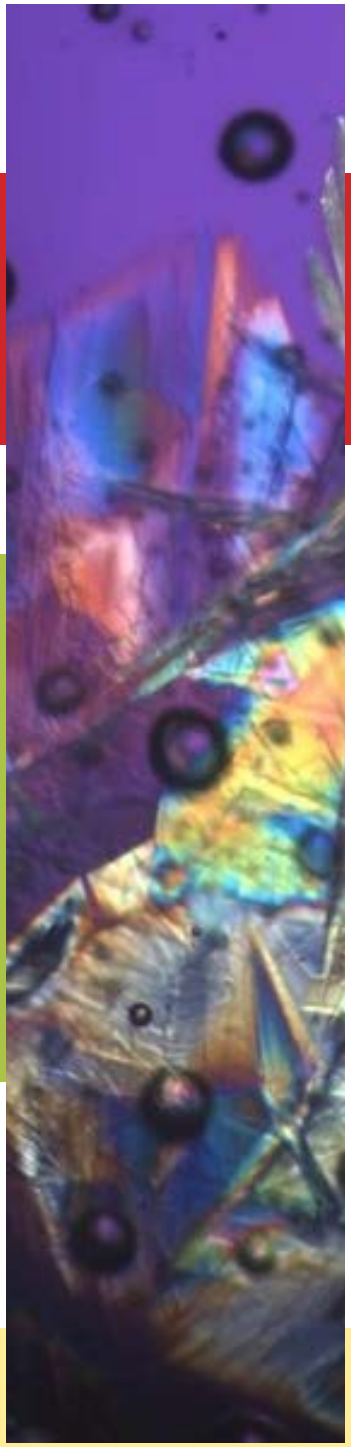
16th Annual

Graduate Student Research Symposium

ABSTRACTS

Wednesday April 5th, 2023 | McKimmon Center

Sixteenth Annual
Graduate Student Research Symposium
North Carolina State University

SYMPOSIUM ORGANIZERS

Graduate School

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

Graduate Student Association

Echo Pan, Functional Genomics (Symposium Lead Organizer for GSA)
Madi Arabi, Industrial Engineering
Alexander Betz, Mathematics
Benjamin Fischer, Physiology
Amiya Haque, Electrical & Computer Engