify AAV capsids in process streams containing numerous potentially interfering impurities. We have executed proof-of-concept experiments of an under-utilized form of chromatography that is strategically suited for purification and quantification of large molecules such as AAV. This mode of chromatography is known as steric exclusion chromatography (SXC). The driving force for retention of AAV on chromatography media using SXC has been referred to as molecular crowding or preferential hydration. It is the result of water molecules being displaced to lower the free energy of an aqueous solution in the presence of high amounts of non-ionic organic polymer such as polyethylene glycol (PEG). We will describe our efforts to develop and automate a high-performance liquid chromatography (HPLC) method capable of controlled retention and elution of AAV by modulation of PEG; this method has been used to quantify AAV from both purified process intermediates as well as from crude lysates and has the potential to address some of the current analytical limitations in the field.

J. Tynan Guerra
Graduate Program: Aerospace Engineering
Advisor: Jack Edwards
Poster Number: 76

Two Phase Flow Modeling for Liquid Injectors

Fuel atomization is a key parameter in sustaining scramjet engine combustion and requires the break up of large liquid droplets into smaller droplets. Two methods to accelerate atomization involve mixing the fuel with a gas upstream of the injection point: aerated-liquid injection, and achieving internal atomization through dissolved gas bubbling. While both these methods offer good atomization, they require storing additional gas on the aircraft as well as a more complex injector design. As such, the performance of pure-liquid injection also needs to be studied as a more realistic means of injection. In pure-liquid injection the process of atomization starts after the liquid has been injected into the crossflow. Primary breakup occurs due to Kelvin-Helmholtz type instabilities and the formation of deformed tendrils of fluid, which split apart and then undergo secondary atomization.

Broadly the objectives of this research are to simulate various methods of liquid injection into supersonic crossflows and validate using existing results from experiments run at the Air Force Research Laboratory. More specifically there are two thrusts: To develop a unified breakup formulation that can be used to simulate both pure- and aerated-liquid injection cases, and to investigate internal atomization through dissolved gas bubbling. This work utilizes NCSU's REACTMB computational fluid dynamics (CFD) code with a Lagrangian droplet tracking engine. Thus far, significant improvements have been made to the code through additional subroutines to the droplet tracking engine. These include modifying the aerated-liquid code to handle pure liquid injection and developing an accompanying Kelvin-Helmholtz primary breakup model. In order to simulate internal atomization, it is necessary to be able to capture phase equilibrium. To accomplish this we are using a vapor-liquid equilibrium model in conjunction with the Peng-Robinson equation of state.

Ethan Johnson, Jonathan McCready, Venkat Narayanaswamy, Jack Edwards
Graduate Program: Aerospace Engineering
Advisors: Venkat Narayanaswamy, Jack Edwards
Poster Number: 90

Hypersonic Airbreathing Engine Inlet Evaluated at Off-Design Conditions

Streamtraced inlets offer unparalleled efficiencies for scramjet engines, but limited experimental information is available on the sub-design performance of these inlets. In this study, the operation of a streamtraced half-Busemann inlet with a design point of Mach 5.5 and a contraction ratio of 3:1 is experimentally studied in a Mach 4.0 flow. Several non-intrusive flow measurement techniques are employed to provide an unprecedented understanding of the intricate flow field within these inlets at various operational conditions. These techniques include several laser diagnostics as well as state of the art pressure sensitive paint measurements to resolve full field dynamics. Together, these datasets provided a unique understanding of the flow evolution and load distribution within the inlet at various operational phases that include tare condition, without back pressuring, as well as back pressure operation until unstart. The facility effects on the inlet operation is also explored where it was found that without boundary layer conditioning the wind tunnel starting shock could not be swallowed by the inlet. However, this "fails to start" operation enabled a unique lens to the flow field in the unstarted inlet throat that was not possible with back pressure due to optical access restraints.

Jishnudeep Kar
Graduate Program: Electrical Engineering
Advisor: Aranya Chakrabortty
Poster Number: 93

An Integrated Generative Adversarial Network for Identification and Mitigation of Cyber-Attacks in Wide-Area Control

Cyber-security solutions for wide-area control of power systems have garnered significant attention over the past decade. Two most common and pertinent types of attacks that have been addressed in the literature include false data injection (FDI) attacks, where intruders can hack in to the wide-area communication network channels and corrupt the data streams originating from Phasor Measurement Units (PMUs), and Denial-of-Service (DoS) attacks where attackers may temporarily deactivate a link to obstruct the PMU data to reach their desired destination. Majority of the algorithms for detecting and mitigating these types of attacks reported so far are model-based, meaning that they require the knowledge of the exact power system model during a cyber-attack. However, given the recent expansion in the number of PMUs, grid operators are gradually inclining towards more model-free and data-driven approaches.

We propose a generative adversarial network (GAN)-based learning strategy which serves dual purposes of both identification and mitigation of cyber-attacks. The benefit of using GAN over conventional LSTM methods is that GAN learns the probability distribution of the training data, and thereby provides a much more accurate representation of the operating point for the test data. In our proposition, each GAN can be implemented in a decentralized manner at every generating station, thereby avoiding the need for any inter-learner communication. The goal is to collectively ensure that the system states remain bounded in real-time while the attack is resolved. We use an encoder-decoder structure for the ``generator" module of the GAN using LSTM to accurately capture the grid dynamics. The input to the generator is the attacked state vector (containing either missing state entries for DoS, or corrupt state entries for FDI) which is obtained from streaming data from PMUs placed at geometrically observable set of buses, and the output is GAN's best prediction for what these missing or anomalous entries should be in normal conditions.

The novelty of our approach is twofold. Firstly, the method is model-free and decentralized i.e the GANs can be installed independently at critical generating stations although they all work collectively to protect the grid from an incoming attack. The second most unique aspect of our approach lies in the fact that we train a single integrated GAN model for both detection and mitigation that guarantees more accuracy.

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Graduate Programs: Industrial Engineering[1]; Mechanical, Industrial, and Manufacturing Engineering, Oregon State University[2]
Advisor: Osman Y. Ozaltin
Poster Number: 101

Septic Shock Prediction and Knowledge Discovery through Temporal Pattern Mining

Sepsis is the body's adverse response to infection which can lead to septic shock and eventually death if not treated in a timely manner. Analyzing patterns in sepsis patients' health status over time can help predict septic shock before its onset allowing healthcare providers to be more proactive. Temporal pattern mining methods can be used to identify trends in a patient's health status over time. However, these methods tend to return too many patterns hindering knowledge discovery and practical implementation at the bedside in acute care settings. We propose a framework to find a small number of relevant temporal patterns in electronic health records for the early prediction of septic shock. Our framework consists of a temporal pattern mining method and three pattern selection techniques based on non-contrasted group support (PST1), contrasted group support (PST2), and predictive power (PST3). We find that PST3 yields the best prediction performance among these techniques. However, PST2 identifies more multi-state patterns with abnormal health states, which can give healthcare providers indicators of patient deterioration towards septic shock. Hence, from a knowledge discovery perspective, it may be worthwhile to sacrifice a small amount of prediction power for actionable patient health information through the implementation of PST2.

Fengming Lin
Graduate Program: Industrial Engineering
Advisors: Shu-Cherng Fang, Xiaolei Fang
Poster Number: 102

Distributionally robust chance-constrained quadratic support vector machines under moment uncertainty

Support vector machines are proven to be useful for supervised classification in Machine Learning. With only the first and second moments known for the distributions, this paper proposes the distributionally chance-constrained (DRCC) soft nonlinear SVMs to ensure the small probability of misclassification for the uncertain data in the worst case. Considering computability, we prove that the probabilistic constraints in the proposed models can be reformulated as semidefinite constraints and further yield second-order cone constraints for an efficient implementation. The proposed DRCC kernel-free quadratic SVM performs better in dealing with nonlinear uncertain classification than DRCC linear SVM and requires less than DRCC kernel SVM. By introducing the clustering methods, we provide a two-stage algorithm in the context of data-driven uncertain problems and the algorithm shows attracting performance on massive data. Extensive computational experiments using both the synthetic data sets and public benchmark data sets are conducted to show the superior performance in accuracy and time of the proposed DRCC quadratic SVM over other well-known SVM models. The proposed model has dominating performance on a real-world application of battery failure prediction in automated guided vehicles management with highly imbalanced data.

Yajie Liu, Kevin Han, and William Rasdorf
Graduate Program: Engineering
Advisors: Kevin Han and William Rasdorf
Poster Number: 103

Data-driven Flight Mission Planning of Small Unmanned Aerial Systems for Producing Survey-Grade Geospatial Products

Recent advances in computer vision and camera-equipped unmanned aerial systems (UASs) for 3D modeling enabled UAS-based surveys with high spatial-temporal resolutions. Although there have been many studies on various factors that affect the accuracy of UAS-based photogrammetry-based geospatial data, there is little to no quantitative method that identifies the relationships between flight configuration factors and point cloud accuracy. This study assesses five impact factors using the multiple regression (MR) method to understand the influence and the significance levels of impact factors on the accuracy. The influence factors include flight height, average image quality, image overlap, ground control point (GCP) quantity, and focal lengths of cameras. 160 datasets were processed using 40 flight missions collected at a facility site with 4 different numbers of GCPs. The results show that image overlap has a high significance on the vertical and horizontal accuracies. The GCPs quantity only has high significance on vertical accuracy. Also, as a major impact factor with strong influence, GCPs quantity and distribution can significantly influence the UAS-based photogrammetric surveying accuracy. With the increase in the number of GCPs, the accuracy in horizontal and vertical directions will be improved. However, the GCP displacement and measurement are time and labor-consuming. Thus, this research further studied how GCPs quantity and spacing impact the accuracy. The findings of this study can help surveyors better design flight configurations given different site conditions and constraints and also provide a basic understanding of what levels of accuracy could be achieved using different flight configurations.

Grace Maddocks[1], Hayley Richardson[2], Kaila Peterson[1]
Graduate Programs: Electrical Engineering[1], Materials Science and Engineering[2]
Advisors: Michael Daniele[1]and Spyridon Pavlidis[2]
Poster Number: 105

Toward Subcutaneous Electrochemical Aptasensors for Neuropeptide Y

Subcutaneous sensors, similar to the continuous glucose monitor, are advantageous for identifying healthy and pathological patterns of circulating biomarkers. A biosensor for the detection of neuropeptide Y (NPY), marker of stress, has been designed and tested for operation in a flexible microneedle form-factor. The biosensing principle used is affinity binding of NPY to a DNA aptamer-functionalized electrode. A gold microelectrode was functionalized by formation of a self-assembled monolayer (SAM) of a thiol-modified NPY-binding aptamer and poly(ethylene glycol) methyl ether thiol (PEG). The sensors were evaluated by cyclic voltammetry and electrochemical impedance spectroscopy, resulting in a response to NPY over 400pM to 200nM when tested in KCl and K3[Fe(CN)6]/K4[Fe(CN)6], and PBS.

Kartik Naik
Graduate Program: Aerospace Engineering
Advisor: Chris Vermillion
Poster Number: 123

Control-Aware Co-Design of the Geometry and Structure for an Energy-Harvesting Kite

Energy-harvesting kites, which can be designed for airborne or underwater environments, utilize a high-lift wing to execute high-speed flight patterns perpendicular to the prevailing flow, resulting in more than an order of magnitude greater power generation per unit mass than traditional turbines. In this work, an underwater kite is considered, which has the capacity of yielding economically viable power outputs in ocean current resources for which stationary, towered systems are not viable. Achieving an optimal level of performance out of an energy-harvesting kite requires the careful management of geometric, structural, and control system subsystems. This work showcases a combined optimization framework that simultaneously considers all three subsystems, including the coupling between them. In particular, the framework consists of several stand-alone tools – a geometric optimization tool, wing structure optimization tool, fuselage structure optimization tool, and flight control proxy map – which are fused together in a nested optimization framework that accounts for coupling. Two overall optimization frameworks are presented for integrating the aforementioned optimization tools in order to maximize a weighted power-to-mass ratio, which has been accepted as a key techno-economic performance metric for marine hydrokinetic energy systems. One of these frameworks, a dual-objective framework, enables intuitive management of the tradeoff between power and mass but does not allow for designs that correspond to non-convex sections of the mass-power Pareto front. The other framework, a Pareto optimal approach, enables the complete tracing of the Pareto front through a constrained optimization. In addition to presenting the mass-power Pareto front, dynamic simulation results are presented for optimized kite geometries, based on a medium-fidelity dynamic model that has been experimentally validated via a customized tow testing setup.

Gabriel Oliveira
Graduate Program: Computer Science
Advisors: Collin Lynch and Sarah Heckman
Poster Number: 128

A Journey to Find Indicators of Student Progress

Computer Science has a high number of students in the classroom, especially in introductory courses. Students have a variety of backgrounds and prior programming experiences. Due to these factors, it is challenging to identify students that need assistance. Coupled with the fact that most students tend not to look for help, some students might fail the course and/or leave the program.

The goal of this research is to help find a way to automatically detect students that need help. In this stage, we strive to understand students' habits around submissions, particularly to find indicators of progress, or lack thereof, within assignments. Progress indicators, measures from student source and test code, have been studied in prior research. However, exploring data from NC State, we found that some of the existent progress indicators are not appropriate within our course context. For instance, we provide students with an expected structure for their classes and methods. Students are evaluated on creating code that contains the expected classes and methods as a first step in completing their project. Therefore progress indicators that measure an increase in the number of classes and methods are only useful during the first part of the project and not on the later portions where students spend most of their time. s. We are creating additional progress indicators that can provide information on student progress based on our course context. Preliminary analysis suggests that our progress indicators should focus on how students modify code, structurally within classes and methods, to pass the test cases provided.

Sharda Pandit, Pritha Agarwalla, Yevgeny Brudno
Graduate Program: Biomedical Engineering
Advisor: Yevgeny Brudno
Poster Number: 132

Multifunctional scaffold platform for T cell engineering

Adoptive T cell therapies have shown unprecedented success in B cell malignancies and present a new potential therapeutic avenue for solid tumors. However, current CAR-T cell manufacturing procedures involve lengthy and labor-intensive protocols increasing the cost and delaying the initiation of the therapy. Moreover, the in vitro expansion of the generated CAR-T cells produces heterogeneous composition and terminal differentiation, limiting their engraftment and persistence in vivo. Herein, we present multifunctional, tunable, low-cost alginate-based scaffold platforms for T cell transduction, expansion, and release. Our first system- 'DryDux' includes a simple, scalable microporous scaffold that provides excellent static T cell transduction comparable to clinically used reagents like retronectin serving as a potential alternative to current T cell transduction protocols. Our second scaffold platform- 'MASTER' presents appropriate signals for T cell activation and expansion in addition to its static transduction properties. CAR-T cells generated using these platforms show good transduction efficiency and in-vitro cytotoxicity. In addition, cell and vector-loaded scaffolds can be implanted in vivo to expand and release CAR-T cells serving as all-in-one transduction and delivery platform. These revolutionary platforms help fast-tracking the current CAR-T cell manufacturing process by bypassing current costly and labor-intensive procedures.

Saqlain Raza
Graduate Program: Mechanical Engineering
Advisor: Jun Liu
Poster Number: 139

Understanding Direct Contact Membrane Distillation using Molecular Dynamics Simulations

Global water insecurity is surging to its peak, demanding the development of water generation techniques with low energy consumption. Direct Contact Membrane Distillation (DCMD) which can utilize waste grade heat or renewable energy remains a low-throughput process despite extensive studies done over the past decade due to low membrane porosity and membrane flooding issues. This research focuses on understanding the DCMD process using Molecular Dynamics (MD) simulations with an aim to develop relationships between mass flux and hydrophobicity of the membrane. Nanoscale processes such as vapor condensation on the fibers are also studied using the MD simulations technique with the purpose of devising a methodology and defining the optimum design of membranes to prevent this mode of failure. More specifically, the SPC/E molecular model and coarse grain Pea model are considered to simulate water and air respectively. The fibers are constructed as a simple metal lattice with three layers to ensure a fixed position of the fiber at a certain height while allowing free interactions of the outer surface with water and air. Moreover, the contact angle of fiber with water is controlled using a scaling factor from Lorentz-Berthelot mixing parameters. The results indicate that with the reduction in contact angle, hydrophobicity of the fiber reduces, and more vapors are condensed on the fiber. Furthermore, increasing the contact angle results in an increment of mass transfer and average mass flux due to lower condensation of water on the membrane. The volume of the water droplet on the fiber has also been evaluated using the density profile technique and fundamental reasons resulting in the formation of droplets has been developed using temperature profile. Since these simulations are done at 3-4 orders of magnitude smaller than the actual process, scaling factors need to be determined for quantitative assessment.

James Reed
Graduate Program: Mechanical Engineering
Advisor: Chris Vermillion
Poster Number: 141

Iterative Learning-Based Flight Pattern Optimization for an Energy-Harvesting Kite

With the looming pressure of a warming climate, environmentally and economically efficient energy-harvesting methods are in high demand. Energy-harvesting kites (which can be designed for wind energy harvesting in the air or marine energy harvesting underwater) represent an emerging clean-energy solution with the potential for expanding wind and marine hydrokinetic energy harvesting to locations for which traditional towered systems are uneconomical. These systems utilize high-lift wings to fly perpendicular to the prevailing currents, in high-speed figure-eight motions, ultimately yielding more than a magnitude more power than traditional stationary turbines of similar sizes. Power can be generated via on-board turbines or through a ground-based winch and cyclic spooling motion. Either way, a hallmark characteristic of kites lies in their cyclic operation (exhibited through repeated figure-eight motions and also, in the case of ground-based energy generation, cyclic spooling motion). To intelligently capitalize on this cyclic operation, we have developed an iterative learning-based control parameter optimization that strategically adjusts flight parameters between cycles. The algorithm consists of two steps, which are executed after the completion of each spooling cycle. First, a meta-model is updated using a recursive least squares estimate to characterize an economic performance index as a function of a set of flight control parameters. Second, an iterative learning-based update law uses information from past cycles to update control parameters at the next cycle, using a perturbed gradient ascent formulation. This algorithm was experimentally validated on a scaled prototype underwater kite system towed behind a customized test vessel in Lake Norman, North Carolina. Using this experimental system and our iterative learning algorithm, we were able to double the amount of power and tension achieved, relative to an initial baseline controller.

Noah Rubin, Xiaogang Hu, He (Helen) Huang
Graduate Program: Biomedical Engineering, North Carolina State University/University of North Carolina, Chapel Hill
Advisors: He Huang and Xiaogang Hu
Poster Number:152

Validating Motor Unit Decomposition of Surface Electromyography During Dynamic Muscle Activation

Surface electromyography (sEMG) reflects the summation of motor unit action potentials (MUAPs) from a number of motor units (MUs) (each a motor neuron and all the muscle fibers it innervates), considered the smallest independent control units of muscle activation. Multiple blind source separation techniques have been developed to decompose sEMG into individual MU firings, but historically have been limited to well-controlled isometric conditions (muscle activation without joint motion). In recent years, these algorithms have been applied to sEMG recorded in dynamic conditions, but limited effort has been made to confirm the validity of the MUs decomposed. We are attempting to validate the decomposition output of a popular algorithm from sEMG recorded in dynamic conditions. A 4-pin electrode array (Galileo, Delsys, Inc.) was placed on the biceps brachii while subjects conducted bicep curls with and without weight (up to 45 N, 10 lbs) at multiple joint speeds ranging 5-30 degrees per second. sEMG was decomposed into individual MUAPs and corresponding firings with commercial software (Neuromap). Using a modified matching pursuit approach, decomposed MUAPs were shifted in time, frequency, and amplitude to minimize the residual between the raw sEMG signal and represented sEMG based on decomposition. We hypothesize a subset of MUs decomposed from the original output are accurate enough to reduce energy of the residual to 10% of the raw EMG signal, with better performance than using all MUs initially decomposed. We present matching pursuit applied to decomposed sEMG as a novel step to further validate sEMG decomposition and quantify the extent to which recorded MUAPs transform during dynamic muscle activation. Such efforts may improve accuracy in myoelectric control of assistive devices and reliability of noninvasive neurophysiological investigation.

Abinash Sahoo
Graduate Program: Aerospace Engineering
Advisors: Venkateswaran Narayanaswamy and Kevin Michael Lyons
Poster Number: 153

Flameless Oxidation (FLOX): An Ultra Clean Combustion Technology

Flameless Oxidation (FLOX) or Moderate or Intense Low oxygen Dilution (MILD) combustion is an ultra-clean combustion technology that is capable of producing very low levels of pollutants (NOx, CO, CO2, and soot particles) and noise. MILD combustion is also characterized by distributed or volumetric combustion with reduced peak temperature improving the overall thermal efficiency. The main characteristics of MILD combustion are an elevated temperature of the reactant mixture above its auto-ignition temperature and the temperature increase from the combustion process being lower than the difference between auto-ignition temperature and room temperature. To achieve this, practical combustors employ large-scale recirculation of hot exhaust gases that heats up the reactants (700-1200K) and dilutes the oxygen concentration (3-9 %) of the combusting mixture resulting in decreased peak temperature. Lower peak temperature leads to lower thermal NOx loading (can go as low as single-digit PPM levels). The low-temperature chemistry and slower reaction kinetics in the MILD flame lead to low levels of radicals (CH* and OH*) in the reaction zone making the MILD flame non-luminous or invisible. So, the MILD flame is also known as the invisible flame. For stable MILD combustion to occur, the reactant mixture has to be perfectly mixed or stirred before chemical reactions could initiate. In laboratory scale, a canonical jet-in-hot-coflow (JHC) burner has been used to study conventional autoignitive flamelet combustion (luminous flame) as well as MILD combustion (invisible flame). Both experimental and numerical studies are performed to improve our understanding of MILD flames. High-speed imaging was performed to visualize the flamelet combustion (luminous flame) mode and possible transition from flamelet combustion (luminous flame) mode to MILD combustion (invisible flame) mode. Laser diagnostics tools are used for non-intrusive, multi-dimensional, time-resolved measurement of physical parameters such as local temperature, velocity, the concentration of a variety of chemical species such as CH, OH, CH2O, etc. MILD combustion (invisible flame) shows very low levels of CH radical, moderate levels of OH radical, and high levels of CH2O (Formaldehyde) compared to flamelet combustion (luminous flame). This information is used to distinguish MILD flame from conventional luminous flame and study the conditions at which MILD flame is stable. With suitable conditions, MILD combustion can be used in the transportation and energy sector in the future to meet the stringent emission norms and also improve efficiency.

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Graduate Programs: Computer Science[1]; Eshelman School of Pharmacy, University of North Carolina at Chapel Hill[2]
Advisor: Rada Chirkova
Poster Number: 155

Accelerating Drug Discovery by Automatically Extracting and Evaluating Evidence in Knowledge Graphs

Drug discovery is the traditionally long, intensive process by which biomedical experts identify new, likely treatments for diseases. Fortunately, large-scale biomedical knowledge graphs capture information regarding relationships between biomedical entities, e.g., drugs and diseases that can be leveraged to automate parts of the drug discovery process, thereby alleviating much of the time and manual effort required. Recently, many explainable fact-checking approaches have been developed which extract information from knowledge graphs to explain candidate facts and assign a reliability score to each explanation. These approaches could be used to aid in drug discovery by extracting and evaluating explanations for hypotheses of the form "drug treats disease" which can be analyzed by biomedical experts and potentially verified in clinical trials.

Through collaboration with biomedical experts, we have identified features of existing explainable fact-checking tools that do not meet the needs of experts performing drug discovery. Both the output explanations and evaluation metrics of existing approaches do not align with specific domain requirements. To address the challenges faced when applying existing fact-checking approaches to drug discovery, we present a scalable, automated explainable fact-checking approach that meets the needs of biomedical experts. Our explanations take the form of knowledge graph patterns, which are inspired by existing biomedical concepts; our proposed metrics provided a data-supported evaluation of each explanation by considering the available evidence in the knowledge graph. Through various experiments, including a case study, we provide evidence that our explanations are understandable and reasonable to biomedical experts and are useful for many explanation derivation tasks. Moreover, our proposed metrics are accurate, require no domain-specific assumptions, and are capable of identifying strong explanations. Overall, our findings suggest that our proposed explainable fact-checking approach is viable for accelerating drug discovery.

Machi Shimmei
Graduate Program: Computer Science
Advisor: Noboru Matsuda
Poster Number: 164

Automatically Finding Key Concepts to Generate Pedagogically Valuable Questions for Courseware

Answering questions is an essential part of learning in online courseware. It has been shown that answering questions contributes to students learning effectively. However, generating questions is an expensive task and requires a lot of effort. Although there has been some research on the automation of question generation in the literature of Natural Language Processing, these technologies do not necessarily generate questions that are useful for educational purposes. To fill this gap, we propose QUADL, a method for generating questions that are aligned with a given learning objective. The learning objective reflects the skill or concept that students need to learn. We hypothesize that if a probable answer (relative to a specific learning objective) can be identified in a given sentence, then a pedagogically valuable verbatim question can be generated by converting the sentence into a question. Based on the hypothesis, the QUADL method consists of two parts: The Answer Prediction model that identifies a key concept, if any, in a given sentence that has a strong connection with the given learning objective, and the Question Conversion model that converts the given sentence into a question for which the predicted key concept becomes the answer. Existing online course materials that consist of learning objectives and didactic text were used to evaluate the proposed model. In-service course instructors judged 66 % of the predicted target answers were suitable for the given learning objective. The results also showed that the QG-Net model can generate adequate questions in novel domains when appropriate sentences and target answers are given.

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Graduate Programs: Industrial Engineering[1]; Biomedical Engineering[2]; Mechanical and Aerospace Engineering[3]
Advisor: Rohan A. Shirwaiker
Poster Number: 165

Dielectric spectroscopy (DS) enables the non-destructive, real-time quality assessment of biofabricated tissue constructs, but typical tissue maturation bioreactors do not allow in-line DS measurements.

Herein, we describe the hardware and software design of a new perfusion bioreactor system that enables in-line multi-modal quality assessment (DS, dissolved oxygen (DO), and pH) of tissue constructs during their maturation over several weeks. Computational fluid dynamics simulations were used to determine the optimal chamber size, media inlet-outlet locations, and media flow rate that minimized the shear stress on construct surfaces (to which cells attach) and chamber pressure. A software was developed and integrated with the hardware to automate data analysis and visualization. To validate the bioreactor design, a fibroblast cells-seeded 3D bioplotted polycaprolactone was cultured over 6 weeks in a system prototype. In-line DS measurements were performed every three days while DO and pH were recorded continuously. Additionally, traditional offline measurements of glucose and lactate concentration in media sampled from the bioreactor chamber were performed corresponding to each DS reading. The trends in Δε determined from the raw DS data over time correlated well with in-line DO and pH and offline glucose and lactate data. Furthermore, when the media perfusion was disrupted for 36 hours between days 29 and 32, DS was highly sensitive in detecting its effects on cell viability; there was a sudden drop in Δε corresponding to the drop in glucose and spike in lactate. This validated bioreactor system will aid significantly in the development of tissue-engineered medical products in future.

Margaret Tobey[1], Ruoting Li[2], Osman Y. Ozaltin[2], Maria E. Mayorga[2], Sherrie Caltagirone[3]
Graduate Programs: Operations Research[1]; Industrial Engineering[2]; Global Emancipation Network[3]
Advisors: Osman Y. Ozaltin and Maria E. Mayorga
Poster Number: 173

Interpretable Models for the Automated Detection of Illicit Massage Businesses

There are around 11,000 illicit massage businesses (IMBs) across the United States, exploiting an estimated 30,000 people, many of whom are victims of human trafficking. IMBs profit illegally from the sexual exploitation and forced labor of victim-workers and hide in plain sight among legitimate businesses in ordinary strip malls and city streets. Data about massage businesses is available from many sources. We focus our analysis on data that can be easily obtained or scraped from open websites. This includes reviews and business data from Yelp.com, business data from SafeGraph, U.S. Census data, and GIS files of landmarks like truck stops, highways, and military bases. Clues from each of these data sources can be pieced together to uncover IMBs and their complicated networks. Through a partnership with the counter-human trafficking non-profit organization, Global Emancipation Network, and with funding from the National Science Foundation (CMMI Award #1936331), we conduct stakeholder interviews to identify potential IMB indicators in the data and possible use cases for an automated IMB detection tool. From stakeholder feedback and evidence in the literature, we identify features to extract from the data for use in prediction models. Using previously developed modeling packages, we propose two interpretable prediction models for assessing the risk that a given massage business is an IMB: optimal decision trees and optimized risk scores. Once optimally trained, these models are easy to apply to new data, requiring only simple logic or arithmetic, and the results are interpretable. This provides transparency and increases stakeholder confidence, making it more likely that they will be adopted by stakeholders. Our results show comparable prediction performance to various baseline machine learning methods. Our proposed models can save our stakeholders' time and resources of by automatically prioritizing the workflow of IMB investigations.

Benjamin H. Wahls, Srinath V. Ekkad
Graduate Program: Mechanical Engineering
Advisor: Srinath V. Ekkad
Poster Number: 179

A New Technique for Temperature Reconstruction of an Axisymmetric Open Reactive Flow Using Background Oriented Schlieren

An important benchmark in gas turbine combustor design is flow temperature, allowing designers to predict harmful emission levels and help calculate overall engine efficiency. This information is expensive to obtain experimentally and validation of numerical predictions is an ongoing topic in the field. To this end, the novel 3D ray tracing technique for refractive index field reconstruction from displacement datasets acquired in Background Oriented Schlieren (BOS) experiments has been developed and applied to an open, premixed, methane/air flame running on a 12mm circular burner at a Reynolds number of 4,000. The temperature distribution is then calculated using an approximated species independent relationship between local refractive index and temperature and ambient conditions. Reactive flow simulations are carried out to reveal that the error introduced by this relationship is 8% within the inner unburnt region, decreasing to 2% through the reaction zone, and quickly falling to 0% outside flow field. The effect of random noise and reconstruction grid size are evaluated through the use of synthetically generated BOS displacement datasets. The 3D ray tracing method is a direct method, meaning no prior knowledge of flow field parameters is required; only the size of the field and ambient temperature must be known. The method is shown to yield accurate temperature reconstructions in the presence of measured 2D displacement fields, which is a shortcoming of current direct methods in literature. The simple, inexpensive experimental setup and low computational cost make this approach with BOS an appealing option for application into existing experimental combustion systems with minimal effort.

Morgan Westbrook
Graduate Program: Civil Engineering
Advisor: William Rasdorf
Poster Number: 181

LED Traffic Signal Lifespan and Replacement Assessment; NCDOT: History and Future

Traffic signals are a critical traffic control element that engineers use to ensure the safety of drivers and efficiency of transportation systems. Playing such a vital role, a thorough understanding and optimization of the installation, operation, maintenance, and replacement (IOMR) of signals is key to their use. An important, but as of yet unanswered, question regarding signals is “how long do LED modules last and what is an optimal replacement process for them?”

The optimization of traffic signal IOMR processes requires an understanding of both inherent module qualities and knowledge of their management. While module manufacturers have developed lifespans in a laboratory setting, there is a lack of data showing the lifespan of various LED modules in the field. Furthermore, no guidelines exist on replacement strategies to optimize cost, efficiency, and safety leaving agencies to individually determine an appropriate process.

This presentation reports the results of an analysis of IOMR practices documented by NCDOT and models developed to determine future needs. The research team was provided access to the NCDOT DTS database, containing recorded IOMR events from across the state. Using this historic data as a base, the research team was able to incorporate population and budgetary data to develop models for projecting future anticipated LED IOMR resource needs.

What challenge or unmet need are you addressing?

Currently there is no national standard for the replacement or maintenance of LED traffic signals. As NCDOT is working to upgrade their LED systems, having both a cohesive plan for this transition and a guideline for module replacement will ensure that all signals are being replaced in a manner that maintains intersection and personnel safety while also optimizing the cost of doing so. This plan will put in place the data structures and models required to utilize the signals for their full lifespans.

Yiwei Zhang
Graduate Program: Operations Research
Advisor: Maria Mayorga
Poster Number: 193

Impact of Stratified Interventions in School Operations under COVID-19

The novel coronavirus (COVID-19), along with its many highly contagious variants, has spread across the US since 2020. Children are at risk of being exposed to the disease because they weren't eligible for vaccination during the first 20 months of the pandemic, and the children's vaccination rate is relatively low according to recent records. Thus, Non-Pharmaceutical Interventions (NPIs) are extremely important in controlling the disease spread in K12 schools. Our study analyzes the potential impact of COVID-19 transmission within K12 schools as students return to in-person learning, as well as the possible interventions that can be applied to mitigate such impact. We design a contact matrix to simulate the contact patterns between students and teachers. We develop a deterministic stratified SEIR model that captures the role of social contacts between cohorts in disease transmission to estimate COVID-19 incidence under different intervention scenarios such as mask-wearing, randomized testing, contact reduction, school closing, and contact tracing. We find that mask-wearing and reducing contacts can greatly reduce new infections among students. School-closing and Self-quarantining symptomatic infections are also effective in reducing the total number of infections, however, it increases absenteeism.

College of Humanities and Social Sciences

Raymond Abiona
Graduate Program: International Studies
Advisor: Lada Kochtcheeva
Poster Number: 2

Independent but Not Free: The Environmental and Social Effects of Nigeria's Dependency on the British Shell Oil Company

In the 1950s, colonial Great Britain granted its Shell Oil Company (Shell) an exclusive license to begin oil exploration in Nigeria. Despite providing a source of income and employment, several negative environmental and societal impacts can be witnessed in Nigeria, particularly in the Niger Delta region where oil is extracted. The aim of this research is to examine whether the developmental gains of Shell's operations outweigh the environmental and social costs in the Niger Delta region. What explains the challenges and benefits of continuing Shell operations in Nigeria's Delta Region? This research is based on a qualitative analysis of primary and secondary data sources, including the statistics on human development indices of African oil-producing countries. The findings reveal that Shell's operations have been a major source of revenue for the Nigerian government and wealth accumulation for the elites. For example, in 2019, Shell paid $5.63 billion to Nigeria, the most of any transnational company, yet the majority of the region's population continues to live below the poverty line. Significantly, the Niger Delta region and its people have suffered considerably from the devastating impacts of oil extraction on the region's old agrarian culture, arable lands, consumable and fishable waters. Massive environmental damage, resource exhaustion, poverty, and brutal repression of local protests have resulted in the region's incessant occurrence of violent conflicts and armed militancy. This study argues that the environmental and social costs of Shell operations in the Niger Delta region far outweigh the developmental gains, especially as the company's ties to Nigeria's ruling elites continue to produce negative environmental and social outcomes. This study concludes by suggesting some sustainable and ethical approaches for mitigating negative effects and increasing the quality of life in Nigeria's Niger Delta, such as polluter pays principle and review of oil revenue sharing formula.

Kyle Bailey
Graduate Program: History
Advisor: Judy Kertesz
Poster Number: 10

Education and Annihilation: The North Carolina State University Land Grant at War

Abraham Lincoln signed to Morrill Land Grant Colleges Act in July 1862, committing to distributing public lands in the American West to fund endowments for agricultural and mechanical colleges and mandating that the institutions offer instruction in military science and tactics. In 1867, North Carolina received 269,817 acres of western land from the Morrill Act, the proceeds from which remain in the North Carolina State University endowment to this day. The federal government obtained the distributed public land through a multifaceted campaign of indigenous dispossession. The states sold the land received through the Morrill Act in what Robert Lee and Tristan Ahtone have described as "a massive wealth transfer masquerading as a donation," that affected nearly 250 Indigenous communities and transferred up to eleven million acres. The educational institutions established by the Morrill Act played roles in that wealth transfer by acting as military training sites and by spreading the skills among settlers to cultivate and alter the landscape of the West. The Morrill Act established a relationship between the U.S. War Department which included the appointment of officers as military instructors, some of whom interspersed their professorships with active participation in warfare against Indigenous people. By examining the careers of these military instructors at NC State, this project explores the relationship between the land-grant institutions, the US Military, and the Indigenous dispossession that facilitated the donation of "public" lands provided by the 1862 Morrill Act.

Brittany M. Ballard, Emma G. Duling, Emily R. Tingen, Leah P. Foil
Graduate Program: Social Work
Advisor: Qiana Cryer-Coupet
Poster Number: 11

An Evaluation of the Implementation of the Low Barrier Shelter Model at South Wilmington Street Center and its Implications for Future Homeless Shelter Policies

Homelessness is estimated to affect 1.4 million individuals a year in the US, and these numbers are expected to only have increased due to the COVID-19 pandemic. South Wilmington Street Center (SWSC) is a homeless shelter located in Raleigh, North Carolina that provides transitional housing and emergency shelter to men over the age of 18 who are homeless. Before the start of the COVID-19 pandemic, SWSC had begun the process of transitioning into a Low-Barrier Shelter Model (LBSM). The LBSM decreases obstacles for homeless persons to seek shelter. By decreasing bureaucratic policies, which can make it difficult for persons who are homeless to find a shelter, this model emphasizes greater access to shelters which can help in finding permanent housing. Because of the COVID-19 pandemic, SWSC had to drastically reduce the number of individuals experiencing homelessness it could serve. Due to the lower numbers, SWSC was able to begin implementing the LBSM into the shelter policies sooner than they had originally thought. The overall goal of this evaluation is to determine whether or not SWSC follows the new LBSM. Furthermore, the data collected will provide insight on how to improve the newly implemented model in order to provide further success of the LBSM. All the information that is provided aligns with a formative evaluation model. This evaluation utilizes a triangulation of data collected through interviews of SWSC staff, the HMIS database, and record review of SWSC policies and procedures manual. \ We hypothesize that SWSC is not currently aligned with all of the standards of the LBSM because there has been no formal implementation of the model. However, the outcomes experienced by men at SWSC will provide valuable insight into the effectiveness of the LBSM and its ability to be replicated at other homeless shelters.

Brooke Belcher
Graduate Program: Technical Communication
Advisor: Huiling Ding
Poster Number: 15

Instructional Design & Responsible Data Science: Developing Ethics Modules for Future Analytics Professionals

As demands for analytics professionals expand, data science students are required to develop technical, programming, communication, and business skills. Because even well-intentioned data projects can have devastating impacts upon individuals, communities, and businesses, ethical training is also essential to analytics education. However, despite the need for responsible data scientists, many modern US master's programs for analytics have minimal or no official, organized ethics training. The Institute for Advanced Analytics (IAA) at North Carolina State University was an example of one such data science master's program with some ethics training resources; however, these resources needed to be expanded, organized, and updated to meet the competitive standards of other schools and to prepare students for future decision-making. This project met the IAA's need for official data science training through the creation of five core modules on data science topics. A frequency analysis of ethics courses at similar US analytics programs, a literature review of instructional design and data science ethics principles and practices, and an analysis of the IAA's current resources provided an evidence-based foundation upon which to build the modules. After initial research, the modules were created in Moodle and organized by core ethical topics, with an overview PowerPoint, discussion questions, activities, case studies, a reading list, and suggested next steps in each module. Finally, the modules were evaluated by IAA staff and students before final deliverables were produced. The modules meet the IAA's standards for instructional content as well as modern instructional standards for ethics courses; additionally, the modules were created to be easily integrated into the IAA's current program as seminar classes. While implementation and updates of the modules remain a future endeavor, the modules provide an instructional solution to a lack of substantial ethics training at the IAA and also add to the expanding creation of ethics training for emerging data scientists.

Kelly Rusher, Kimberly Bryan, Claire Sanguedolce, Natalie Sprague
Graduate Program: Social Work
Advisor: Qiana Cryer-Coupet
Poster Number: 20

Efficacy of In-Person Versus Virtual Collegiate Mental Health Services

The high prevalence and serious impact of mental health issues on college students are amplified during periods of significant stress, such as the ongoing global COVID-19 pandemic (Center for Collegiate Mental, 2022). Addressing this problem is significant to the social work field due to the increased employment of social workers in collegiate counseling centers. The COVID-19 pandemic forced many mental health providers, including social workers, to move services online and into a virtual setting. Therefore, an examination of the efficacy of online services must be considered to ensure this vulnerable population is still receiving much-needed quality mental health care. A literature review explores the efficacy of different services typically offered within college campus mental health settings including individual therapy, group therapy, stepped care, and virtual mental health services. As the COVID-19 pandemic continues to be a mental health issue across college campuses, there are gaps in knowledge surrounding the effectiveness of virtual mental health services. The information included in this review highlights the unique opportunity to evaluate the effectiveness of virtual mental health services in comparison with pre-pandemic, in-person services for vulnerable populations like college students within an agency such as the NCSU Counseling Center. This review contributes to the dialogue of collegiate mental health and implores future evaluatory research to inform effective provision of mental health services in an increasingly virtual world.

Reference: Center for Collegiate Mental Health. (2022). 2021 Annual Report. https://ccmh.psu.edu/assets/docs/2021-CCMH-Annual-Report.pdf

Matthew Champagne
Graduate Program: Public History
Advisor: Tammy Gordon
Poster Number: 27

More Than Friends: Interpreting Same-Sex Relationships at Historic Sites

The bonds some historic figures formed with members of their own sex have led many historians to question whether their demonstrations of love, commitment, and passion signified something deeper than friendship. But historic figures who lived before the advent of modern terms to describe same-sex desires, actions, and identities, will never be able to come out nor set the record straight. This begs the question: how should historians interpret amorous same-sex relationships between historic figures? While using modern terms to describe the experiences of these figures arguably constitutes historical inaccuracy, is the tradition of describing their relationships as those of "just good friends" accurate? My research will not claim to determine the legitimacy of any rumors surrounding any historic same-sex couples, or "out" any particular historic figure as an ancestor of the modern LGBTQ+ community. Instead, as a public historian, my research will determine the best practices for museum practitioners who commonly respond to queries about the sexuality of their historic subject. My research will show them the most appropriate and inappropriate ways to navigate the tenuous connection between the past and the present. Through an analysis of the methods used by interpreters at a variety of historic sites where same-sex couples once lived, my research lays bare the implicit and explicit ways institutional homophobia plagues traditional museum interpretation theory and practice and highlights how some sites rail against this unfortunate reality. I do so to make historic sites safer places for LGBTQ+ visitors. But rooting out the problematic approaches of interpreting the queer past will be no simple task. My research, naming them plainly, is the first step to do so.

Allen Coin[1], Abigail Presley[2], Veljko Dubljević[1,3]
Graduate Programs: Liberal Studies[1]; Osteopathic Medicine, Lake Erie College of Osteopathic Medicine[2]; Philosophy, North Carolina State University[3]
Advisor: Veljko Dubljević
Poster Number: 30

The Qualitative Empirical Research into the Ethics of Brain Computer Interfaces

Since the first publication about brain-computer interfaces (BCI) almost half a century ago, this area of science has retained a 'futuristic' outlook. Research into BCI technology has progressed rapidly in recent years, prompting increased scholarly interest in the pertinent ethical and social issues. As the (mostly positive) media representation of BCI technology drastically increases, apprehension about indirect pressure to use the technology and over-promising of BCI medical utility grows, while professionals report an increase in ethical concerns. With this in mind, we conducted a first-of-its-kind principled literature review focused on analyzing all empirical papers published about BCI ethics to investigate the moral and societal implications of this technology. We focus on the available empirical literature in order to ground the ethical discussion in fact, as opposed to fiction.

Our search was conducted in PubMed and Web of Science utilizing structured queries, and yielded 413 sources. 124 were excluded at title-level screening, 154 were excluded at abstract-level screening, and 31 were excluded as tangential during coding, leaving a final sample of 18 articles. Inclusion criteria included publications that were (a) in English, (b) in a peer-reviewed journal, (c) an original report of qualitative empirical data, and (d) relevant to ethical issues of BCIs. The most frequently discussed ethical concern was Psychological Factors (77.8%), a category comprising of psychological disruptions emerging from BCI use (e.g., fatigue, frustration, or depression/anxiety). Discussed at nearly the same frequency were Societal Implications and Usability and Feasibility (72.2 %). The former category largely discussed BCI influences on burden of care, while the latter focused on "BCI illiteracy," or the inability to properly control BCI devices. User Safety, Research Ethics and Informed Consent, and Humanity and Personhood were discussed at an equal frequency (66.7%). The related categories of Autonomy and Responsibility and Regulation were also discussed at equal frequencies (61.1%), followed by Privacy and Security (55.6%), which included discussions of BCI-related privacy breaches. Dependence (38.9%) is an emerging two-fold theme gaining increasing notice in BCI ethics literature within recent years, in the form of 1) dependence on the technology, and 2) physical dependence on caretakers.

Tiffany Dangleben
Graduate Program: Psychology
Advisor: Kate Norwalk
Poster Number: 36

Empowered Voices Falling on Implicitly Biased Ears: An Examination of Black Families Advocating for their Child with Autism

Autism spectrum disorder is a widely prevalent neurological disorder classified by areas of need in communication and social interaction, as well as restricted and repetitive patterns of behaviors and interests (American Psychiatric Association, 2013). There is an abundance of literature on autism and autism services; however, the research primarily focuses on White families from middle class backgrounds and often conflates race and socioeconomic status. Thus, findings suggests that disparities in access to autism services is due to a limitation in economic resource. Emerging research suggests racial differences in the acquisition of an autism diagnosis and autism services are strongly related to social barriers, such as implicit bias and lack of understanding about autism. Furthermore, when analyzing facilitators to parents accessing autism services, research identifies advocacy as an effective tool (Pearson & Meadan, 2018); though the research examining Black families, autism, and advocacy is limited. This study fills the gap by examining: (a) advocacy among a sample of Black families of children with autism, and (b) their perception of the effectiveness of their advocacy efforts. Emergent themes in parent responses (n = 12) during a semi-structured interview were identified and cross-checked for reliability. Results indicate that parents advocated for their child because of feeling dissatisfied when engaging with their child's medical and service provider, as well as school personnel. These encounters were underlined with implicit bias, medical professional's lack of autism knowledge, feelings of not being taken seriously, and concerns about maltreatment. Furthermore, parents' perceived effectiveness of advocacy efforts were dependent on their knowledge about autism and systemic and cultural issues. Subsequently, results from this study dispels the notion that socioeconomic status serves as the main barrier to Black families' access to an autism diagnosis and services. Rather, it supports holistic literature that identifies the implications of race and implicit bias.

Ronald P. Dempsey
Graduate Program: Liberal Studies
Advisor: Veljko Dubljević
Poster Number: 38

Exploring and Understanding Law Enforcement's Relationship with Technology: A Study of Police Officers in North Carolina

Despite the considerable growth of research examining the contributions of Artificial Intelligence (AI) technologies to societal development, relatively few studies to date have explored police officer perspectives in the application of AI in the domain of law enforcement and its ethical considerations. Drawing on qualitative research, this paper examines the perception of AI technologies based on 20 semi-structured interviews conducted in North Carolina at the local and state law enforcement levels. This study explores AI technologies to investigate how the integration of technological advancements to include autonomous vehicles impacts the relationships between communities and police jurisdictions. The evidence suggests that police officers maintain that AI technologies play a limited role in the law enforcement domain but believe the technologies will expand and become widespread in the next five to 10 years, improving public safety, reducing crime, and increasing policing capability and capacity. Conversely, the evidence also suggests that law enforcement professionals believe that AI technologies will not necessarily increase trust between police and the community, citing ethical concerns of autonomy, privacy, affective empathy, and the potential to infringe on civil rights if the technology is not used responsibly. Moreover, police officers believe that autonomous vehicle technology in its current and future states blur the lines when considering responsibility and accountability in the context of traffic infractions and vehicular incidents. Based on the findings and despite the net gains and benefits, it is thus argued that the trends toward integrating AI technologies into the law enforcement domain is not without risk and has the potential to erode critical normative and legal safeguards around civil rights, which are central to liberal democracy. Overall, society has a moral obligation to craft and implement policies that address these concerns to mitigate the consequences of fully integrating AI technologies into the law enforcement domain.

Natasha Derezinski-Choo
Graduate Program: English
Advisor: Agnes Bolonyai
Poster Number: 40

How did we get here and when will it end? Chronotopes of Prediction in Pandemic-Era Journalistic Podcasts

This project examines the discursive strategies used by journalists to understand how people construct chronotopes (timespace relationships) (Bakhtin, 1981) of the pandemic. Chronotopes are "invokable semiotic constellations of time, space, activities, moral dispositions, and actors" (Goebel & Manns, 2020, p. 82) that are crafted in discourse. Chronotopes of the pandemic reveal how individuals engage in shared meaning-making of current events by negotiating causal relationships between past, present, future, and space. In this project, I analyze the speech of three journalists who appear in three podcast episodes from The Daily from the period July 2020-September 2021. First, I analyze how time periods and spaces/places become imbued with new meanings via journalistic discourse. Second, I examine how journalists construct social types within these chronotopic configurations and the discursive strategies they use to position their own identity vis-à-vis the chronotope. Third, I show that the construction of social types in each chronotope can lead to othering or exclusion. I draw on the theories of chronotopes (Bakhtin, 1981; Blommaert, 2019, 2020; De Fina & Perrino, 2020), spatialization (Nichols & Wortham, 2018), narrative analysis (Koven, 2012), and identity in developing my analysis.

In my results, I demonstrate that there are three chronotopes in the data: "Normal Times," "New Behaviors," and "Trajectory." Speakers construct these chronotopes by referencing or indexing specific social actors, behavioral scripts, temporal unites, spatialized locations, and ideologies. These three chronotopes reflect into journalists' efforts to make predictions or convey certainty and to encourage the public to participate in certain behavioral scripts that may end the pandemic. I suggest further that the othering of specific social types—especially those who do not participate in new COVID-19 protocols—may run counter to these journalists' goals of using their platform and knowledge to aid public health efforts.

Darien Dixon
Graduate Program: Sociology
Advisor: Melvin Thomas
Poster Number: 44

Experiencing School in Black & White: Analyzing Race Consciousness during the Racial Integration of Schools

I examined 30 semi-structured interviews of adult North Carolina residents who experienced the racial integration of schools firsthand. My main research question: how did Black and White people perceive the racial integration of schools as it initially unfolded? My interviewees' stories clarified a crucial sociohistorical moment in the United States (U.S.), as de jure racial segregation collapsed before their eyes. Centralizing memories of school during racial integration, I investigated how Black and White interviewees navigated race talk. Across my data segments, I expected that Black participants would discuss race more than White participants when recounting memories of school during integration. I reasoned that interviewees unaffected by anti-Black racism during integration would eschew race talk, unless prompted by the interviewer(s) to delve deeper into race-related conversation. My findings supported my predictions and other salient themes emerged that supported past literature about color-blind rhetoric. From documenting interviewees' narratives, I aimed to highlight and disrupt rhetoric that may sustain racial color blindness and anti-Black racism in social discourse about U.S. history.

Jannatul F. Dola and Michael J. Struett
Graduate Program: International Studies
Advisor: Mark T. Nance
Poster Number: 45

Ethical Traps in the Territorial Limitation to the ICC investigation into the Rohingya Situation in Bangladesh/Myanmar

Genocide and crimes against humanity are crimes under customary international law wherever they occur. However, the International Criminal Court only has jurisdiction over such crimes when they are committed on the territory of a state party, by nationals of a state party, or when the UN Security Council confers jurisdiction by referral of a situation to the ICC. Myanmar is not a party to the Rome Statute, which established the ICC, so the Court does not have jurisdiction over crimes committed solely within Myanmar's territory. However, the ICC judge's decision of Nov. 14, 2019, authorizes the ICC prosecutor to investigate any genocide or crimes against humanity commited in Myanmar, where some part of the criminal conduct takes place on the territory of Bangladesh, which is a state party to the ICC. While forced deportation as an element of a Crime Against Humanity or Genocide will likely fall within the ICC's jurisdiction, many other acts including murder, torture, and the systematic persecution against the Rohingya that is embodied in the Myanmar constitution and citizenship laws likely will not fall in the court's territorial jurisdiction. That means some perpetrators, including some of those most responsible will likely escape justice in ICC proceedings. This paper will offer an assessment of the extent of the violations of international criminal law in Myanmar that will not likely fall within the jurisdiction of the ICC, and will consider the ethical implications of the ICC's ability to proceed against only some perpetrators, but not others. Recommendations will be offered for mechanisms to address serious international law crimes that are outside the International Criminal Court's remit.

Kelsey Dufresne and Mary Downs
Graduate Program: Communication, Rhetoric, and Digital Media
Advisor: Fernanda Duarte
Poster Number: 46

"QR Code Quilt"

For me and for many, quilting is a distinctively feminist practice: it is a practice and art of labor that is centralized on constructing an artifact of comfort, rooted in the home, rooted in the family, and rooted in collaboration. Such as Alice Walker's "Everyday Use" explores, these quilts are active participants in my family and our life together, messy and falling apart at the seams, but warm and comforting. Our fabric materials and artifacts have lasted and will continue, and yet our society esteems a greater prioritization on the electronic. On the "digital." For this project, I am especially interested in QR codes - which are nifty communicative tools that take a user, via their phone, to a web-based site. But QR codes are not designed for cute, approachableness - rather to provide an efficient and fast transfer of information. They are rigid in design, rather inflexible (one can change some components - but the overall design composition and conventions are rather concrete). They are, pointedly, visual codes. Coding itself, including QR codes, is gatekept behind the computational elite, a demographic that is traditionally gendered in itself due to a male-dominated STEM field/systemic and societal gender notions. Therefore, quilting and QR codes are developed by two very different gender populations and communities, with very different priorities and goals.

Here we have a couple threads to tie together, namely challenging the broad understandings of what is "digital" by sewing a QR code quilt with my mom. Through co-design and collaboration, both strong pillars of inclusive design and design justice, my mom and I engage in discursive and critical design to explore a gendered practice and act of labor through a particular focus on the "digital." As such, this project aligns with digital humanities, critical making and discursive design, as well as cultural media studies - ranging from both scholarly audiences and, quite intentionally, families, quilters, and anyone with beloved artifacts of everyday use.

Lydia Elrod
Graduate Program: English
Advisor: Walt Wolfram
Poster Number: 55

An Inheritance of Black Ancestral Legacy: The Case of Cherry Town Road

By employing a cultural rhetorics framework that privileges embodied forms of story-telling alongside contemporary race scholarship that interrogates the influence of the past on the present, I explore the ancestral legacy of a once thriving Black community in eastern North Carolina through the medium of documentary film. Cherry Town, and its religious and cultural center Second St. Paul Missionary Baptist Church, are located within Hallsboro, NC and consist of a small group of elderly residents and members who have lived in the farming community since childhood. In filmed interviews, community members recall the legacy of Cherry Town through personal stories about the community's educational, religious, and self-preservation practices from the Jim Crow era to the present. At the same time, current community members express concern for the future of Cherry Town, as their children and grand-children have left the area and the elderly population continues to decline. Similarly, descendants of Cherry Town's current and former residents discuss the influence of the ancestral legacy that they have inherited and their participation in the Black cultural practices of the community today. As the great-great granddaughter of the community's founder, Charlie Cherry, I am invested in the preservation of Cherry Town's history and committed to the protection of the Black ancestral legacy that has been passed down to me. To honor my ancestors, this documentary project is guided by the primary question, "How have descendants of the Cherry Town community maintained their cultural inheritance?"

Morgan Ericson
Graduate Program: Foreign Languages and Literatures
Advisor: Rebecca Ronquest
Poster Number: 56

The grammaticalization of gender in professions: A two-part study investigating the creation of feminine forms in the Spanish language

The grammaticalization of gender in professions is a topic that has been researched by Epperson (2005), Bengoechea (2006), Epperson and Ranson (2010), and Capraru (2016, 2017, 2017), among others. Spanish speakers have several options for referring to women in certain work positions: feminine form, masculine form, common gender, periphrasis, suppletion, suffixation, or innovative use of 'x', 'e', or '@' to replace standard gender morphology. The grammaticalization of genders in professions typically follows a three-phase model (unisex form > common gender > differentiated forms; e.g., el médico > la médico > la médica; RAE 2020), with the third stage reflecting more inclusive language. The goal of the present study is to offer important insight into the frequency of the creation of feminine forms in professions to determine whether the evolutionary process is continuing in the Spanish language.

For the first part of the study, data were obtained from the News on the Web corpus to search for the overall frequency of over twenty different forms of twenty-five professions. Language Variation Suite and Rbrul were used to examine the distribution and interaction of variables in the data. Preliminary results suggest that several professions considered, such as presidente, have possibly progressed to the third stage of grammaticalization of gender, judging by their frequency in articles published from 2012-2019.

The second part of the study analyzes preferences of native Spanish speakers, currently residing in North Carolina, when referring to women who work within the same twenty-five professions. A semi-replication of Epperson and Ranson (2010) was conducted to collect demographic data and the responses of participants. Preliminary analysis suggests the coexistence of two forms of several professions, like juez and jueza, indicating that gender morphology may be moving towards differentiated forms in the Spanish language. Additional results and conclusions will be discussed.

Oliver Fischer
Graduate Program: Technical Communication
Advisor: Jason Swarts
Poster Number: 58

Analyzing the costs and benefits of moving to a structured authoring environment

The move to a structured authoring environment can improve efficiency and help authors process documentation faster, but not all companies would benefit equally. Initial costs (training, licenses) need to be weighed against the potential benefits. There are different standards to choose from, so companies can struggle to make the right decisions. This research investigates the costs and benefits associated with converting legacy documentation into XML documentation using the DITA and S1000D standard. XML documents contain information about content and structure, creating the backbone of structured authoring systems. While this promises easier reuse of content to save time and money, implementation costs, especially for custom solutions tailored to organizational needs, can be high. To provide some guidance for organizations considering the move to structured authoring, an experience report was crafted following the conversion of existing legacy documentation from the automotive tuning company AC Schnitzer. Converting their documentation into DITA and S1000D compliant documents and considering factors such as training time, benefit to the reader and potential challenges writers at companies in similar positions may face, provided some insight into the potential costs and benefits associated with moving to a structured authoring environment.

Megan Flannery
Graduate Program: Communication, Rhetoric and Digital Media
Advisor: Nick Taylor
Poster Number: 59

Faces of an Anti-Sexual Violence Organization: A Visual Content Analysis

There continue to exist certain inaccurate beliefs or “rape myths” about who constitutes a real sexual assault survivor. Many of these myths have to do with the survivor’s physical appearance, such as age, race, gender, etc. These rape myths, often assumed by law enforcement, attorneys, judges, and potential jurors, can affect whether the survivor is viewed to be trustworthy or blameless in her assault. Many anti-sexual violence organizations work to dispel rape myths so that all survivors can find the support they need to heal. In our increasingly multimodal and digital world, it is important to analyze if these organizations are truly inclusive not only in their textual messaging but in their visual messaging as well. This research offers a visual content analysis of the nation’s largest anti-violence organization’s website to determine how they portray survivors, non-survivor advocates, and perpetrators. Ultimately, this study concludes that the images of individuals represented on their website lack diversity and actually support myths of what a survivor “should” look like. This suggests the need to include more images of survivors that go against the common stereotype of survivors, particularly those underrepresented communities who are statistically more affected by sexual assault such as BIPOC women.

Sloan Hammer
Graduate Program: Technical Communication
Advisor: Jason Swarts
Poster Number: 80

Framework for the Creation of Minimalist Animated Educational Content

Educational content has become some of the most popular and prevalent content on the video-sharing social media platform, YouTube, with roughly 1 million educational videos being uploaded every day. Of this content, minimalist animated educational content is among the most popular. Channels, such as Kurzgesagt - In a Nutshell, are exceedingly effective at creating well-researched educational videos that are presented in a clear and concise manner that is both entertaining and engaging for learners and covers a wide variety of complex scientific and technical topics of interest or relevance. With the growing understanding of how educational videos can enhance the learning process, it is ever more important to better understand the creation of extremely effective educational content to help facilitate effective learning for learners. Minimalist animated educational content features several characteristics that improve the learning process (concision, visual appeal, engagement, retention, reinforcement, credibility, and accessibility) that can be transferred to the potential creation of more minimalist animated educational content. The framework is based on observations pulled from popular content topics, namely COVID-19 related videos from Kurzgesagt - In a Nutshell's YouTube channel. Additionally, there are tentatively no other materials working to better understand the popularity and effectiveness of minimalist animated educational videos despite the extensive research and academic literature on multimodal educational content and videos.

Melody Hunter-Pillion
Graduate Program: Public History
Advisor: Blair L.M. Kelley
Poster Number: 88

Can I Get a Witness: Preserving the Stories of Black Farmers and Fishers for Climate Change Resiliency in Coastal North Carolina

Climate change is global, but resilience is local. While all communities will be impacted by climate change, communities of color will suffer impacts disproportionately according to the EPA's 2021 "Climate Change and Social Vulnerability" report. Climate vulnerability is not only determined by place-based exposure, but also social conditions. Racial discrimination historically determined the spaces marginalized communities occupied and their ability to adapt to environmental change. Minority voices have been historically silenced, and their absence from climate change conversations impedes workable solutions. Using oral history methodology to capture and preserve marginalized voices, humanists can work with scientists to identify strategies for resiliency and adaptation. This project focuses on historical environmental resiliency through oral traditions in North Carolina's coastal African American communities. My work records narratives from five Black farmers and one shrimper. Using these testimonies—along with archived narratives from the Library of Congress, UNC, and Duke—I explore if past cultural responses to inequities and environmental change reveal potential contemporary uses. Which narratives survive over time to inform resiliency? The project also examines how Black oral traditions counter master narratives regarding land ownership and stewardship. Narrators demonstrate intergenerational connections with local environments and continuity of history. Oral testimonies are unique resources communities can use to create their own solutions for challenges specific to their historical circumstances and natural resources. My work supports development of communications tools and fosters working relationships between communities and scholars. I produced a podcast and video to model use of the narratives. UNC's Southern Oral History Program hosts the podcast, which WUNC Radio featured. I presented the video during the 2020 Association of Critical Heritage Studies Conference and other events. I will expand the project by overlaying historical climate data, further animating the ways Black farmers and fishers experience and respond to climate change.

Broderick McCurdy
Graduate Program: English
Advisor: Jeffrey Reaser
Poster Number: 111

Y'all! The Changing Indexical Value of America's Favorite Pronoun

The pronoun y'all is one of the most easily recognizable and frequently cited features of Southern American English. Linguists Tillery, Wilke, & Bailey (2000), however, found that younger people outside of the South were increasingly using the pronoun y'all and that the demographic patterns of this pronoun's spread indicate that y'all "has begun to lose its association with Southerness" (p. 288). That finding is now over two decades old, and there have been no subsequent studies examining whether y'all's connotations and usages have changed as it has been adopted by more people outside its traditional range. This two-part study collects and examines observational and folk linguistic data to understand the possible linguistic and social forces propelling the spread of the pronoun outside of the South. In the first section, I conduct linguistic analysis on Twitter data containing the word y'all to provide an updated account of the linguistic the social versatility of this pronoun. In the second section, I conduct both in-person interviews and an anonymous survey with non y'all users, native y'all users, and late y'all adopters to better understand the positive factors incentivizing speakers to acquire the pronoun. Early data suggests that, while the pronoun is still primarily associated with Southerness, it is increasingly developing into a marker of socially-progressive identity due to its status as a gender-neutral alternative to you guys and its use in slogans like 'Y'all Means All' and 'Yallidarity.' This association however seems to predominate among younger late y'all adopters; native y'all users and older non-y'all users still primarily associate the pronoun with Southern-ness. In addition to its socially progressive connotation, the linguistic and social versatility of the pronoun as a discourse marker in written communication might also facilitate its spread.

Eva McKinsey[1], Sarah L. Desmarais[2], Jeni L. Burnette[1], Brandon L. Garrett[3]
Graduate Programs: Psychology[1]; Policy Research Associates, Inc.[2]; Duke University School of Law[3]
Advisor: Jeni L. Burnette
Poster Number: 112

Impact of Growth Mindset-Enhanced Trauma Education on Criminal Legal Professionals' Attitudes and Perceptions

To successfully address mass incarceration in the United States, criminal legal professionals must shift away from reliance on carceral punishment and toward support for alternative approaches to justice. We propose that education on the physiological, social, and behavioral impacts of traumatic events (i.e., trauma education) that is enhanced with messaging about the malleability of human behavior (i.e., a growth mindset intervention) may be one strategy to promote this shift. In this study, we assessed the impact of trauma education alone and enhanced with a growth mindset intervention on criminal legal professionals' attitudes about the criminal legal system and perceptions of trauma education. We further assessed whether intervention impact was moderated by professional role (law student, lawyers and judges, probation/parole officers). We randomly assigned 343 criminal legal professionals to receive one of two online trauma education curricula (with vs. without a growth mindset intervention) and measured their expectations of recidivism, support for alternative sentencing, and perceptions of trauma education. Mindset-enhanced trauma education led to increased perceived appropriateness of considering trauma in the context of judicial decision-making ($p = .011$) and greater support of alternative sentencing for nonviolent crimes among lawyers and judges ($p = .020$). Findings support the enhancement of trauma education with growth mindset interventions as a means of promoting attitudes and perceptions that are conducive to fostering alternative forms of justice in the United States.

Kimberly Miglino
Graduate Program: International Studies
Advisor: Mark Nance
Poster Number: 114

Why Do They Get Married? Documentary Content Analysis on Marriage Motivations of Mail-Order Brides and Grooms

There is often no debate on why modern mail-order brides choose what could be an economic, transactional marriage. It is extremely difficult to find direct accounts from modern mail-order brides on why exactly they made this choice. If marriage is an economic transaction, are modern mail-order brides simply capitalizing on their labor and commodification in the free market? Additionally, Western feminism plays a role regarding what it means to be liberated and have agency. Based on a content analysis of documentary interviews (n=30) with men and women across multiple nationalities in mail-order marriages, I argue that both mail-order brides and their grooms (1) have multiple motivations for marriage and (2) that those motivations are socio-cultural, as well as economic. What can be generalized is that even if there were economic motivations for a mail-order marriage, it was rarely the only reason for a bride to make this decision. Men also had various non-economic motivations for engaging in this type of marital transaction. A lack of a local mate that met the mail-order bride or groom's desired specifications or a search for a more traditional relationship were often cited reasons to engage in the marriage. Interestingly, a significant portion of women wanted traditional marriages where there was a male breadwinner and the woman could stay home and raise a family. Finally, while not all mail-order marriages were based on love, the evidence suggests that it was for 38.5% of men and 40% of women examined.

Honey Minkowitz
Graduate Program: Public Administration
Advisor: Tom Birkland
Poster Number: 116

Narratives help people understand complexity and make sense of their experiences.

Stories can be powerful tools to construct realities and create meaning. Policy actors use stories to convey their preferred policy solutions and to convince the public. The persuasiveness of a narrative is increased when the audience feels absorbed in the story and when stories are relatable. Current research has found that narrative elements, like story characters and narrative settings, can contribute to the persuasion effect because they help the audience become affectively engaged in the story. Other types of narrative elements, such as frames, package and organize discrete messages in stories. Frames can elevate aspects of a story to direct attention to or away from issues that the frame author chooses to manipulate. Frames can also increase the persuasive quality of a narrative because they trigger cognitive shortcuts, but not all types of frames influence people in the same ways. Scholarship on the framing of heath messages regarding covid-mitigation measures determined that certain types of frames increased the intention to adopt mitigation measures. However, policy coalitions may also use frames strategically to sway public opinion toward their preferred policy solutions. This research examines what framing strategies policy actors used during the pandemic.

Courtney Moisan
Graduate Program: Communication
Advisor: Kami Kosenko
Poster Number: 117

Concealing and Revealing Polyamorous/Consensually Non-Monogamous Identities

Polyamory and consensual non-monogamy have long been misunderstood and stigmatized identities. As a result, the decision to reveal one's identity and lifestyle can be very difficult for some individuals. This qualitative, one-on-one interview, study sought to assess what motivates people to conceal or reveal their polyamorous or consensually non-monogamous relationship status? And how do polyamorous or consensually non-monogamous people disclose and reveal their identity? Previous research on polyamory and non-monogamy were key pieces; along with research on 'Communication Privacy Management Theory (CPM)', and 'Concealed Stigmatized Identities (CSI)'. The purpose of this study is to get multiple first-hand perspectives on the motivations of these Poly/CNM individuals throughout their processes of concealing and revealing their identities. The hope is that these findings and first-hand stories will create further awareness for a less stigmatized world that these individuals can navigate easier in the future. This study also shed light on some further areas of research for the future.

Settle Monroe
Graduate Program: English
Advisor: Anne Baker
Poster Number: 118

More than a Pretty Picture: How Kate Chopin's The Awakening Paints a Portrait of the Female Artist

Kate Chopin's 1899 novel, The Awakening, provides an illustrative account of a nineteenth century female artist's struggle to negotiate traditions of domestic femininity and romantic individualism. Chopin's protagonist, Edna Pontellier, represents the New Woman's spheres of power and oppression as a mother and as an artist. Through impressionistic language, hints of realism, and framing arrested moments in the novel, Chopin paints the literary portrait of an artist that her protagonist cannot complete. The Awakening questions the role of art for women at the turn of the century while examining the society that contains it. Ultimately, neither art nor love can save the novel's heroine, but Chopin's illumination of the complex feminine interior offers readers more than a pretty picture. She exposes the dark realities of female oppression and restricted creative expression.

With Chopin's painterly eye as a lens, I examine examples by three female portrait artists: Mary Cassatt, Alice Neel, and Amy Sherald. Their work spans the twentieth century, providing visual representations of female artistry and the societies they inhibit. This interdisciplinary approach foregrounds a literary analysis of The Awakening while integrating art history, American history, and feminist studies.

Paige L. Moore, MSW
Graduate Program: Public Administration
Advisor: RaJade M. Berry-James
Poster Number: 119

Advancing Social Equity in Healthcare: A Case for Culturally Competent Intervention Strategies

The United States has a long history of denying marginalized populations access to adequate and culturally competent healthcare and has allowed for discriminatory practices to influence the quality of care received by individuals in minority communities. Despite the preventative measures taken to halt the spread of the COVID-19 pandemic, vulnerable populations such as low-income individuals and those belonging to racial and ethnic minorities have been disproportionately impacted. Through a review of the available literature and quantitative analysis of surveillance data, this paper will answer the research question: Are culturally competent intervention strategies effective at reducing COVID-19 mortality rates in racial and ethnic minority communities in North Carolina? This paper will explore how gaps in vaccine distribution for minority populations were addressed by the leadership in the State of North Carolina. By answering the question posed, this study aims to contribute to the current literature by making the case for culturally competent healthcare access and practices to be included in disaster planning during the pandemic and beyond.

Baiyina W. Muhammad
Graduate Program: Liberal Studies
Advisor: Carolyn Bird
Poster Number: 121

Bridging the Gap: Building Community Through the Establishment of the North Carolina Black Disabilities Network

The exclusion and subsequent invisibility of the experiences of Black peoples when living with developmental disabilities and other co-occurring conditions has created a myriad of challenges for individuals and their families. They face the dual challenge of anti-Black racism and ableism that is often not considered or overlooked in the scholarship, within educational systems, and across systems of service that they seek to gain support. The North Carolina Black Disabilities Network was established to illuminate the connection between the practice of anti-Black racism and ableism, to create an access point for individuals and families to break through the barriers to quality healthcare and treatment, appropriate education, adequate housing, and employment opportunities, and to transform systems that serve the population.

The first major initiative of the NC-Black Disabilities Network is an inaugural conference. The North Carolina Black Disabilities Network Conference aims to illuminate the intersections of race and disability that many do not realize. The effort is both critical and historic because, to date, it is the first of its kind to exist in the southeast. The conference aims to coalesce three seemingly disparate groups — educators, practitioners, and service providers — together with Black disabled communities. It seeks broad participation from the academic community, state and local government, educators, social service agencies, and individuals with disabilities. The conference will feature a keynote speaker and will include sessions on the racialized experience of Black families, post-secondary experiences of Black disabled students, disability justice in education, advocacy, service accessibility, and preparing future professionals. Attendees will develop new strategies for eliminating barriers faced by Black disabled populations and their caregivers.

Israel Perez Medina
Graduate Program: Foreign Languages and Literatures
Advisor: Shelley Garrigan
Poster Number: 134

"Marginality, Violence and Globalization in the novels Desierto Sonoro by Valeria Luiselli and Páradais by Fernanda Melchor"

In the current era of globalized economies and cultures, literature plays the role of vocalizing and narrating the impacts and consequences on underrepresented members of society. The characters of these stories occupy the social margins that are in part the products of neoliberal politics, and their lives are narrated from a place of discursive otherness, thus opening a new space for heterogeneity.

Specifically, as Mexican women writers have recently begun to achieve national and international recognition, their novels both address and reflect the effects of globalization and circulate within the transnational currents that are facilitated by it.

Valeria Luiselli and Fernanda Melchor are, at first glance, Mexican women authors with vastly different literary styles, yet uniting them despite their stylistic and thematic differences. Under that surface, they revolve around the same topics from their own perspectives drawing the current issues of our society. Reading them together sheds new perspectives on the ways that globalization, violence and marginalization interact in the production and maintenance of systemic inequalities as reflected in literature.

In this presentation, I will focus exclusively on the theme of globalization as treated in these vastly different literary styles, in order to shed light on how contemporary Mexican women authors are using it as a backdrop to explore different forms of systematic marginalization.

Alexa Roland
Graduate Program: Foreign Languages and Literatures
Advisor: Michael Garval
Poster Number: 147

Fashion's Modernist Manifesto

In October of 1908, couturier Paul Poiret self-published 250 copies of an album illustrated by Paul Iribe called Les Robes de Paul Poiret. Within the album, Iribe illustrated using the pochoir technique ten idyllic scenes of women in vividly colorful ensembles, who engage with and are surrounded by art objects. These copies were intended for a small, upper class audience, yet in the following decades, the album has landed in the libraries of many art-lovers beyond its initial 250 admiring and elite readers. It is not immediately apparent upon examining the album, however, why Poiret created a document such as this and how the album fits into the norms regarding fashion publishing and aesthetics.

The style of Paul Iribe and the nature of this document's circulation set Les Robes de Paul Poiret apart from contemporary works both in its style and format. This makes a transition from fashion publication to an art object in and of itself. It had resounding effects on the development of the Art Deco style and the relationship between fashion and art through the collaboration of Paul Poiret the designer and Paul Iribe the illustrator.

This project aims to situate Les Robes de Paul Poiret within the period's women's magazines and fashion publications to show that the document is a visual artistic manifesto. Poiret's use of this document as well as its aesthetic qualities reveal an album demonstrating the inherent dichotomy in fashion between aestheticism and commercialism. Les Robes de Paul Poiret is a work of early fashion branding that shows Poiret's meditations on fashion as made-to-measure art during the most pivotal point in fashion history.

Ciele Rosenberg
Graduate Program: Anthropology
Advisor: Julie K. Wesp
Poster Number: 148

Fluctuating Asymmetry and the Embodiment of Maternal Stress at Newton Plantation, Barbados

This paper examines fluctuating asymmetry (FA) in a population of enslaved individuals at Newton Plantation in Barbados to understand the mother-infant nexus through the embodiment and legacy of maternal stress. The Newton Plantation was a large-scale sugar plantation in Barbados that operated between the 17th and 19th centuries and previous historical research has shown that poor living conditions, nutritional deprivations, disease, and the stress of extreme labor impacted the quality of life for enslaved individuals. Analysis of FA can be used as a proxy of fetal developmental instability, which is directly linked to the stress experienced by the mother during pregnancy. This paper will present results based on the evaluation of bilateral metric and nonmetric skeletal and dental data for each (N= 35) individual as well as explore trends in the population to identify any patterns related to age, sex, or other skeletal indicators of stress from previous research at the site. FA studies have been underemployed in bioarchaeological investigations, though they provide a lens that offers a salient view of the entanglement of the environmental and social realms and their manifestation into our biology. Presentation will contain images of human remains.

Lev Rosenberger
Graduate Program: Public History
Advisor: Tammy Gordon
Poster Number: 149

Surveying the Southern Voice: Opportunities and Limits of Historical LGBTQ Newspapers

Founded in 1988, Southern Voice (SoVo) was a gay and lesbian publication based out of Atlanta, GA., that provided the southeastern US with news coverage of LGBT issues. For over twenty years SoVo provided the Southeast with national, regional, and Atlanta specific information about the ongoing fight against AIDS, marriage inequality, discrimination, and violence against LGBT people. Providing critical coverage against the disinformation and hysteria of other newspaper coverage, it also offered their readers levity and cultural news coverage for drag performers, concerts, bars, bookstores, and more, making it a crucial publication for the LGBT south.

This paper is drawing from my work with the Invisible History Project which uses Southern Voice as a gateway into a community whose history, despite how recent it is, has been repressed and hidden. It places itself in conversation with LGBTQ historians and archivists who have also made use of publications to build educational programs. Furthermore, it argues for the importance of using archival material, such as SoVo, to connect multiple LGBTQ generations through their shared history. Finally, it reflects on the limits and possibilities of a thirty-year-old magazine like SoVo, to connect young southern LGBTQ+ people with their history.

Deijah Scales
Graduate Program: Technical Communication
Advisor: Huiling Ding
Poster Number: 154

Intersections of Marketing and Technical Communication Standards in using Social Media: An Analysis

This project analyzes the current style and documentation standards of marketing and technical communication, synthesizes similarities and differences between the fields, and examines how current standards of both genres are applied for users in social media contexts. My research reveals that while marketing documentation often connects users to a product or service even before a purchase, technical communication documentation often connects users to the later stages of product development and distribution stages through manuals, guides, how-to videos, procedural content and more. While both marketing and technical communication style guidelines dictate attention to user needs, there is a lack of extensive research as to how the fields can properly intersect to create an understanding of how these genres work together, especially in the shifting digital landscape. Although marketing and technical communication are not the same fields and we experience the content from each field differently, my research analyzes more efficient methods used to identify marketing and technical communication when we see it in practice. Understanding the documentation standards and intersections of the two fields provides insight for how to better create and analyze communicative content in digital spaces, for technical communication and marketing practitioners, and their users.

Savannah Scruggs
Graduate Program: Communication
Advisors: Kami Kosenko; Paper under the guidance of Melissa Johnson
Poster Number: 160

The Role of Images in Abortion Providers' Informational Webpages

Although abortion is a common health practice, it remains a highly stigmatized topic in contemporary society. The prevalence of antiabortion attitudes and restricted abortion access may drastically affect one's perceived options for dealing with an unwanted pregnancy. Thus, in a time where online information regarding personal health is abundant, individuals considering abortion may increasingly rely upon abortion providers' websites as an avenue for learning more about both the medical practice itself, as well as the presumed overall experience. However, visual imagery may play just as important of a role in portraying the abortion experience as textual information. Using a visual content analysis of the images featured within United States-based abortion providers' websites, the purpose of this study is to better understand contemporary practitioner portrayals of a highly stigmatized medical practice.

Maurika Smutherman
Graduate Program: Communication, Rhetoric and Digital Media
Advisor: Nick Taylor
Poster Number: 167

Decolonizing the Literate Subject: A Genealogy of Black Multiliteracy

This paper employs the multiliteracy theory of the New London Group (1996) to argue that a genealogy of Black multiliteracy may be used to decolonize what has come to be known as the 'literate subject.' Literacy, traditionally viewed through the hegemonic lens of print communication, devalues modes of expression used by underrepresented groups (Cohen & Glover, 2014; Towns, 2016). Studies of new literacies show that the concept of multimodality (i.e., the simultaneous use of multiple modes of expression) presented by Gunther Kress and Theo van Leeuwen (2001) is an empowering approach to communication, especially in today's digital world (Kress, 2010; Banks, 2011; Turner, Hayes & Way, 2013; Whitney, 2016; Baker-Bell, 2020). While multiliteracy and multimodality are relatively new approaches, analysis of Black social justice movements throughout time demonstrate that multimodality is an embodied practice embedded in Black communication. Through tracing these "cultural assemblages" (Slack & Wise, 2015) the genealogy of Black multiliteracy emerges, challenging long-held stereotypes about Black literacy and building on previous scholarship to empower communication practices of African Americans beyond print, recentering orality and other non-textual modes of expression.

Amneris Solano
Graduate Program: Communication
Advisors: Alice Cheng (academic advisor) and Fernanda Duarte (advisor for this research project)
Poster Number: 168

#FutureTechBoss: Analyzing How Black Girls Code and Girls Who Code Use Intersectionality and Speculative Feminism to Address the STEM Diversity Gap

Despite an increasing number of educational interventions and decades of interdisciplinary research that addresses the diversity gap in technology industries and academia, men continue to significantly outnumber women, people of color, LGBTQ individuals, and members of other marginalized communities in STEM fields. Lack of diversity in the STEM workforce is a critical issue because it affects how new and existing technologies are designed and implemented in society. Research shows that existing AI tools can already be biased and harmful to marginalized groups. While systemic issues must be addressed, increasing the participation of members from marginalized communities in STEM fields is still an important factor in closing the diversity gap, and coding workshops, STEM academies, and summer camps have become an increasingly popular way to bridge the gap. With that in mind, this study is a comparative textual analysis of how Black Girls Code (BGC) and Girls Who Code (GWC) engage in speculative feminism and intersectionality on their websites and social media platforms to address the issue of diversity inequality in STEM fields.

Stevi Vaughn
Graduate Program: Foreign Languages and Literatures
Advisor: Rebecca Ronquest
Poster Number: 176

Vos, ¿qué decís? A study of el voseo in North Carolina

Second person forms of address (e.g., tú, usted, and vos) are among the most complicated variations Spanish speakers experience in a linguistically varied region like the Mid Atlantic. North Carolina's Spanish varieties and Hispanic communities are rapidly growing (Census 2020) and merit further investigation. Previous studies have shown that many voseante speakers residing in the United States accommodate to tú as a result of their interactions and contact with other varieties of Spanish which only employ tú and usted (Woods, 2010; Raymond, 2012; Sorenson, 2013, 2016). The present study examines the contexts and motives that drive traditionally voseante Spanish speakers living in North Carolina to choose one form of address over another. Examples of contexts include family members and friends versus strangers. Preliminary results show that Argentines maintain their use of vos in NC because it is a strong part of their identity. In contrast, Central American speakers show little evidence of shifting from vos to tú, as has been reported in other regions (Sorenson 2016; Woods & Rivera Mills 2010), but instead show increased use of usted. Additional results indicate that country of origin followed by context are the significant variables in their choice of pronoun. The importance of variables such as speaker gender and time in the United States will also be discussed.

Victoria Vojnovich
Graduate Program: Liberal Studies
Advisor: Karey Harwood
Poster Number: 177

How The Covid-19 Pandemic Illuminated the Shaky Foundation on Which Gender Equality was Built and Set Gender Equality Back Decades

The Covid-19 global pandemic brought to light multiple cracks in our global systems. From deficiencies in global supply chains, to failing national economies built on tourism as a major industry, to issues with public health systems on local, national, and global levels, to highlighting the systems of social, economic, and ethical inequalities that exist world-wide, we have much to learn from this pandemic. One such system of inequality that was not only highlighted but worsened during the pandemic was gender equality. What Covid-19 has revealed is that the foundations upon which gender equality are being built are not rooted in the type of permanence that is required to sustain gender equality, and that this pandemic and any future global crisis can systematically crumble the system. To address gender equality on a global scale, significant work needs to be done to the foundational sociological and economic systems that have promoted gender inequality, globally.

The sociological factors (which translate into economic impacts) affecting gender equality include:

- The demands of “intensive mothering”
- The burden and inequality of unpaid care and domestic work
- The tendency during a crisis to return to more traditional gender roles (patriarchy)
- Most single-parent households are led by women
- The economic factors affecting gender equality include:
- Women’s employment in industries particularly susceptible to collapsing during crises
- Women’s participation in the “pink” economy
- Lack of gender pay parity (which gets significantly greater for women of color)
- United States policies and policy agendas that do not support working mothers
- Less access to social protections and safety nets

The United Nations estimates that gender equality globally has regressed 40 years due to Covid. Unless we address foundational factors, we cannot have any assurances that advancements will stick in the long term.

Elliott Whiteside
Graduate Program: International Studies
Advisor: Mark Nance
Poster Number: 183

Migrant Labor Abuses in Arab Gulf States: Focus on the UAE

In the glitz and glamour of the United Arab Emirates’ (UAE) booming construction and infrastructure development, there is an underbelly of exploitation involving migrant workers that is oftentimes ignored. Within the UAE and other Gulf Arab states, migrant workers are subject to physical, mental, sexual and psychological abuses at the hands of employers, and with little state intervention in protecting migrant workers. Workers’ complaints are silenced, and existing gaps in human rights legislation reinforces abuses. This research evaluates UAE’s migrant abuses through competing international relations frameworks. There are varying perceptions about the nature of the UAE’s labor migration system. Some believe it is a necessary system, providing structure and obligating migrants to fulfill their work contracts. Others see it as an egregious assault on human rights, and that the Kafala sponsorship system cultivates an environment allowing for such abuses to take place. International relations theory can be applied to understand and deconstruct the different actors and perspectives surrounding the issue, to craft possible solutions for ending the abuses faced by migrant laborers and reforming the sponsorship system that encourages it.

Benjamin Whitley
Graduate Program: Communication
Advisor: Melissa Johnson
Poster Number: 184

Southern Icons in a Digital Landscape: Visual Content Analysis of Landscapes in Southern Living

Landscape designers and architects play a pivotal role extending personal identities outside a living structure and into public viewing spaces. Do-it-yourself home gardeners carry out this role in their privately-owned yards drawing inspiration from various media including magazines. This research bridges both communication cultural studies with landscape architectural studies to define what plant arrangements and plant genuses have come to dominate home gardening media, specifically the front covers of Southern Living magazine from January 1966 to October 2021. Southern Living has promoted itself as embodying the "modern south." Visual content analysis was used to define how the "modern south" was being presented to the home gardener through the covers' compositional elements, embed landscape arrangements, and identifiable plant genuses. The author found the genus Acer to be the most frequent plant on the magazine covers. The most frequent landscape arrangement included a combination of herbeacus, shrub and tree species suggesting a higher degree of ecological function in gardens of the "modern south." These results open the door for future research to investigate how regional media indexes climatic shifts and influences ecological processes of a particular region.

Chenxing Xie
Graduate Program: Communication, Rhetoric and Digital Media
Advisor: Huiling Ding
Poster Number: 189

Framing Anti-Asian Hate During COVID-19 Pandemic: An Intercultural Content Reuse Perspective

The outbreak of COVID-19 as a global pandemic has brought human society tremendous pressure and significant changes. As society went through these difficulties, minority people had a hard time as they were at the brink of getting marginalized even further. At the beginning of the pandemic, a series of incidents evoked the anti-Asian attitude in the U.S, which inflicted a dual pandemic of coronavirus and racism on Asian American people. An organization named Anti-AAPI-Hate publishes yearly reports regarding anti-Asian hate, the content of which was reused by mass and social media in China and the U.S. To analyze the influence of culture plays on writers' content reuse tendency, I adopted content reuse and intercultural communication theories to conduct a qualitative content analysis on the reused content in Chinese and American media. I collected twenty news reports and six social media posts. By comparing the "Stop AAPI Hate National Report" and news reports/social media posts, I identified five content reuse strategies: "verbatim," "paraphrase," "extend," "compress," and "genre." The results show that the most frequently used content reuse strategy in Chinese media was "compress" (30.9%), followed by "extend" (25.5%), "paraphrase" (20.0%), "verbatim" (14.5%), and "genre" (9.1%). In American media, the most commonly appeared content reuse category was "verbatim" (39.7%), followed by "paraphrase" (19%), "genre" (19%), "compress" (15.5%), and "extend" (6.9%). The findings indicate that Chinese journalists employed the "compress" strategy more frequently in reusing the content from "Stop AAPI Hate National Report." In contrast, American journalists used the "verbatim" strategy more frequently. The different tendencies of content reuse strategies reflected the division between low-context and high-context cultures. Technical communicators need to take culture into consideration when adapting content from one culture to another.

College of Management

William Harris
Graduate Program: Economics
Advisor: Umut Dur
Poster Number: 82

The Boston Mechanism with Reservation Priority

School choice enables disadvantaged students to have access to better schools and is an important tool in the fight against inequality. A reserve system sets aside a predetermined number of seats for a defined under-represented population. In this paper, we analyze the application of a reserve system under student assignment mechanisms. We evaluate the reserve system implemented by Charlotte-Mecklenburg Schools. We show that while the current mechanism respects diversity, it performs poorly by wasting school seats. We propose two mechanisms that respect diversity while eliminating waste.

College of Natural Resources

Jin Bai, Michael Caslin, Madhusudan Katti
Graduate Program: Forestry and Environmental Resources
Advisor: Madhusudan Katti
Poster Number: 9

How did the 2020 pandemic anthropause impact bird communities in the Triangle areas of North Carolina?

The COVID-19 pandemic lockdown around the world provided a unique research opportunity for urban ecologists to investigate whether the reduction of human activities would influence wildlife populations and urban biodiversity. The term Anthropause was then created to describe the phenomenon of the immediate decrease of human activities due to pandemic lockdown. Here we explored if the 2020 pandemic anthropause in the triangle areas of North Carolina could influence bird communities. During the spring of 2020, NC Governor issued a statewide “stay-at-home” order starting March 30th, 2020 at 5 pm, which resulted in a significant reduction of traffic levels starting one week before the lockdown. We used data from eBird in a week-by-week structure during the period of decreased traffic levels from March 24th to April 27th of 2020 and compared the data with 2019 and 2021. We also used data from Triangle Bird Count during April and May of 2019 and 2021 to explore potential long-term impacts of anthropause on avian species richness. We found some evidence of short-term positive impacts of anthropause on avian species richness during the week before lockdown started in 2020. We found stronger evidence of long-term anthropause impacts from both data sources that the avian species richness was significantly higher in 2021 than in 2019. Our study supports that the 2020 pandemic anthropause in the triangle areas of North Carolina may contribute to a significant increase of avian species richness from both short-term and long-term impacts.

Christopher Boyer and Danielle Smith
Graduate Program: Parks, Recreation and Tourism Management
Advisors: Jonathan Casper and Jason Bocarro
Poster Number: 19

Perceptions of ACC Sport Psychologists and Athletic Trainers on Mental Health Strategies for Student-Athletes

The NCAA has recognized the growing issue of mental health among student athletes (SAs). Data have shown that Division I college SAs report elevated levels of depression (NCAA, 2016), higher levels of stress, and other behavioral health issues, when compared to non-athletes (Johnson, 2021). Despite increased focus and related NCAA legislation, there is concern that institutional resources devoted to supporting the clinical and psychological needs of SAs is lacking.

Way et al. (2020) found that while athletic departments are building mental health into their cultures, some initiatives were poorly received. There have been few efforts to evaluate the effectiveness and implementation of these mental health services and resources (Way et al., 2020), all conducted prior to the pandemic. A review of the literature found no studies that have explicitly explored the perceptions of sport psychologists and athletic trainers (ATs) related to mental health services, resources, and initiatives for SAs.

The purpose of this study is to understand perceptions of sport psychologists and ATs at Division 1 institutions to mitigate emergent mental health issues facing SAs. Using inductive reasoning, findings will add a sports lens to Mental Health Literacy theory (MHLt), which suggests that knowledge, attitudes, and beliefs around the causes, recognition, and sources of knowledge can help predict the ability to seek help (Spiker & Hammer, 2019).

Qualitative data obtained from eight focus groups conducted in early 2021 with 20 sport psychologists and ATs across 11 Division 1 institutions were collected and coded. A multi-coder constant comparison analysis identified several consistent themes related to SA mental health services and issues.

These themes, and implications, will be discussed. Findings are critically important as the demand for services combined with significant financial challenges facing universities will force many institutions to be more resourceful in addressing the mental and behavioral health of SAs.

Rodrigo Buitrago-Tello, Richard Venditti, Hasan Jameel, Darlene Echeverria
Graduate Program: Forest Biomaterials
Advisors: Richard Venditti and Hasan Jameel
Poster Number: 21

Anthropogenic greenhouse gas (GHG) emissions have altered the natural balance that keeps the temperature of the planet under normal conditions

In this regard, the pulp and paper industry has a substantial impact on GHG emissions due to the high energy requirements of its process. Among the different pulp and paper products, fluff pulp plays an important role in the market, given that it is the main raw material for indispensable commodities, including hygienic products. Regardless of this relevance, the environmental implications of bleached fluff pulp's production are not deeply documented. The present study provides the carbon footprint of fluff pulp production based on process simulation and Environmental Life Cycle Analysis. The simulation tracks the anthropogenic and biogenic carbon across the unit operations that constitute the mill. The implications of switching the source of energy used in the process and operational conditions were evaluated. The results show that 1 kg of fluff pup represents the emissions of 1.10 kg CO2-eq in a 100-year time horizon. Most of the biogenic carbon fed to the mill (52%) is used to produce steam and electricity; this represents a neutral emission of CO2. Simultaneously, the use of wood from residual biomass in a CHP cycle represents a 13.4% CO2-eq emission reduction compared to natural gas burned to cover the steam demanded. This benefit is increased when biomass demand is increased to achieve power self-sufficiency or to achieve a 20% surplus electricity. One important parameter in the Carbon footprint is the biomass lignin content; a higher lignin content represents a higher black liquor heating value at the recovery boiler and an increase in the solids burned. This double effect reduces the Global CO2eq fossil emissions. The present study results are a reference for the development of detailed carbon footprint studies of various products produced from pulp.

Elyssa L. Collins[1], Georgina M. Sanchez[1], Helena Mitasova[1,2], Adam Terando[1,3,4], Ross K. Meentemeyer[1,5]
Graduate Programs: Geospatial Analytics[1]; Marine, Earth and Atmospheric Sciences[2]; U.S. Geological Survey, Southeast Climate Adaptation Science Center[3]; Applied Ecology[4]; Forestry and Environmental Resources[5]
Advisor: Ross Meentemeyer
Poster Number: 32

Modeling future flood probabilities using a scenario-based approach

Floods are the costliest natural disaster in the United States and are projected to continue to cause devastating impacts as the frequency and magnitude of extreme weather events increase with climate change. To guide floodplain management decisions (e.g., zoning, flood insurance policy) and enhance community resilience, process-based flood models have been leveraged by the Federal Emergency Management Agency (FEMA) to accurately estimate the extent of flooding for a particular return period. However, the types of hydrologic and hydraulic modeling that FEMA relies on are costly (in terms of dollar value and time), do not account for ongoing and future change in climate, oversimplify the representation of risk as "inside" vs. "outside" the mapped risk zone, and are not well suited to characterize uncertainty. In this study, we developed a novel application of terrain-based inundation modeling to rapidly simulate the impacts of different climate change scenarios on flood probabilities. Climate projections of streamflow were coupled with the height above the nearest drainage inundation methodology to simulate flood depths and extents for each day between 2005–2100. Daily flood extents were aggregated into ensemble 1) baseline flood probabilities, 2) annual projected flood probabilities, and 3) annual projected relative probability changes from 32 global climate models and for 2 greenhouse gas emissions scenarios. Our computationally efficient and reproducible approach allows for a scenario- and uncertainty-based assessment that can inform flood adaptation planning. The resulting maps of future flood probability can assist researchers, policymakers, and land-use planners to visualize and anticipate flood hotspots. Furthermore, we anticipate that our scenario-based approach will better inform risk management and development decisions across the study area.

Ana Cubas Baez
Graduate Program: Natural Resources
Advisor: Erin Sills
Poster Number: 33

Safeguards for Forest-based Climate Change Mitigation: gender-differentiated local perceptions from two sites in Peru

Tropical deforestation has been one of the main causes of climate change and environmental degradation in the past decades. Therefore, reducing carbon emissions from deforestation and forest degradation and enhancement of carbon stocks (REDD+) has emerged as a key strategy to mitigate climate change through incentives for activities to reduce deforestation and degradation. The United Nations negotiations and certification systems for voluntary carbon offsets have led to requirements that REDD+ must provide social and economic co-benefits to local people, which can be secured through "REDD+ safeguards" to protect livelihoods while mitigating climate change. However, it is challenging to monitor and assess safeguards on the ground. The main goal of this research is to identify relevant indicators for "social co-benefits" based on local perceptions in two REDD+ sites in the Peruvian Amazon: Madre de Dios and Ucayali. Data were collected from eight "intervention villages" participating in two subnational REDD+ initiatives and eight matched control villages (outside REDD+ sites), in three years (2011, 2014, and 2018). In each village, group interviews were held with (a) villages leaders and key informants - mostly men and (b) women. Using group interview data, I identified key dimensions of well-being from the perspectives of local (mostly male) leaders and local women to inform guidelines for monitoring and reporting on safeguards. I grouped their responses into seven well-being categories related to the Sustainable Development Goals (basic needs, housing, education, health, income, community-family values, miscellaneous). I estimated a logistic regression to assess whether the categories of indicators suggested in the group interviews varied across the two sites, REDD+ vs. control villages, phases of the survey, and meetings with village leaders vs. women. Understanding local perceptions of well-being can help to identify the best way to measure, monitor, and report on safeguards related to co-benefits for local communities.

Christopher Dunstan
Graduate Program: Geospatial Analytics
Advisors: Laura Tateosian and Aaron Hipp
Poster Number: 47

Modeling the Spatiotemporal Evolution of Dance Trends and Styles

Dance is a rapidly evolving art form to which members of under-represented communities are contributing significant innovations. Social media enables the dispersion of new dances so rapidly that the originators often do not receive credit for their new dances. Developing a new dance is a challenging and creative process. Moves such as contortion pushups or headspins take months to develop. An infamous example of the lack of accreditation in dance is the BlackTikTokStrike. During the BlackTikTokStrike, Black artists on TikTok halted the creation of dances to draw attention to the history of not receiving credit for their work. In a widely publicized example, the Georgia teen who invented the renegade dance did not receive credit until public outcry drew attention to her plight. Prior to this, the renegade dance was performed by others at NBA games without acknowledging the teen. Improving recommendation systems and creating new platforms for dance can prevent appropriation of this nature. Data mining and geospatial analytics can be used to trace the emergence and path of new phenomena such as the creation and sharing of new dances. By using Natural Language Processing, text social media posts can be studied to highlight the reception of a new dance. Domain Expertise is also a key factor in evaluating new dances. By using data across different forms of social media and Sapiotemporal Modeling, the innovators and the spread within different dance styles can be determined. The study of trends and styles can provide the framework for accreditation systems in dance. In this study, flexn, a dance from New York, is studied in order to acredit innovators within the dance.

Xiaojie Gao[1] and Josh M. Gray[1,2]
Graduate Programs: Geospatial Analytics[1]; Forestry and Environmental Resources[2]
Advisor: Josh M. Gray
Poster Number: 69

Does chilling explain the divergent response of spring phenology to urban heat islands?

Urbanization is known to have direct impacts on plant phenology, the timing of plants' life-cycle transitional events. Understanding these effects is important to biodiversity dynamics, ecosystem structure, carbon cycles, and human health. Temperature increases from the Urban Heat Island (UHI) effect are thought to be the main driver of plant phenological changes around cities. However, trends in plants' start of growing season (SOS) dates around urban areas, compared to the surrounding countryside, have diverged across the globe: some advance, and some delay. Divergent SOS trends have been observed in field measurements as well as satellite remotely sensed terrestrial vegetation seasonality—land surface phenology (LSP). However, the reasons for this phenomenon remain unclear. We hypothesize that divergent SOS trends can be explained by the interaction between UHI-induced seasonal temperature changes and variable plant chilling requirements—the need for plants to be exposed to sufficiently low temperatures to release dormancy in spring. We developed a Bayesian hierarchical model to produce over 30 years of LSP records at 30 m spatial resolution that provides a unique opportunity to test the chilling hypothesis in urban areas. Multiple process-based and data-driven models are applied to phenological observations and daily temperature records across urban-rural gradients to explore the chilling effect on spring phenology. Our results will provide critical information on global plant spring phenology under current and future climate change conditions.

Joseph N. Gutierrez, Lucian A. Lucia, Nathalie Lavoine
Graduate Program: Forest Biomaterials[1]
Advisors: Nathalie Lavoine and Lucian A. Lucia
Poster Number: 78

Merging science and art for sustainable nature-inspired coloration patterning

Nature is a vast font of knowledge that we should continue to exploit through biomimicry. A perfect example of one of the most clever and stunning nanoengineered materials is found in the brightest and most vivid colors of living organisms such as the Morpho blue butterfly, the peafowl, the hummingbird, the royal beetle, and the sea mouse. Instead of using pigmentation, the colorations are due to complex nanoscale architectures that interact with light in a way leading to refracted vivid and angle-dependent colors or, more properly, iridescent patterns whose existence would otherwise be impossible. Iridescent colors on products such as holographic clothes or glittering fabrics tend to be artificially created using glass, plastic, or metallic nanoparticles. A more sustainable approach that we have proposed involves the use of cellulose nanocrystals (CNCs) extracted from renewable sources such as wood. Researchers have used CNCs to create iridescent patterns and colorations in various solid and well-defined substrates such as plastic, glass, metals, and even wood, with remarkable results for artistic or visual purposes. Pursuing a combination of art and applied science, we engineered a set of structural colors on metallic surfaces for exterior decoration protecting the material against outdoor conditions opening new possibilities for artists and architects. Next, we developed a novel approach for creating on-demand patterns or figures on textiles with strong iridescent effects. This part of the project presents a simple technique to create iridescent patterns on highly porous, absorbent, and flexible materials such as fabric, studying the factors that affect the CNC self-assembly characterized by a chiral nematic structure responsible for iridescent coloration. Our findings provide evidence that CNCs could reimagine conventional coloration through structural motifs, offering a more sustainable pathway for coloration and patterning to diverse industries such as textiles and opening new collaborative opportunities at the intersection of art and science, and engineering.

Soojin Kwon, Marielis C. Zambrano, Joel J. Pawlak, Richard A. Venditti
Graduate Program: Forest Biomaterials
Advisors: Richard Venditti and Joel Pawlak
Poster Number: 98

Aquatic biodegradation of Polypropylene/Poly(β-hydroxybutyrate) blended fibers: accelerated biodegradation and analysis of biodegradation residuals

With the increasing recognition of the plastic waste crisis, many put forward ways to improve the biodegradability of non-biodegradable synthetic polymers. Polymer blending of synthetic polymers with biodegradable material has been put forward as a possible solution. Several patents have been issued, and commercial/research-stage polymer additives are currently available to increase biodegradability of the overall material. However, the literature has not reported the biodegradability of blends of the synthetic and biodegradable polymers in a scientific, transparent, and detailed manner. To provide such a detailed report, in the present study, Polypropylene (PP) was blended and melt-spun in monofilament form with poly(β-hydroxybutyrate) (PHB), a well-known bio-based/biodegradable polymer. Five mass percentages of PHB in the blends (0%, 25%, 50%, 75%, and 100%) were prepared and characterized. The biodegradability in an aquatic aerobic condition with wastewater solids as the inoculum was tracked for 42 days.

The pure PP and PHB fibers had 0 and 60% ultimate biodegradation. The biodegradation extent of PP/PHB blend with 25% PHB content showed near-zero biodegradation, indicating that PP prevented the biodegradation of PHB at high PP concentrations. The extent of PHB biodegradation increased with increased PHB content at concentrations greater than 25%. The PHB in fibers with 75% PHB degraded approximately the same as the 100% PHB fibers, indicating that the PP did not interfere with the PHB biodegradation at PP concentrations of less than 25%. The biodegradation residuals were analyzed with various techniques, including thermal analysis, electron microscopy, and x-ray diffractometer. After biodegradation, PP polymer remained in the undegraded residual solids as fine fibrils (300-400 nm diameters). This result suggests that simply blending non-biodegradable and biodegradable polymers may not improve the biodegradability of the non-biodegradable polymers. Indeed, this blending may cause other problems, such as creating finer forms of non-biodegradable polymers like micro/nano elements after biodegradation.

Hannah Mazeski
Graduate Program: Parks, Recreation and Tourism Management
Advisors: Kathryn Stevenson and Bethany Cutts
Poster Number: 110

Examining the Inclusivity of National Parks Facebook Posts

The mission of the National Parks Service (NPS) is to preserve and protect nature, share natural beauties, and educate current and future generations. Yet the social construction of nature and ideals upon which the parks were founded are exclusionary. As a consequence, non-dominant identities continue to be underrepresented among both employees and visitors; and park-based activities often privilege dominant-group preferences for outdoor recreation and nature (Stanley, 2020). Recognizing that parks do not serve people of all backgrounds, the NPS established an Office of Relevancy, Diversity, and Inclusion (RDI) in 2012. However, it is unclear what RDI ideas are conveyed to the public through social media. As of 2021, the NPS uses multiple platforms to share information on over 400 NPS locations (U.S. NPS, 2019).

To better understand whether social media posts reinforce dominant-cultural characteristics of the US, I will analyze the messages from 9 national parks' Facebook pages. Sites were chosen based on the popularity and frequency of posts. The sample of posts was taken from September 1st, 2020 to September 1st, 2021 and accessed through Brandwatch, a digital consumer company (Brandwatch, n.d).

I will complete a content analysis to identify the presence of written content aimed to signal inclusion. This includes, but is not limited to, the following non-dominant social identities in the US: people of color, women, members of the LGBTQ+ community, and differently-abled people. Next, I will perform a discourse analysis to examine the hidden messages and patterns that may be present in posts. While national parks' social media accounts operate individually, their collective impact has the potential to portray who the National Parks System benefits. At the moment, this content has gone largely unexplored and deserves attention. This study will be able to depict who the national parks are talking about and in what capacities.

Adriana Millan
Graduate Program: Forest Biomaterials
Advisors: Joel Pawlak and Richard Venditti
Poster Number: 115

Conductive cellulose paper. The effect of fiber type, refining and paper properties on the electrical conductivity of carbon black-CMC coated paper

Conductive coatings research focuses on the conductive ink materials rather than on the paper substrate´s effect on the electrical conductivity. Cellulose paper is not conductive; therefore, it is assumed that it has no impact what so ever on the electric performance of the conductive coating. However, this research demonstrates how paper properties substantially impact on the conductivity of the resulting coating layer. More specifically, this study evaluates the effects of the fiber type used (hardwood vs. softwood) and refining levels in the resulting conductivity. TAPPI standard methods were followed to create and evaluate hand-sheets. The papers´ mechanical and surface properties such as roughness, air permeability, and water retention, were determined. These properties were then correlated with the coating conductivity. Conductive ink is created by dispersing nanoparticles of carbon black into a 1% sodium carboxymethyl cellulose aqueous solution. The coating sheet resistance is evaluated using a four-point probe equipment, and these results are integrated with the thickness of the coating, calculated by SEM images. Moreover, an experiment was developed to assess the integrity (durability, adhesion) of this specific type of coating. Unrefined hardwood fibers resulted in the lowest sheet resistance values, i.e. best conductivity. At those conditions, the amount of coating present in the hand-sheet increases due to the high porosity and water retention properties. The roughness of the paper substrate also has a critical effect on conductivity. However, its correlation with coating weight and sheet resistance is more complex and varies depending on the fiber type and the refining. Future work, will evaluate the effect of using a mixture of fibers (hardwood vs. softwood) and the impact of multiple coatings on the electrical properties of papers.

Vinicius Perin
Graduate Program: Geospatial Analytics
Advisors: Mirela G. Tulbure
Poster Number: 135

Fresh water stored by on-farm reservoirs (OFRs) is an important component of surface hydrology and is critical for meeting global irrigation needs

Farmers use OFRs to store water during the wet season and for crop irrigation during the dry season, yet their seasonal and inter-annual variability and downstream impacts are not quantified. In this study, we propose to use a multi-sensor satellite imagery approach to monitor daily changes in OFRs water volume, which is key information to model the OFRs impact on surface hydrology. We will apply the Soil and Water Assessment Tool (SWAT) to model the impact of 695 OFRs in eastern Arkansas, US—the third most irrigated region in the country that has seen rapid increase in the number of OFRs during the past three decades. We expect that OFRs' impact will vary in time and space, with greater impact on the reduction of stream discharge and peak flow during drier months and years, a key implication in the context of climate change. With the OFRs' cumulative impact on surface hydrology becoming an emerging issue in hydrology, it is imperative that a multi-sensor approach is implemented to monitor OFRs' water volume across space and time. Upon successful implementation, this project can help policymakers and water authorities in eastern Arkansas by enabling them to understand and quantify the OFRs' volume change in space and time, as well as OFRs' cumulative impacts on the watersheds where they occur, with implications for their future construction in certain areas.

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Advisors: Kelly Oten and Clyde Sorenson
Poster Number: 138

Adventures in Beetle Busting: Alternative Methods for the Eradication of Asian Longhorned Beetle in South Carolina

The Asian longhorned beetle (ALB; Anoplophora glabripennis) is a highly destructive and invasive beetle in the United States and the target of three distinct federal quarantines in the midwest and northeast The newest quarantine zone was established in Hollywood, SC in 2020 after ALB was detected for the first time in the South. This infestation is unique from previous zones in that it contains coastal bottomland sites that cannot support the current practice of removing infested trees with heavy machinery. Here, three alternative approaches are being investigated to facilitate eradication without physically removing the woody host material from hard to access sites. The study is being conducted in a 143-acre, unoccupied bottomland site with more than 600 trees declared infested by the federal eradication program. Fifty-seven red maple trees (Acer rubrum) of equivalent infestation level and of various size class and drainage levels were treated with 3 alternative management techniques: herbicide, felled and left whole on-site, and felled and cut into logs and left on-site. Mortality of Asian longhorned beetle life stages and emergence is assessed on a subset of the trees every 3 months; trees are removed from the site, split, and ALB larvae assessed. Trees left on the forest floor are also assessed for ambrosia beetle damage as a measure of decomposition.

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Advisor: Lincoln R. Larson
Poster Number: 143

Using Participatory System Dynamics Modeling to Address Complex Conservation Challenges: Tiger Farming as a Case Study

Conservation practitioners routinely work within complex social-ecological systems to address threats facing biodiversity and to promote positive human-wildlife interactions. Yet inadequate understanding of the direct and indirect, short- and long-term consequences of decision making within these dynamic systems can lead to misdiagnosed problems and interventions with perverse outcomes. Participatory system dynamics (SD) modeling is a collaborative approach that synthesizes existing research and knowledge while developing new insights. Simultaneously it helps to increase trust and consensus and improve transdisciplinary collaboration to solve complex problems. Tiger conservation and the illegal tiger trade exemplifies a complex social-ecological system. With a population of less than 4,000 animals, wild tigers remain severely threatened by various factors, including habitat constraints, human-wildlife conflict, and persistent consumer demand for their body parts. Meanwhile, there are over 7,000 tigers in commercial captive tiger facilities meeting some of this consumer demand. Opinions differ on whether these facilities reduce or increase the threat wild tigers face from poaching for trade, resulting in policy conflict among diverse stakeholder groups. In this research we are working with international conservation partners through a virtual participatory SD modeling process with the goal of using models to better understand and promote coexistence of humans and wild tigers. This research is evaluating the benefits of participatory modeling to build trust and consensus among diverse partners to enhance collective knowledge, reduce conflict, and improve the efficacy of conservation interventions.

Moriah Van Voorhis
Graduate Program: Fisheries, Wildlife, and Conservation Biology
Advisor: Robert Scheller
Poster Number: 175

Predicting Habitat Suitability for Southeastern Fox Squirrels in North Carolina: Modeling Species Distribution with Citizen Science Data

The southeastern fox squirrel, Sciurus niger niger, is a subspecies of fox squirrel that is found in southeastern North Carolina (Carraway et al 2017). Once widely distributed in North Carolina, the existing communities have been gradually declining in population over the past 100 years with a more noticeable decline occurring in recent years (Wiegel 1989). In North Carolina, the southeastern fox squirrel is classified as a vulnerable population that is limited to a specific geographic region with an at-risk population (Hall 1981). Throughout North Carolina there are occurrences of suitable habitat containing no populations of southeastern fox squirrels. This leads to uncertainty regarding southeastern fox squirrel habitat range and connectivity (Carraway et al 2017). Southeastern fox squirrels occur primarily in longleaf pine forest but in the absence of suitable habitat they may potentially be found in bottomland and successional forests, pine plantations, and even urban areas (Meehan and Jodice 2010). The purpose of my study was to use crowdsourced southeastern fox squirrel locations throughout the state of North Carolina to identify state-wide habitat amount and location. I expected a preference for open woodlands given the species' association with the longleaf pine ecosystem but hypothesize that with deforestation resulting in the absence of longleaf pine, southeastern fox squirrels will be utilizing pine plantation and agricultural land in fragmented areas. This study builds on the existing literature by identifying southeastern fox squirrel habitat in North Carolina on the basis of habitat characteristics. Using updated and crowdsourced data, a generalized habitat classifier was created that can be used on a management relevant scale. Understanding the occurrences and variety of utilized and un-utilized habitat in North Carolina will provide wildlife biologists with information to aid in managing this species. It is the goal of this project to provide this information.

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Graduate Programs: Parks, Recreation and Tourism Management[1]; Forestry and Environmental Resources[2]
Advisor: Lincoln R. Larson
Poster Number: 178

Diverse University Students Across the United States Reveal Promising Pathways to Hunter Recruitment and Retention

As the number of hunters and anglers dwindles, "R3" initiatives to recruit and retain new outdoor recreationists have been embraced by wildlife agencies and conservation organizations around the country. R3 efforts focused on "non-traditional" pathways into wildlife recreation have attracted substantial attention, often targeting groups such as women, racial/ethnic minorities, and locavores (individuals committed to the local food movement). However, despite rapidly growing interest and resource allocation, the ultimate return on R3 investment – particularly among these populations – remains uncertain. Our research highlights a promising approach to R3 that could help strengthen connections with millions of potential "non-traditional" recreationists. At colleges and universities across the country, diverse millennials are eager to learn new things and try out new activities. Their developmental proclivities, coupled with the vibrant social context of college campuses, create a situation where R3 initiatives can thrive. Our team spent two years studying college students in 22 states across the U.S., focusing on their participation in, beliefs about, and support for wildlife recreation. Through over 15,000 surveys, we found that, regardless of academic major, urban/rural upbringing, or a variety of other demographic characteristics, many college students are interested in hunting (19% will engage in future hunting, another 27% might try it) and fishing (34% will engage in future fishing, 40% might try it). Students' motivations for engaging in these activities tend to focus on acquisition of local food and wildlife population management. Even more students might be eager to pursue other forms of outdoor recreation; for example, 68% currently hike, 51% camp, 35% engage in adventure recreation, and 33% watch wildlife. Our work is uncovering ways that wildlife agencies and conservation organizations can connect with college students, helping to advance R3 and foster outdoor enthusiasts who may experience and support wildlife recreation for the rest of their lives.

College of Sciences

Mohamed A. Abba
Graduate Program: Statistics
Advisors: Brian Reich and Jonathan Williams
Poster Number: 1

A key task in the emerging field of materials informatics is to use machine learning to predict a material's properties and functions.

A fast and accurate predictive model allows researchers to more efficiently identify or construct a material with desirable properties. As in many fields, deep learning is one of the state-of-the art approaches, but fully training a deep learning model is not always feasible in materials informatics due to limitations on data availability, computational resources, and time. Accordingly, there is a critical need in the application of deep learning to materials informatics problems to develop efficient {\em transfer learning} algorithms. The Bayesian framework is natural for transfer learning because the model trained from the source data can be encoded in the prior distribution for the target task of interest. However, the Bayesian perspective on transfer learning is relatively unaccounted for in the literature, and is complicated for deep learning because the parameter space is large and the interpretations of individual parameters are unclear. Therefore, rather than subjective prior distributions for individual parameters, we propose a new Bayesian transfer learning approach based on the penalized complexity prior on the Kullback–Leibler divergence between the predictive models of the source and target tasks. We show via simulations that the proposed method outperforms other transfer learning methods across a variety of settings. The new method is then applied to a predictive materials science problem where we show improved precision for estimating the band gap of a material based on its structural properties.

Emerald Bender
Graduate Program: Biology
Advisor: Terry A. Gates
Poster Number: 16

Patterns of Evolutionary Covariation Among Sexually Selective Traits in Ceratopsian Dinosaurs Support Different Functions for Brow and Nasal Horns

Ceratopsians were herbivorous dinosaurs typified by the elephant-sized Triceratops in the latest Cretaceous, with origins 100 million years earlier as dog-sized ancestors that lacked the complex head adornments of brow and nose horns and large elaborate frills of their Cretaceous counterparts. Paleontological research supports a social and/or sexual communication function of both horns and frills, with frills functioning as visual ornaments and horns applied as weapons in intraspecific combat. Each of these communication systems provides different information, which allows a unique opportunity to decipher the socio-sexual behavior recorded in long-extinct animals. Using binary presence/absence data of ceratopsian brow and nasal horns and continuous linear measurements of frill length and body size proxies (femur and skull length), we tested for relationships between the presence of horns and the evolution of both body and frill size. Evolutionary models were fit to the data that tested evolutionary rates, optimal trait values, and the strength of the pull towards an optimum. Linear correlations were estimated in a phylogenetically controlled analysis. The analyses revealed dissimilar evolution between brow and nose horns. Nose horns are associated with increased frill length, shortened skulls, and movement towards more complex frill margins. Brow horns are uncorrelated with frill shape, instead showing an association with decreased evolutionary rates in frill length and body size. Femur length and skull length are consistently best represented by models of evolution towards a selective optimum. We propose that within Ceratopsian dinosaurs, postorbital horns functioned as weapons independent of the visually signaling frill, whereas rostral horns were subsumed into the visual cranial ornamentation system. Importantly, this demonstrates that similar morphology does not imply similar function in sexual selection. Furthermore, the deceleration of body size evolution in association with brow horns may indicate that the mechanical requirements of physical battle constrain evolutionary trajectories.

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Advisor: Kenan Gundogdu
Poster Number: 18

Room Temperature Superfluorescence

Observation of a coherent macroscopic state, in other words, the collective behavior of an ensemble, is crucial for emerging quantum technologies. However, to this day, these collective quantum phenomena namely superconductivity, Bose-Einstein condensation, and superfluorescence are all observed at stringent conditions such as extremely low temperatures or high magnetic fields. Creating a coherent state at high temperatures has been a big challenge due to the thermal noise in the ambient, which shortens the dephasing time. Here, we show a hybrid perovskite thin film, exhibiting the signatures of superfluorescence up to room temperature. The discovery of high-temperature superfluorescence clearly indicates that there is an intrinsic mechanism in these material systems that protects the system from ambient noise. Here I will present our experimental results and model that possibly explains the high-temperature superfluorescence in these materials. Further study of this high-temperature superfluorescence phase transition and understanding the mechanism of this protected coherence will pave the way for future quantum technologies.

Cole Butler
Graduate Program: Biomathematics
Advisor: Alun Lloyd
Poster Number: 23

Gene drives and over-suppression

Suppression gene drives (SGDs) spread a deleterious genetic cargo through a population by biasing their own inheritance. This technology offers a promising solution to the burden posed by crop pests and vectors of important human diseases. Presently, theoretical and experimental studies favor SGD constructs that quickly eradicate a population. If drive killing occurs faster than drive spreading, however, the target species can be locally eradicated. In the presence of migration from a non-controlled region, local eradication risks the re-invasion of wild-type immigrants, consequently undermining or even reversing suppression efforts. How might we balance drive lethality with target population permanence in the presence of bidirectional migration? In this work, we seek to answer this question for select SGDs. We use a patch-based model to account for heterogeneity in population density across a landscape. Bidirectional migration is considered between a target and non-target population. SGD performance is studied as migration levels vary, and we seek to establish under what conditions the drive persists in a suppressed target population while remaining robust to migration.

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Advisors: Martha Burford Reiskind, Matthew Breen
Poster Number: 43

Dogs of Chernobyl: Developing a model for human health effects arising from chronic exposure to radiation, heavy metals, and other environmental toxins

In 1986, a steam explosion at the Chernobyl Nuclear Power Plant (NPP) destroyed reactor 4, releasing an incredible amount of radioactive debris into the atmosphere, and contaminating surrounding regions of Ukraine, Belarus, and Russia with more than 1018 Bq of various radioisotopes. Within 48 hrs, authorities evacuated ~50,000 residents of Pripyat, and thousands of others from dozens of towns and villages within a 30 km radius of the NPP. To limit the spread of radiation, teams of “Liquidators” were sent in to euthanize agricultural livestock and pets left behind. Nevertheless, some dogs escaped destruction. Today, a population of several hundred semi-domesticated animals live around the NPP and Chernobyl City, receiving handouts from several thousand workers still employed there. The region is still heavily contaminated by 137-Cs, 90-Sr, heavy/toxic metals, organics, and chemicals left over from decontamination efforts, deconstruction, and 35 years of decay of this former industrial complex as well as a nearby military base. Genetic effects of these toxic exposures on the resident canine population are still unclear. Two populations of semi-feral dogs; one living around the NPP and another living ~18 km away in Chernobyl City are being studied. Preliminary analyses highlight genetic differentiation between these populations and candidate outlier loci within the NPP population. We hope to 1) identify local adaptation, methylation differences, and differential expression between the NPP and Chernobyl City populations and, 2) relate these genetic impacts of chronic exposures on animal health. The subsequent Fukushima nuclear disaster, as well as potential future large-scale nuclear or industrial accidents, highlights an urgent need to better understand how such exposures can adversely impact the genome and epigenome. Findings from these dogs are likely to provide vital insights concerning identification of biomarkers of human exposure that can predict subsequent adverse health outcomes after future environmental disasters.

Emmanuel Echeverri-Jimenez
Graduate Program: Chemistry
Advisor: Maria Oliver-Hoyo
Poster Number: 49

Visual-Spatial Strategies Comparison between graduate and undergraduate students inside a Virtual Reality Learning Environment

Communicating visually demanding organic reactions requires high visual-spatial abilities and representational competence. These skills are not acquired passively, and explicit visual-spatial instruction might improve students' attitude and success. This study begins with the description of the pedagogical and theoretical frameworks used to construct a model to extract, represent, and predict three-dimensional characteristics of Organic Chemical Reactions. This is followed by the introduction of an evidence-based Virtual Reality Learning Environment (VRLE) designed to reduce the cognitive load linked to mastering visual-spatial abilities and representational competence. Therein, the visual-spatial skills and difficulties associated with analyzing a visually demanding reaction were characterized for six graduate- and six undergraduate students from the Chemistry Department at NC State. Identifying the most common visual-spatial skills and difficulties at different levels of expertise is an important step for developing and assessing a VRLE as an effective pedagogical resource. This project aims towards a student-centered, self-paced, immersive virtual resource complementary to traditional lecture for studying and communicating visually demanding organic reactions.

Alexandra G. Forderhase[1], Jack S. Twiddy[2], Lailah A. Ligons[2], Emilie M. Norwood[2], Gregory S. McCarty[1], Leslie A. Sombers[1]
Graduate Programs: Chemistry[1]; Biomedical Engineering[2]
Advisor: Leslie A. Sombers
Poster Number: 60

Optimizing and Characterizing the Fabrication of Glucose Oxidase-Modified Carbon Fiber Microbiosensors for Simultaneous Detection of Glucose and Dopamine

Neuronal communication is an energetically demanding process that is necessary for supporting normal brain function. There is substantial evidence indicating a dysregulation in brain metabolism and dopamine dynamics in neurological disease states, such as Alzheimer's disease and addiction. However, there is a critical lack of analytical tools and techniques capable of studying energetic substrates and dopamine dynamics simultaneously at a discrete location in brain tissue. Carbon-fiber microelectrodes are commonly coupled with fast-scan cyclic voltammetry (FSCV) for the subsecond detection of neurotransmitters, such as dopamine, in situ. These carbon-fiber microelectrodes can be modified with enzymes to create microbiosensors capable of simultaneously quantifying real-time fluctuations of non-electrochemically active substrates, such as glucose or lactate. Hydrogel entrapment of glucose oxidase (GOx) within a chitosan matrix on the carbon-fiber surface has previously been shown to provide for stable, sensitive, and selective detection of glucose and dopamine using FSCV. The purpose of this study is to characterize the chitosan hydrogel that entraps oxidase enzyme on the electrode surface, and the effects of the hydrogel's physical nature on acquired electrochemical data. This is important, because even slight modifications to the sensor surface can significantly affect the performance of the microbiosensor. Hydrogel was deposited using linear sweep voltammetry (LSV), and membrane consistency and electrochemical performance were characterized to optimize the deposition potential range and sweep rate. Electrochemical impedance spectroscopy (EIS) was used to relate impedance and capacitance measurements to sensor performance before and after electrodeposition, as well as after electrochemical conditioning. Finally, voltammetric measurements were used to determine the most consistent deposition parameters and how this relates to optimal sensor performance. Overall, these experiments are important because they provide an improved understanding of the hydrogel matrix that is integral to microbiosensor function, thus advancing this much-needed technology for monitoring real-time neurochemical kinetics.

Akhil Francis[1], Daiwei Zhu[2,3], Cinthia Huerta Alderete[2,4], Sonika Johri[5], Xiao Xiao[1], James K. Freericks[6], Christopher Monroe[2,3,5], Norbert M. Linke[2], Alexander F. Kemper[1]
Graduate Programs: Physics[1]; Joint Quantum Institute and Department of Physics, University of Maryland[2]; Center for Quantum Information and Computer Science, University of Maryland[3]; Instituto Nacional de Astrofísica, Óptica y Electrónica[4]; IonQ Inc.[5]; Department of Physics, Georgetown University[6]
Advisor: Alexander F. Kemper
Poster Number: 62

Many-body thermodynamics on quantum computers via partition function zeros

Matter exists in different phases; e.g., water exists in solid, liquid, or gaseous forms. Apart from these commonly observed phases, there are unconventional phases in quantum systems, among which some have significant applications, such as superconductors used in MRI machines. Hence studying different phases of matter and transitions between them is relevant from a fundamental science and technological perspective. But many of their properties, including phase diagrams, are difficult to compute. Even supercomputers cannot simulate some interacting quantum systems. It is where quantum computers could potentially help. Quantum computers which operate on quantum principles are more efficient in studying quantum systems than classical computers. Even though present quantum computers are noisy-intermediate machines, quantum computers having significant advantages over classical computers will hopefully be available in the future. In our work, we use quantum computers to explore the phase transitions of a quantum system using a new approach based on partition function zeros, which are complex zeros of the partition function, which is a function that determines the thermodynamic properties of a system. These partition function zeros contain information about the phase transitions, as shown by Lee and Yang, and later these were measured experimentally. Here, we show how to find partition function zeros on noisy intermediate-scale trapped-ion quantum computers in a scalable manner, using the XXZ spin chain model as a prototype, and observe their transition from XY-like behavior to Ising-like behavior as a function of the anisotropy. While quantum computers cannot yet scale to the thermodynamic limit, our work provides a pathway for this as hardware improves, allowing the future calculation of critical phenomena for systems beyond classical computing limits.

Indrila Ganguly and Srijan Sengupta
Graduate Program: Statistics
Advisor: Srijan Sengupta
Poster Number: 67

Fast resampling methods for massive Generalized Linear Models

Residual bootstrap is a popular and widely used mechanism in the context of multiple linear regression for assessing the quality of estimators. Moulton & Zeger (1990) described a Residual Bootstrap method in the context of Generalized Linear Model (GLM), a flexible generalization of Ordinary Linear Model. However, for massive datasets prevalent increasingly in today's world, these Residual bootstrap techniques turn out to be computationally demanding and hence less feasible. In this context, we introduce a Subsampled Residual Bootstrap strategy for Generalized Linear Model, which is much more computationally efficient, and better applicable in cases with a stringent time budget. We have so far ptoved the consistency and asymptotic normality of our proposed estimator (using ordinary least squares) for multiple linear regression model,and working on extending the results for Generalized Linear Model. We demonstrate the advantages of our method through numerical simulations.

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Advisor: Katherine Mack
Poster Number: 68

Matter Power Spectra in an Early Matter Dominated Era With A Hot Hidden Sector

If dark matter resides in a hidden sector minimally coupled to the Standard Model, another particle within the hidden sector might come to dominate the energy density of the early universe temporarily, causing an early matter-dominated era (EMDE). During an EMDE, matter perturbations grow more rapidly than they would in a period of radiation domination, which leads to the formation of microhalos much earlier than they would form in standard cosmological scenarios. These microhalos can boost the dark matter annihilation signal, but this boost is highly sensitive to the small-scale cut-off in the matter power spectrum. If the dark matter is sufficiently cold, this cut-off is set by the relativistic pressure of the particle that dominates the hidden sector. We determine the evolution of dark matter density perturbations in this scenario, obtaining the power spectrum at the end of the EMDE. We analyze the suppression of perturbations due to the relativistic pressure of the dominant hidden sector particle and express the cut-off scale and peak scale for which the matter power spectrum is maximized in terms of the properties of this particle. We also supply transfer functions to relate the matter power spectrum with a small-scale cut-off resulting from the pressure of the dominant hidden sector particle to the matter power spectrum that results from a cold hidden sector. These transfer functions aid the quick computation of accurate matter power spectra in EMDE scenarios with initially hot hidden sectors.

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Advisor: Benjamin Callahan
Poster Number: 86

Meta-Analysis of the Vaginal Microbiome Reveals Cross-Study Signals of Preterm Birth Risk During Gestation

Preterm birth (PTB) is the primary cause of neonatal morbidity and mortality. Many studies have suggested PTB is related to the vaginal microbiome. However, the mixed and sometimes inconsistent findings often caused confusion. A cross-study comparison is needed to understand the factors that affect the reproducibility of the association between the vaginal microbiome and PTB, and reveal the consistent signals across studies. In this work, we performed a meta-analysis using 12 vaginal microbiome 16S rRNA gene sequencing datasets, with in total 1926 pregnant women (PTB, n = 568). We found vaginal microbiome community can be well characterized by 25 gene-level microbial features in all these studies. Using these microbial features, the cross-study prediction accuracy of PTB is overall low (13% of the area under the receiver operating characteristic curve (AUC) > 0.65) by applying the machine learning approach with a random forest (RF) classifier. However, the RF classifier reached to acceptable or good discriminatory ability to distinguish early PTB and late TB (47% of AUC values between 0.65 and 0.85) compared with the low discriminatory ability to distinguish late PTB and late TB (all AUC values <= 0.65). In intra-dataset analysis, amplicon sequence variant (ASV) level features and genus-level have similar performance and have better performance than other broader taxonomy-level features. Moreover, by performing the cross-study differential abundance analysis using a generalized linear mixed model, we found decreasing in Lactobacillus crispatus, and increasing in Gardnerella, Prevotella and other 6 taxa are risk factors of PTB.

Matthew R. Jenkins and Brian R. Langerhans
Graduate Program: Biology
Advisor: Brian R. Langerhans
Poster Number: 89

Effects of artificial light at night on behavior and morphology of eastern mosquitofish (Gambusia holbrooki)

As the human population continues to grow it is becoming increasingly important to study the adaptive changes in organisms as a result of urbanization and to understand the evolutionary implications behind them. In this study we seek to answer questions surrounding one of the most obvious and pervasive effects of modern human civilization, artificial light at night (ALAN). ALAN can have critically important consequences for diverse taxa–and a plethora of studies have documented widespread biological impacts—and yet we know very little about how it might alter organismal traits, especially for aquatic organisms. To accomplish this, we tested for the impacts of ALAN in a common freshwater fish (Gambusia holbrooki) that regularly persist in urban streams. We used both a field study and common garden laboratory study to answer 1.) Do diel behavioral patterns and morphology differ between populations with and without ALAN? 2.) Do elevated nighttime foraging behaviors enhance fitness with ALAN? And 3.) To what extent do altered traits reflect phenotypic plasticity, evolutionary divergence or both?

Somayeh Kashani[1], Jeromy James Rech[2], Tuo Liu[3], Kyle Baustert[3], Wei You[2], Kenneth Graham[3], and Harald Ade[1]
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Advisor: Harald Ade
Poster Number: 95

Exciton Binding Energy in Organic Semiconductors

A transition to renewable energies is the key factor to overcome many crises of the modern life including global warming, energy crisis and food inequality. Since solar energy is one of the cheapest and most available renewable recourses, tremendous effort has been done so far to improve the efficiency of all sorts of solar cells. Organic Photovoltaics are one of newest type of solar cells developed from Carbon-based Organic Semiconductors (OSCs). OPVs have attracted intensive attentions for commercial implementation due to the potential advantages over the inorganic silicon-based or perovskite solar cells. Despite their phenomenal characteristics including tunable optoelectronic properties, mechanical flexibility, light weight, low cost, easy and green fabrication, the efficiency of OPVs is still lagging their inorganic counterparts. In the process of conversion of light to electricity in OPVs, an exciton (bound electron and hole) is formed upon absorption of a photon. Exciton Binding Energy (Eb) is the energy required to dissociate excitons into to free carriers (free electron and hole) that can contribute to the electrical current. Due to the small dielectric constant (3-4), Eb of OSCs is quite large (300meV-1eV). The large Eb in these materials has the major contribution to the energy loss and indeed small efficiencies of OPVs. As a result, it is becoming increasingly important to figure out how to reduce Eb of OSCs. Here, we explore the structure-function correlation for both dielectric properties and Eb of OSCs. We also explore and compare the most common methods used by the OPV community for the purpose of Eb measurement. Among different methods, we focus on combination of Ultraviolet Photoelectron Spectroscopy and Inversed Photoelectron Spectroscopy (UPS-IPES), Cyclic Voltammetry (CV) and Photocurrent Spectroscopy. We show that there is an inconsistency between the methods which can be rooted in either the exciton dynamics or difference in the surrounding medium and measured parameters in each technique. The results of our study shed light on understanding the mechanisms of Eb measurement. Also, the structure-function correlation for Eb can be implemented for designing new OSCs with smaller Eb and high performance OPVs.

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Advisor: Mette S. Olufsen
Poster Number: 99

Hemodynamics of single ventricle patients after surgical reconstruction

Patients with hypoplastic left heart syndrome (HLHS) are born with an underdeveloped left ventricle and aorta. They typically receive a series of three surgeries that result in a univentricular (Fontan) circulation. While these patients usually survive into early adulthood, they are at risk for cardiovascular problems, including reduced cardiac output that leads to insufficient cerebral and gut perfusion. Newer means of flow analyses for this patient population include three-dimensional, time-resolved phase contrast cardiac magnetic resonance (4D MRI). However, this imaging modality cannot predict absolute pressures, and it does not provide information outside of the imaged region. To remedy these limitations, this study combines 4D MRI data with 1D fluid dynamics models to predict hemodynamics in the major systemic arteries, including the cerebral and gut vasculature. Specific focus is placed on studying the effects of aortic reconstruction that occurs during the first surgery and is known to cause abnormal morphology of the ascending aorta. To study these effects, we compare simulations conducted in geometries obtained from an HLHS patient with one from a matched control patient that has double outlet right ventricle (DORV) physiology with a native aorta.

Kelsey Lund
Graduate Program: Physics
Advisor: Gail McLaughlin
Poster Number: 104

Actinide Dating Stars: Nuclear Uncertainties in Cosmic Age

Nuclear cosmochronometry is the process of using known radioactive decays together with astronomical spectra as a method of interpreting the ages of stars on cosmic timescales.

Particularly useful are measurements of the long-lived isotopes of the actinides Thorium and Uranium, which are produced via the rapid neutron capture process (r-process). The production of these actinides in r-process simulations is sensitive to the nucleosynthetic conditions in which their production occurs. Beta decay rates play an important role in the r-process as they compete with the rate at which nuclei capture neutrons, thereby setting the timescale on which the r-process can occur as well as determining the extent to which heavy nuclei are populated. In this work, I investage theoretical uncertainty in astrophysical conditions for the r-process as well as currently unmeasured beta decay rates and how these uncertainties propagate into age predictions for a selection of r-process enhanced, metal-poor stars.

Morgan Maly[1,2,3], Mia Keady[4], Meagan Maxwell[1], Reade Roberts[1], Laurie Marker[5], Adrienne Crosier[2]*, and Carly Muletz-Wolz[3]*
Graduate Programs: Genetics[1]; Center for Species Survival, Smithsonian Conservation Biology Institute, Front Royal, VA[2]; Center for Conservation Genomics, Smithsonian Conservation Biology Institute, Washington D.C.[3]; Nelson Institute for Environmental Studies, University of Wisconsin-Madison, Madison, WI[4]; Cheetah Conservation Fund, Otjiwarongo, Namibia[5]; *co-senior authors
Advisors: Reade Roberts and Matthew Breen
Poster Number: 107

The health of endangered animals is critical for their future survival. Gut health and its relationship to gut microbiota are important aspects that may be influential in the care and well-being of endangered species, such as the cheetah.

The cheetah is listed as Vulnerable by the International Union for Conservation of Nature with only 7,100 individuals in the wild. The declining number of wild cheetahs emphasizes the importance of captive cheetah populations as insurance policies against extinction. Unfortunately, cheetahs in human care experience several health conditions, including gastrointestinal (GI) diseases, which pose significant risks to animal survival, welfare, and breeding success. In contrast, these potentially terminal GI-diseases are rarely observed in wild cheetahs. We hypothesize this is due to the notable difference in diet and animal fiber between wild cheetahs and those living in zoos or conservation facilities. This study aimed to characterize and identify discernable differences in cheetah fecal microbiota between two captive cheetah populations from two different locations (Front Royal, VA, USA and Otjiwarongo, Namibia) and consuming different diets (commercial diet + carcass supplements and carcass only, respectively). Fresh fecal samples were collected from 14 cheetahs (Virginia, n = 6; Namibia n = 8) and analyzed for bacterial content using 16S rRNA sequencing. Cheetahs in Namibia had higher number of bacterial taxa, more phylogenetically diverse bacteria and were compositionally distinct (Bray-Curtis dissimilarity, Jaccard, and unweighted UniFrac measures) from cheetahs in the USA. We also found that the predictive functions of the fecal microbiota showed significant differences in pathways related to dietary metabolism and disease between the two populations. Overall, our findings suggest that major differences exist between these populations and warrant further investigation into the influence of diet and population origin on the gut microbiota and health of cheetahs.

Cole Manschot and Emily C. Hector
Graduate Program: Statistics
Advisors: Emily C. Hector and Eric Laber
Poster Number: 108

Functional Regression with Intensively Measured Longitudinal Outcomes: New Lens through Data Partitioning

Modern longitudinal data from wearable devices consist of biological signals at high-frequency time points and offer unparalleled opportunities for new health insights. Distributed statistical methods have emerged as a powerful tool to overcome the computational burden of estimation and inference with these intensively measured outcomes, but methodology for distributed functional regression is limited. Developing functional regression tools is critical to appropriately modeling and understanding these data. We propose an efficient distributed estimation and inference procedure for functional and scalar regression parameters with intensively measured longitudinal outcomes. We circumvent traditional basis selection problems by analyzing data in subsets with low dimensional basis functions. Our statistically efficient one-step estimator derives from a constrained generalized method of moments objective function with a smoothing penalty and leverages dependence between data subsets for optimal statistical efficiency. We show theoretically and numerically that the proposed estimator is as statistically efficient as a non-distributed approach and more efficient computationally. We demonstrate the practicality of our approach through application of our method to accelerometer data from the NHANES data set.

Jessica Martinez-Baird
Graduate Program: Genetics
Advisor: Caroline Laplante
Poster Number: 109

Robust mechanism of tension production compensates for doubling the genetic dosage of myosin Myp2 in the cytokinetic contractile ring

Cytokinesis partitions a mother cell into two daughter cells by the constriction of a contractile ring of actin and myosin. In the contractile ring, myosin motor proteins can generate tension by binding to and pulling on actin filaments. Yet, how myosins in the contractile ring drive the production of tension during cytokinesis remains unknown. Cytokinesis is best understood in the fission yeast, Schizosaccharomyces pombe. In fission yeast, two myosins cooperate to drive cytokinesis. The myosin Myo2 functions primarily in ring assembly while the myosin Myp2 functions primarily in ring constriction. Based on its role during constriction, I hypothesized that the amount of tension generated by the contractile ring scales with the amount of Myp2. To test this hypothesis, I doubled the genetic dosage of Myp2 (2XMyp2) by integrating a second copy of the myp2 gene into the genome of a strain that expressed the endogenous myp2 gene tagged with mEGFP. I captured movies of the mEGFP-Myp2p in 2XMyp2 cells by fluorescence confocal microscopy and measured the rate of contractile ring constriction. Surprisingly, doubling the amount of Myp2 did not alter the rate of contractile ring constriction, suggesting that the total amount of tension generated by the contractile ring does not scale with the dosage of Myp2. However, doubling the dosage of Myp2 caused a striking change in the distribution of mEGFP-Myp2p in the contractile ring. I will determine whether this molecular reorganization affects the mechanical properties of the contractile ring using laser ablation. Overall, my work suggests that the mechanisms that govern tension production are robust and can compensate for doubling the amounts of myosin motors in the contractile ring.

Melanie T. Odenkirk[1]; Kevin Francis[2]; Erin S. Baker[1]
Graduate Programs: Chemistry[1]; Cellular Therapies and Stem Cell Biology Group, Sanford Research, Sioux Falls, SD[2]
Advisor: Erin S. Baker
Poster Number: 127

Elucidating longitudinal lipidome alterations of pluripotent neural and mesodermal stem cell lineages

Pluripotent stem cells (PSCs) are a unique, primary cell line with differentiation capabilities and the potential to facilitate clinical research. However, prior to using PSCs to attain a better molecular understanding of diseases, it is vital to evaluate what influences PSC differentiation to distinct, specialized cell types. Lipids are a class of molecules ubiquitously present in biological processes which have previously shown significant alterations throughout disease processes and during PSC differentiation. Herein, we longitudinally monitor lipid changes occurring as cells transition from an induced pluripotent (iPSC) state to either neural or mesodermal cells. For these analyses, lipid extracts of iPSCs, cells at intermediate stages of differentiation, and mature cells were analyzed with liquid chromatography-ion mobility spectrometry-mass spectrometry (LC-IMS-MS). Statistically significant lipid alterations across subsequent time points were then assessed across both head group (HG) and fatty acyl (FA) lipid composition. From these investigations, the greatest lipid alterations were observed during iPSC differentiation to the mature neural and mesodermal stem cell lineages. This was anticipated given the differences in functionality between these cell types. Additionally, shared and unique lipid perturbations were observed when comparing neural and mesodermal cell lineages to one another. Triglycerides (TGs), for example, were increased in early iPSC samples, a finding that may reflect lipid droplet accumulation. Both cell lineages also showed an upregulation of plasmalogen lipids in the early iPSCs. Later time points showed unique changes in expression for mesodermal and neural lineages. Additionally, the mesodermal lineage also exhibited increasing levels of the 20:4 (arachidonic acid) fatty acyl moiety that, upon differentiation, decreased. This result agrees with the established role of highly unsaturated lipids as precursors for signaling molecules used in cell differentiation. Taken together, these results suggest that lipids play major roles in stem cell development and specific changes occur to create the different cellular lineages.

Sarah E. Orr[1], Jamie K. Cochran[2], David B. Buchwalter[1]
Graduate Programs: Toxicology[1]; Biology[2]
Advisor: David B. Buchwalter
Poster Number: 129

Developing a mayfly model to assess salinity stress and acclimation in freshwater ecosystems

Freshwater ecosystems are becoming increasingly salty due to human activities and ecologists are observing steep declines in some sensitive groups of aquatic insects, such as mayflies. However, no laboratory models exist to represent these sensitive taxa and the ionoregulatory biology of these organisms remains understudied. Our lab is developing the Baetid mayfly, Neocloeon triangulifer, into a model organism to further assess the physiological consequences of salinity stress. Previous work in our lab has revealed that high salinities delay development, decrease body mass and egg production, and ultimately reduce survival. We used radiotracers to show that in naïve larvae, ion transport rates are concentration dependent. However, in the case of Na, we observed that acclimated larvae maintain a consistent Na uptake rate (± SEM) of 38.5 ± 4.2 µg Na/g/hr across ambient Na concentrations of 0.9 to 15 mg/L, demonstrating significant acclimatory capacity. At 157 mg/L Na, however, this "preferred" rate of Na transport was exceeded by 89% despite the acclimatory transport rate response being 50% lower than those observed in naïve larvae at this concentration. In contrast, while the acclimatory response of larvae to elevated SO4 was substantial (88% lower transport rates than those observed in naïve larvae), the SO4 transport rates were still 13-fold higher than those of control larvae, and resulted in toxicity, while the elevated Na treatments were tolerated. These results suggest that excessive SO4 uptake in acclimated larvae is an energetic drain that results in developmental delays. Combining molecular and physiological techniques, we can link multiple levels of biological organization (e.g., mRNA expression, ion flux rates, and life history outcomes) to determine the overall effects of freshwater salinization in this mayfly model.

Alejandra Oyarzun Mejia[1] and Michael Hyman[2]
Graduate Programs: Toxicology[1]; Plant and Microbial Microbiology[2]
Advisor: Michael Hyman
Poster Number: 130

Applications of Activity-Based Labeling of Bacterial Monooxygenases

Bioremediation using bacteria is a cost-effective methodology used to remediate soil and water resources contaminated by diverse organics. Traditionally, the effectiveness of bioremediation approaches has been monitored by measuring the contaminant itself or its metabolic byproducts. These approaches are limited to variables in the contaminant distribution, degradation rates and appropriate sampling times. Also, these methods are based in understanding the microbial degradation pathways of the site microbial community.

Successful remediation projects require effective monitoring approaches, especially those that exploit the activities of native or augmented microorganisms. This work describes applications of a recently developed Activity-Based Labeling (ABL) approach that can be used to detect, identify, and quantify Monooxygenases; the main group of enzymes responsible for catalyzing the initial biotransformation of contaminants. ABL is a strategy to label enzymes using chemical -often bifunctional- probes to monitor enzyme function in samples of high complexity. The target enzyme activates one of the functional groups on the probe forming a covalent enzyme:probe adduct. The inactivated enzyme can then be detected by covalently attaching a reporter molecule, usually by using a copper-catalyzed azide/alkyne cycloaddition (CuAAC) reaction, or "click" reaction.

In this study we explored some of the challenges faced in developing ABL approaches for use in filed samples. These challenges include methods for applying ABL to soil and ground water samples as well as approaches for using this technique to characterize inhibitors of microbial processes such as nitrification. Native bacteria were studied on water samples obtained from site monitoring wells at contaminated sites. Bacterial cultures (N.europaea, B.vietnamiensis G4 and R.rhodochrous ATCC 21198) were used to evaluate soil extraction, cell permeabilization and inhibitors characterization. Our results show it is possible to detect Monooxygenases in different sample types, however further studies are needed before it can be reliably used as a monitoring tool.

Michael Redle
Graduate Program: Applied Mathematics
Advisor: Alina Chertock
Poster Number: 140

Well-Balanced Scheme for the Shallow Water MHD Equations with a New Divergence-Free Treatment of the Magnetic Field

PDEs constrained by a divergence-free magnetic field or velocity provide mathematical models to many complex physical systems of fundamental interest and are used in a wide range of applications arising in astrophysics, geophysics, and engineering. A close examination of the nature of such PDEs typically reveals their deep mathematical structure, and thus, typically require a very fine mesh resulting in a computationally expensive simulation. To ensure these structures are preserved exactly in numerical approximations on a less computationally expensive mesh, a careful algorithmic construction is required. In this talk, we restrict our attention to an important sub-class of divergence-free constrained systems – the shallow water magnetohydrodynamic equations, keeping in mind that the developed structure-preserving methods can be extended to other models constrained by zero-divergence. We present a new method that exactly preserve both the divergence-free constraint and equilibrium states of the shallow water magnetohydrodynamic system. The design scheme is successfully tested on a number of examples.

Grace Rhodes, Marie Davidian, Wenbin Lu
Graduate Program: Statistics
Advisors: Marie Davidian and Wenbin Lu
Poster Number: 142

Dynamic Prediction of Residual Life with Longitudinal Covariates Using Long Short-Term Memory Networks

When making treatment decisions, clinicians and patients desire accurate predictions of mean residual life (MRL) that leverage all available patient information, including longitudinal biomarker data. Biomarkers are biological, clinical, and other variables reflecting disease progression that are often measured repeatedly on patients in the clinical setting. Dynamic prediction methods leverage accruing biomarker measurements to improve performance, providing updated predictions as new measurements become available. We introduce two methods for dynamic prediction of MRL using longitudinal biomarkers. In both methods, we begin by using long short-term memory networks (LSTMs) to construct encoded representations of the biomarker trajectories, referred to as “context vectors.” In our first method, we dynamically predict MRL via a transformed MRL model that includes the context vectors as covariates. In our second method, we dynamically predict MRL from the context vectors using a feed-forward neural network. We demonstrate the improved performance of both proposed methods relative to competing methods via data application. Specifically, we dynamically predict the restricted mean residual life (RMRL) of septic patients in the intensive care unit using electronic medical record data.

Michael C. Rosko, Kaylee A. Wells, Cory E. Hauke, Felix N. Castellano
Graduate Program: Chemistry
Advisor: Felix N. Castellano
Poster Number: 150

Synthesis and Photophysics of Next-Generation Cu(I) MLCT Photosensitizers

Developing metal complexes featuring 1st row transition metals in the place of heavier 2nd and 3rd row transition metals will enable such chemistry to become more accessible. In particular, Cu(I) complexes exhibit favorable photophysics which can be easily applied to systems replacing already established precious metals, such as Ru(II). This exploratory study reports five newly conceived Cu(I) bis(phenanthroline) metal-to-ligand charge transfer (MLCT) photosensitizers featuring 2,9-cyclohexyl subunits flanked by 3,8-methyl steric supports. Complete synthesis, structural characterization, and electrochemistry, in addition to static and dynamic photophysical properties of these chromophores will be reported on all relevant time scales. Cyclic voltammetry experiments in CH3CN indicate systematic variation of the metal-based one-electron oxidation and first one-electron ligand-based reduction as a function of heteroatom substitution on the cyclohexyl moieties. The resulting energy gap variation appears to be responsible for the increased lifetimes and PL quantum yields observed. Ultrafast transient absorption spectroscopy enabled the assignment of the singlet-triplet intersystem crossing time constants in these molecules. This contribution demonstrates that the substituent variation within the cyclohexyl platform represents an effective means to create tailor-made long-lifetime Cu(I) photosensitizers with deterministic photophysical properties, precisely designed for solar photochemistry applications.

Kuncheng Song
Graduate Program: Bioinformatics
Advisor: Yi-Hui Zhou
Poster Number: 169

C3NA – correlation and consensus-based cross-taxonomy network analysis for compositional microbial data

We present Correlation and Consensus-based Cross-taxonomy Network Analysis (C3NA), a user-friendly tool for in-depth investigation of compositional microbial sequencing data, identifying different taxa-taxa correlation patterns across different phylogenetic levels for a single phenotype. C3NA can subsequently be used to compare the modules between two phenotypes. We applied C3NA with two well-studied diseases: Colorectal Cancer and Inflammatory Bowels datasets, discovered unique taxa modules via preservation analysis and highlighted critical taxa.

Arvind Subramaniam, M.S. [1,2], Shannon Ford, Ph.D.[3], Charity Oyedeji M.D.[2], Nirmish Shah M.D.[2]
Graduate Programs: Physiology[1], Duke University Department of Medicine - Division of Hematology[2], University of North Carolina at Greensboro School of Nursing[3]
Advisors: Paul Mozdziak, Charity Oyedeji, Nirmish Shah
Poster Number: 172

"So, Tell Me How You Really Feel" - Utilizing mHealth Technology and Complex Symptom Networks to Better Understand the Disease Experience of People Living with Chronic Illnesses

Patients with chronic diseases account for the majority of healthcare costs in the United States. Recently, mobile health (mHealth) technology and smartwatches have been leveraged to better communicate the disease experience of those living with chronic illnesses. An increase in mHealth tools has led to improved capabilities and customizability, providing users an individualized voice to their disease experience. The data captured via mHealth tools can be used to build complex symptom network maps, giving providers a snapshot of the overall symptom experience of their patients.

Our mHealth app, Nanpar, was developed using feedback from patients, families, and medical team members. Nanpar engages with users through winnable badges, education on their health, data visualizations, and a daily symptom reporting log. Nanpar also pairs with smartwatches to collect biometric information such as steps, activity, sleep quality, heart rate, and other useful information. Nanpar was built to give patients living with chronic illnesses a communication method for their disease experience that could convey their condition to their physician over time and regardless of location or access to healthcare facilities. The data collected with Nanpar was used to build complex symptom networks, providing an overall picture of the user's disease experience by visualizing the correlations and partial correlations of their symptoms. In complex symptom networks, the nodes or circles represent an individual symptom, while the thickness of the lines between them represents the correlation between those symptoms. Complex symptom networks help amalgamate the various pieces of data collected via Nanpar into a singular image that shows the multitude of symptoms their patients face, alongside the relationships between symptoms. Nanpar and the coinciding symptom networks created give providers a multitude of information on their patients to provide actionable and clinically relevant data to better address the concerns of the patient and improve patient outcomes.

Hailey Young
Graduate Program: Chemistry
Advisor: Caroline Proulx
Poster Number: 192

Chemoselective Functionalization of N-Arylglycinyl Peptides with Boronic Acid Derivatives on Solid Support

Chemoselective late-stage functionalization of peptides have been reported and subsequently used in structure-activity relationship (SAR) studies of therapeutically relevant peptide sequences. While there are examples of peptide backbone modifications, they often require harsh conditions (e.g. metal catalyst, chemical oxidant, high temperature). Specifically, N-aryl glycine derivatives have been shown to oxidize to an α-imino amide intermediate, which allows for coupling to a variety of nucleophiles at the α-carbon. However, examples of such oxidative couplings on longer functionally dense peptide sequences remain scarce. We previously demonstrated that electron-rich N-aryl peptides undergo oxime ligation reactions with aminooxy nucleophiles under mild aqueous, catalyst-free conditions. Here, we describe the late-stage α-C-H functionalization reaction of resin-bound N-aryl peptides with boronic acid nucleophiles in organic solvent under catalyst-free conditions. We explore the effect of the electronics of the N-aryl ring on reactivity and present a scope of the optimized reaction where both the peptide sequence and nature of boronic acid derivatives are varied.

Marwen Zrida[1], Andrew Papanicolaou[2], Negash Medhin[2]
Graduate Programs: Operations Research[1]; Mathematics[2]
Advisors: Negash Medhin and Andrew Papanicolaou
Poster Number: 194

Q-Learning the Nash Equilibrium for General Two-Player Games

We study a two-player asymmetric game between an industrial firm and a government policy-maker in times of pandemic. The industrial firm optimizes net revenue by controlling wage levels, and the government optimizes the pandemic's public health and economic situation through the use of Non-pharmaceutical interventions. The problem is computationally challenging because the players' preferences are asymmetric and do not form a zero-sum game. In this paper we simulate the pandemic using Agent Based Modeling and we propose a Q-Learning algorithm that will return a Nash equilibrium for the firm and government. Simulations of this Nash equilibrium produce public health statistics that are comparable to those predicted by SIR models. Furthermore, if our model includes elements from inventory theory about industrial production cycles, then our simulations will produce economic cycles that are comparable to those predicted by the Goodwin model and others from economic wage theory.

College of Textiles

Melissa K. Armistead[1,2], Anuja B. Dandekar[1,2,] Marc Mathews[2,] Mark Gaskill[1,2,] A. Shawn Deaton[2,] and R. Bryan Ormond[1,2]
Graduate Programs: Textile Engineering[1]; Textile Protection and Comfort Center, North Carolina State University[2]
Advisor: R. Bryan Ormond
Poster Number: 7

An Animatronic Headform Assessment to Evaluate the Inward Leakage of Barrier Face Coverings and Medical Masks

Supply shortages at the beginning of the pandemic made it difficult to obtain traditional respiratory protection. Alternative products were encouraged for the general public as a method of source control and have rapidly evolved to meet demands. These face coverings can provide variable efficacy depending on the material properties, fit to the face, and environment in which they are worn. Current testing and standards often evaluate these products at the material level, which does not account for leakage due to poor fit or movement when worn. This research developed an animatronic headform assessment to evaluate the performance of barrier face coverings and medical masks on a headform in an effort to incorporate fit into the total filtration efficiency value. Each test cycle consisted of static and dynamic segments with sinusoidal breathing. A polydisperse NaCl aerosol was generated inside the chamber while the differential particle counts from 0.3 to 10.0 µm were recorded inside and outside the sample to calculate the penetration and total filtration efficiency. A modified version of this test cycle was repeated to determine breathing resistance from the differential pressure measured during exhalation. These results were compared with data collected using the recent standard specification for barrier face coverings, ASTM F3502. An initial analysis showed a positive correlation between the methods. The headform test was able to successfully differentiate between products. The nonwoven medical masks showed moderate filtration and variable breathing resistance attributed to their loose fit. Cloth face coverings generally had lower efficiency, although hybrid materials and design could significantly improve performance. Alternative products have been shown to provide some degree of filtration; however, they are not replacements for certified respirators and should be carefully selected based on the perceived risk.

Dylan Dakota Batch and Katherine Annett-Hitchcock
Graduate Program: Textile, Technology and Management
Advisor: Katherine Annett-Hitchcock
Poster Number: 13

Entrepreneurial Ecosystems in the Textile and Apparel Industry

Before the 1980s, research involving entrepreneurship focused on a person's personality, risk aversion level, and other internal qualities that affected business ownership success. However, researchers began to examine the influence of externalities such as regional, social, cultural, political, and economic structures on the entrepreneurship process (Dubini, 1989; Spilling, 1996; Spigel & Harrison, 2018; Van de Ven, 1993). Entrepreneurs are now seen as intimately tied through their social relationships to a broader network of actors (Hoang & Antoncic, 2003) in their entrepreneurial ecosystems (EE). These systems have become a subject of inquiry by scholars who have sought to explain why and how particular geographic regions experience more significant start-up growth than others (Lyon-Hill et al., 2017). The Textile and Apparel industry comprises complex networks that include design, production, and distribution. Entrepreneurial ecosystem research examines how regions' social, cultural, political, and economic structures can impact business success. These factors plus other connected actors can be developed in such a way that can create productive entrepreneurship within an area. Ecosystem mapping research can help small businesses, support organizations, and other network actors identify opportunities and constraints within the micro and macro entrepreneur ecosystem (Vedula & Kim, 2019). The purpose of this research is to introduce the ecosystem research approach in the global Textile and Apparel Industry with a focus and call to action in the following areas: Public Policy and Government Support, Human Capital, and Sustainability and Infrastructure.

Hui Cheng, Chaoyi Yan, Raphael Orenstein, Mahmut Dirican, Shuzhen Wei, Nakarin Subjalearndee and Xiangwu Zhang
Graduate Programs: Fiber and Polymer Science
Advisor: Xiangwu Zhang
Poster Number: 28

Polyacrylonitrile Nanofiber-Reinforced Flexible Single-Ion Conducting Polymer Electrolyte for High-Performance, Room-Temperature All-Solid-State Li-Metal Batteries

Single-ion conducting polymer electrolytes (SIPEs) can be formed by anchoring charge delocalized anions on side chains of a crosslinked polymer matrix, thereby eliminating the severe concentration polarization effect in conventional dual-ion polymer electrolytes. Addition of a plasticizer into the polymer matrix confers advantages of both liquid and solid electrolytes. However, plasticized SIPEs usually face a trade-off between conductivity and mechanical strength. With insufficient strength, there is potential for short-circuiting failure during cycling. To address this challenge, a simple and mechanically-robust SIPE was developed by crosslinking monomer lithium (4-styrenesulfonyl) (trifluoromethylsulfonyl) imide (LiSTFSI) and crosslinker poly(ethylene glycol) diacrylate (PEGDA), with plasticizer propylene carbonate (PC), on electrospun polyacrylonitrile nanofibers (PAN-NFs). The well-fabricated polymer matrix provided fast and effective Li+ conductive pathways with a remarkable ionic conductivity of 8.09 × 10-4 S cm-1 and a superior lithium-ion transference number close to unity (tLi+ = 0.92). The introduction of PAN-NFs not only improved the mechanical strength and flexibility but also endowed the plasticized SIPE with a wide electrochemical stability window (4.9 V vs. Li+/Li) and better cycling stability. Superior long-term lithium cycling stability and dynamic interfacial compatibility were demonstrated by lithium symmetric cell testing. Most importantly, the assembled all-solid-state Li metal batteries showed stable cycling performance and remarkable rate capability both in low and high current densities. Therefore, this straightforward and mechanically reinforced SIPE exhibits great potential in the development of advanced all-solid-state Li-metal batteries.

Hannah M. Dewey[1], Jaron Jones[1], Sydney Lucas[1], Nigar Sultana[1], Shelby Hall[1,2], and Januka Budhathoki-Uprety[1]
Graduate Programs: Fiber and Polymer Science[1]; Chemical Engineering, Pennsylvania State University[2]
Advisor: Januka Budhathoki-Uprety
Poster Number: 42

Development of Optical Nanosensors for the Detection of Quaternary Ammonium Compound Disinfectants

Quaternary ammonium compounds (QACs) are active ingredients in a large number of common disinfectants recommended for use against SARS-CoV-2 (COVID-19) virus. A recent study reported a 72% increase in disinfection practices in households during the pandemic with over 80% of these households using QAC containing disinfectants. Humans can be exposed to these compounds through dermal absorption during application, hand-to-mouth ingestion of disinfectant residues, and inhalation of indoor air. Recent studies have reported detection of higher QAC concentrations in human blood and indoor dust particles during the pandemic. In addition, exposure to QACs have been linked to asthma and COPD, effects on cholesterol homeostasis, mitochondrial function, and increase in inflammatory cytokines. The continuous and overuse of these compounds could have adverse human health and environmental impacts.The complete biological fate of QACs, however, remains unknown. Thus, the monitoring of QACs exposure is deemed necessary to help mitigate further human exposure and toxic side effects. Although QACs in environmental samples can be detected by chromatographic methods and mass spectrometry, these methods are sub-optimal in measuring QACs in biological samples. Therefore, a real-time, user-friendly, self-monitoring system that can provide quantitative information within biological environments is crucial.

Nanomaterials have been explored for the development of nanosensors due to their tunable size and physicochemical characteristics. Among those, single-walled carbon nanotubes (SWCNTs) possess unique optical, electrical, and mechanical properties. Their non-photobleaching fluorescence in the near-infrared region, high optical sensitivity, high stability, and sizes within the nanoscale, provide great potential for an implantable, real-time, wireless optical detection method. SWCNT-based optical sensors have been investigated for the detection of neurotransmitters, proteins, lipids, mRNAs, COVID-19 virus, etc. in buffer, in vitro, and in vivo. Herein, we investigated multiple nanosensors composed of SWCNTs for the detection of QACs. The information gained from this study will be used to create a library of nanosensors for the development of an implantable, real-time, wireless, optical detection method for the monitoring of QAC disinfectants in biological environments.

Jeannie Egan
Graduate Program: Textile Chemistry
Advisor: Sonja Salmon
Poster Number: 51

Converting Textile Waste to Pumpable Slurry for Biogas Production through Enzymatic Fiber Separation

Around 11 million tons of post-consumer textile waste (PCTW) are disposed of in U.S. landfills annually, making up 8% of all municipal solid waste and equating to at least $10.5 billion in lost value. PCTW is landfilled because it contains complex blends of natural and synthetic fibers that are not easy to separate. By deconstructing PCTW into less complex material streams, it will be possible to recover synthetic fibers, generate energy-rich feedstock for anaerobic digesters (ADs), and efficiently treat residuals to divert PCTW from landfills. The goal of this project is to optimize mild enzymatic methods to convert cellulosic portions of PCTW from large heavy solids to pumpable slurries with compositions that are compatible with microbial communities in ADs, while recovering valuable non-degraded synthetic fractions for recycling. Careful tracking and analytical characterization of chemical residuals from deconstruction of dyed and finished fabrics using model dyes and finishes will provide a more robust sustainability profile of the methodology. This project will expand industry knowledge on new waste fractionation approaches that could lead to sustainable revenue for landfills in collaboration with AD projects.

Wenna Han
Graduate Program: Textile Technology Management
Advisor: Yingjiao Xu
Poster Number: 81

Investigation of Chinese Consumers' Adoption Intention toward Smart Closet: A Perspective of Psychological Needs and Motivations

Tackling the problem of "having a closet full of clothes but nothing to wear", Smart Closet apps have emerged in recent years as a digital closet assistant. Smart Closet apps offer functions including wardrobe management, outfit coordination, and shopping guide, to help consumers get dressed easier. Users are also enabled to share their coordinated outfits in the online community as well as get inspiration from others' postings. However, Smart Closet is still in the initial stage of its development and has not yet been widely adopted by consumers, especially in the Chinese market, the world's largest fashion market. Accordingly, not much is known regarding consumers' responses to this new technology. The current study aimed to investigate Chinese consumers' adoption intention toward Smart Closet, from the motivational and underlying psychological needs perspective. In particular, perceived usefulness and perceived enjoyment of Smart Closet were examined as extrinsic and intrinsic motivations respectively toward the adoption intention, while three basic human psychological needs (i.e., perceived autonomy, perceived competence, and perceived relatedness) were investigated as underlying antecedents of motivations. Data from 346 Chinese consumers were collected via an online survey and analyzed using structural equation modeling. Results indicated that consumers would have high adoption intention when they perceive Smart Closet useful and enjoyable to use. Moreover, perceived autonomy and perceived relatedness of using Smart Closet were confirmed to have positive impacts on consumers' motivations of adoption. Additionally, consumers' fashion consciousness was found to moderate the Smart Closet adoption process as an individual characteristic. This study not only provides insights into Chinese consumer behavior on Smart Closet, but also lends managerial implications to fashion retailers and practitioners pertaining to the implementation of Smart Closet.

Mars Harvey
Graduate Program: Fiber and Polymer Science
Advisor: Abdel-Fattah Seyam
Poster Number: 83

3D Printed Auxetic Metamaterials for Improved Footwear Comfort

Footwear comfort is a complex, highly individual experience. Still, it is widely recognized that comfort directly impacts health, safety, and quality of life. Material innovation is required to improve footwear comfort, across all populations and end-use applications. This work undertakes material development from an interdisciplinary standpoint, combining distinct but complementary innovations from industries of footwear, additive manufacturing, and material science. Results promise implications for each area of study as well as how they might be further integrated in future work.

3D printing has experienced explosive market growth in recent years, and its array of relevant applications and compatible materials continues to broaden. It offers undisputed potential for the footwear industry with regard to mass customization and design agility. Despite this technology's promise, it remains under-optimized, particularly for flexible materials best-suited for under-foot applications. This work began by exploring and reconfiguring common 3D printing mechanisms and parameters for flexible filament, to improve print quality and uniformity for the creation of novel cushioning materials.

Material development often stems from new polymers, but even well-established polymeric materials can offer exciting new responses with carefully engineered macrostructures. Metamaterials use specific geometries to generate material responses that are distinct from the properties of base material itself. The auxetic metamaterials studied gain their characteristic negative Poisson's ratio from a reentrant hexagonal honeycomb design, rather than the thermoplastic polyurethane printing filament. Mechanical properties typical of auxetic metamaterials include improvements to many properties desirable for underfoot cushioning systems. This study aims to quantify how changes to the metamaterial's geometry impact the auxetic response and other footwear-relevant mechanical properties, ultimately seeking a multi-faceted approach to improving footwear comfort via material development.

Rong Huang
Graduate Program: Fiber and Polymer Science
Advisors: Emiel DenHartog and Jeffrey Joines
Poster Number: 87

Advanced mathematical analysis to optimize image processing for pore size assessment of knitted fabrics

Fabrics stand out among engineering materials because of their porous structure. Pores, characterized by pore size along with their distribution, have a significant impact on fabric characteristics, e.g., air permeability, heat transfer, and filtration efficiency. The reliable measurement of pores is fundamental to studying the structure and performance of fabrics. Image processing is a popular method for assessing fabric pores due to its convenience and efficiency. General steps include converting color images to grayscale, binary images, and performing the morphological operation, i.e. erosion and dilation, and then finding pore contour. However, no standardized approach has been put forward and there exists many ambiguities in the choice of thresholds which makes pore assessment too subjective to compare. For example, the morphological operation, identified by the shape and size of the structural element, is essential to probe the fabric images with hairy surfaces, where structural element size influences the area of pores detected. However, no article explicitly discussed the selection of structural element size in fabrics. We evaluated the impact of structural element size on fabric pore size and its distribution and proposed a way to find the optimal threshold. Besides, our work separated intra-yarn and inter-yarn pores and simulated the distribution of inter-yarn pore size.

In general, the paper using plain weft-knitted fabric as an example, proposed a standardized process to find pores in fabric using image processing. The advanced mathematical analysis was adopted to optimize the threshold selection, isolate the intra-yarn pores and inter-yarn pores, and simulate pore size distribution. We suggested a more objective way to perform image analysis of fabric pores and provided an in-depth understanding of pore size distribution in fabrics.

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Poster Number: 91

Exploring A Wildland Firefighting Uniform Company's Perceptions of the Use of 3D Apparel Visualization Software

Digital product creation and 3D assets are now regarded as key vehicles to streamline the apparel product development process and achieve a leaner global supply chain. Nonetheless, there is still a lack of scholarly information and empirical research addressing a functional clothing company's perception of firm-level technology initiatives. This study explores the potential of introducing 3D apparel visualization software into an industrial product design and development process for one category of functional apparel: wildland firefighting protective clothing. Acton research and in-depth interviews were employed by recruiting two employees of a wildland firefighting protective clothing company located within the United States with less than ten years' history. Through a series of interviews, a principal investigator entered an interview setting as an instructor to influence the participants' learning of 3D apparel visualization software so they could envision how the software could be integrated into their business. Diverse learning modules were provided to introduce different functions and features in each interview, and the interview session was an interactive learning process. A set of pattern pieces of garments shirt and pants designed by the company was used to simulate 3D virtual garments to demonstrate in the interviews. Interviews focused on identifying which stage and activity 3D apparel visualization software can be employed in the current product development process, examining how the company perceives 3D apparel visualization software, and identifying decision factors of adopting 3D apparel visualization software for the company. Interviews were transcribed, and textual data was interpreted through content and thematic analysis. Analysis indicated that 3D apparel visualization software could facilitate pinpointing the sizing and fit issues and communicating them with pattern makers and manufacturers. Moreover, virtual fitting on an avatar can reduce the number of physical samples and save time. However, the interoperability of 3D virtual garment data and information with manufacturers should be improved for common utilization.

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Poster Number: 96

An Evaluation of Base Layer Fabric – Skin Interaction under Loads

Physiological clothing comfort is essential when selecting garments for everyday wear. Sensorial comfort (or discomfort) involves the feeling of fabric in contact with the skin. The perceived feeling of fabric is driven by the material and surface properties such as bending rigidity, surface roughness, and friction. Many professions and scenarios require people to wear layered garment systems either for protection or environmental necessity. Additional layers add pressure either due to garment weight or fit that can further influence how the base-layer mechanically interacts with the underlying skin. Motion induced shear forces will also contribute to the overall sensation of wearing layered garments by introducing a dynamic friction component. In extreme cases of discomfort wearers can experience skin abrasion and damage to the stratum corneum. The aim of this research is to better understand how pressure, shear, and their effect on surface and fabric properties affects skin health and comfort. In a preliminary study to characterize the surface properties of knitted fabrics, the surface tester from Kawabata Evaluation System was used to measure the surface roughness and kinetic friction coefficient for 6 different structures. The structures selected provide a wide range of textures and each were tested under two tensions to assess if two levels of strain would result in a change in the surface properties. Based on the results, the fabric structure does appear to influence the resulting surface roughness and specific constructions including a rib and link-links are more affected by varying strain levels and fabric orientation. The friction results highlight the limitations for using the standard probe when testing more rigid fabrics due to the non-deformable probe material and the lack of ploughing action that most likely occurs during skin contact.

Courtney Michaels
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Poster Number: 113

Distinguishing wicking performance in commercially-advertised moisture management fabrics through a single-pore wicking evolution apparatus for textiles

Many companies use terms such as “wicking’ and “moisture-management” to advertise their performance fabrics. This research compares the wicking capabilities of multiple fabrics by analyzing their directional wicking. A newly developed test method for analyzing moisture movement through textile structures known as the ‘single-pore wicking evolution apparatus for textiles (SWEAT)’ was designed to create testing conditions that mimic the delivery of sweat from a single sweat gland. The SWEAT method provides a continuous microfluidic flow of solution through a needle, thus replicating one sweat gland. Through image analysis of the SWEAT test, apparent wicking lengths were obtained in both coarse and whale direction for each fabric. Though all fabrics tested were selected due to their commercially advertised wicking capabilities, the calculated wicking rates showed significant variations in the wicking rates between these moisture management fabrics. Some fabrics also exhibited a greater propensity for directional wicking despite having the same knit construction. These results further provide evidence for the SWEAT test as a new reliable method to assess wicking.

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Poster Number: 126

An Evaluation of Expandable Knit Structures for the Development of Size-Changing Shoes for Children

This research examines the integration of novel auxetic knit structures for the development of size-changing shoes for children. Children's feet grow rapidly requiring a shoe size change every few months. The goal of this research is to develop a knit upper for footwear that can fit more than one child's shoe size. The growth rate of children's feet has been a popular topic for podiatrists, pediatricians, and orthopedists; ill-fitting shoes can affect posture and gait. Shoes should appropriately fit children while also being affordable. The integration of expandable knit fabrics may allow for more natural growth of the foot. Nike released the first flatbed knit upper in 2012. The upper of a shoe is around the laces, where materials are present to protect the foot. Knit uppers are more extensible than traditional woven or leather uppers, allowing more space for movement in a shoe. The integration of auxetic knit structures may allow for longer lasting footwear for children. Auxetic materials expand laterally when stretched and become narrower when compressed. Auxetic design elements can be used in knitting due to the variety of fabric structures possible combined with the use of advanced machinery. The integration of auxetic structures in knit footwear will result in a more sustainable option for children's footwear. The upper can contract and expand where appropriate for the foot, lessening the probability of impacted growth. The fabrics developed in this study will be tested against conventional knit uppers from the children's footwear market. The fabrics will be evaluated for physical properties such as burst strength, breathability, and extensibility. Furthermore, the market feasibility of such a product will be evaluated through interviews with children and parents. It is anticipated that the outcome of this research will contribute to a more sustainable footwear option for children and parents alike.

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Poster Number: 65

Whole Genome or Single Genes? A Phylodynamic and Bibliometric Analysis of PRRSV

Diversity, ecology, and evolution of viruses are commonly determined through phylogenetics, an accurate tool for the identification and study of lineages with different pathological characteristics within the same species. In the case of PRRSV, evolutionary research has divided into two main branches based on the use of a specific gene (i.e., ORF5) or whole genome sequences as the input used to produce the phylogeny. In this study, we performed a review on PRRSV phylogenetic literature and characterized the spatiotemporal trends in research of single gene vs. whole genome evolutionary approaches. Finally, to determine the most accurate type of data to be applied to understand and predict the evolutionary trends of PRRSV, we used publicly available data to produce a Bayesian phylodynamic analysis following each research branch and compared the results to determine the pros and cons of each particular approach. We observed that the key variable to determine whether to use one approach or the other relies on the accuracy needed on the ancestral reconstruction, where whole-genome inputs provide more robust results than single-gene databases. This study provides an exploration of the two main phylogenetic research lines applied for PRRSV evolution, as well as an example of the differences found when both methods are applied to the same database. We expect that our results will serve as a guidance for future PRRSV phylogenetic research.

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Poster Number: 77

Artemin/GFRα3 signaling axis is involved in the functional plasticity of sensory neurons in osteoarthritis pain

Osteoarthritis (OA) is a leading cause of disability, with ~100 million US adults suffering from chronic joint pain, widespread sensitization, and decreased mobility. Clinically efficacious and safe therapeutics for OA pain management are limited. Thus, there is an urgent need to develop novel, clinically relevant analgesics for OA pain. We identified increased concentrations of a neurotrophic factor, artemin, in the serum of humans, cats, and dogs with naturally occurring OA pain and linked it to joint pain in dogs. Further, GFRα3 expression (artemin's receptor) was increased in dog OA sensory neurons, compared to controls. Despite our compelling data, no studies have elucidated the role of artemin/GFRα3 signaling in the development and maintenance of OA pain. Our current work employs cellular and molecular approaches to identify (i) the source of artemin's release in the periphery, (ii) changes in sensory neuron colocalization of GFRα3 and downstream "pain channels," such as transient receptor potential (TRP) ion channels, and (iii) the functional role of artemin/GFRα3 signaling in OA pain. We hypothesize that artemin released from OA joint tissues results in functional upregulation and de novo expression of GFRα3 in sensory nerves, producing pain via TRP channel upregulation. Tissues from humans with naturally occurring OA and the monoiodoacetate mouse model of OA pain show that synoviocytes express artemin. Further, in the monoiodoacetate mouse model of OA pain, systemic anti-artemin monoclonal antibody reversed OA-associated hypersensitivity and lameness. This is the first evidence investigating the functional role of artemin/GFRα3 signaling in OA pain and limb use. Our ongoing work explores which other peripheral joint tissues (subchondral bone and cartilage) release artemin and changes in GFRα3 and TRP channel expression in sensory neurons serving OA joints. Our work will elucidate the role of artemin/GFRα3/TRP signaling in OA pain and define putative targets for developing safe and effective treatments.

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Poster Number: 136

Inhalable exosomes outperform liposomes as mRNA and protein drug carriers to the lung

Respiratory diseases are among the leading causes of morbidity and mortality worldwide, coupled with the ongoing coronavirus disease 2019 (COVID-19) pandemic. mRNA lipid nanoparticle (LNP) vaccines have been developed, but their intramuscular delivery limits pulmonary bioavailability. Inhalation of nanoparticle therapeutics offers localized drug delivery that minimizes off targeted adverse effects and has greater patient compliance. However, LNP platforms require extensive reformulation for inhaled delivery. Lung-derived extracellular vesicles (Lung-Exo) offer a biological nanoparticle alternative that is naturally optimized for mRNA translation and delivery to pulmonary cells. We compared the biodistribution of nebulized Lung-Exo against commercially standard biological extracellular vesicles (HEK-Exo) and LNPs (Lipo), where Lung-Exo exhibited superior mRNA and protein cargo distribution to the bronchioles and parenchyma. Lung-Exo were then reformulated for dry powder inhalation (DPI), to provide a room-temperature-stable therapeutic. Lung-Exo maintained its integrity and efficacy through DPI in the lungs of rodents and nonhuman primates. In a therapeutic application, severe acute respiratory coronavirus 2 (SARS-CoV-2) spike (S) protein encoding mRNA loaded Lung-Exo (S-Exo) elicited greater immunoglobulin G (IgG) and secretory immunoglobulin A (SIgA) responses than its spike protein loaded liposome (S-Lipo) counterpart. Importantly, S protein encoding mRNA remained functional at room temperature storage for one month. Our results suggest that Lung-Exo can serve as an mRNA drug delivery system that is naturally optimized for respiratory diseases. Lung-Exo effectively and efficiently deliver functional therapeutics that are formulated for inhaled drug delivery and vaccination.

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Poster Number: 180

Unraveling Complex Pathogen Interactions: Translational Approaches for Studying Escherichia coli and Enterococcus faecalis Polymicrobial Infections

Extraintestinal pathogens E. coli (ExPEC) and Enterococcus faecalis (EF) frequently escape the intestinal niche and colonize extraintestinal tissues. Co-infections of these two pathogens result in debilitating polymicrobial urinary tract and bloodstream infections in people and animals. Factors contributing to disease occurrence, severity, and resolution include bacterial genetics, synergistic interactions between ExPEC and EF, and the host response. Unraveling the drivers of ExPEC/EF polymicrobial infection requires a multifaceted approach. By chelating iron, an essential nutrient for ExPEC, an in vitro co-culture assay was developed to mimic the iron limitation in the extraintestinal environment. This model allowed us to screen a genetically-diverse ExPEC collection and identify strains that could overcome low iron in response to diffusible EF signals. Then, an in silico comparative genomics approach implicated iron scavenging siderophores, protective polysaccharide capsule, and conjugative sex pili as potential drivers of ExPEC growth induction by EF. The co-culture model was expanded to include RNA-sequencing and capsule quantitation, which demonstrated some of these features are overexpressed or overproduced by ExPEC in response to EF. Finally, an in vivo embryo infection model quantified the virulence of ExPEC and EF co-infections. ExPEC strains that were unresponsive to EF signals in vitro were attenuated during co-infection in vivo. Thus, our translational approach revealed a complex induction mechanism requiring several coordinated steps in ExPEC as they respond to EF. This interaction requires further characterization using a variety of methods so that therapeutic approaches to disrupt it can be employed to treat ExPEC/EF polymicrobial infections.

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Poster Number: 191

Detection of Cytauxzoon Felis in the Salivary Glands of Amblyomma Americanum

Cytauxzoon felis is a tick-borne hemoparasite that causes life-threatening disease in cats. Despite the critical role that ticks play in disease transmission and development, our knowledge regarding the C. felis life cycle remains limited to the feline hosts and no stage of the parasite has been identified or investigated in ticks. Sporozoites is the infectious stage that are transmitted by ticks. This life stage has been a key element in establishing in vitro culture, developing vaccines, and discovering therapeutic targets for other closely related tick-borne hemoparasites. To aid us in pursuing similar avenues in C. felis research, the objective of this study is to evaluate different molecular and microscopic techniques to detect C. felis sporozoites in tick salivary glands (SG). A total of 140 Amblyomma americanum ticks that were fed on C. felis-infected cats as nymphs were evaluated for this study. Dissected SGs were quartered and subjected to C. felis RT-PCR, direct azure staining, histology and RNAscope® in situ hybridization (ISH), and transmission electron microscopy (TEM). C. felis RT-PCR was also performed on respective half tick carcasses. C. felis RNA was detected in 26 ticks via either RT-PCR or ISH. In ISH-positive tick SGs, hybridization signals were easily visualized in portions of rare acini. Direct visualization via light or electron microscopy did not reveal distinctive features that could be associated with C. felis infection in tick SG. These results suggested that molecular techniques such as RT-PCR and ISH are more reliable techniques to definitively detect the parasites in ticks when compared to direct microscopic visualization. This study has laid the foundation for us to utilize sporozoites in C. felis research and these forthcoming studies should employ these molecular techniques for parasite detection in ticks.

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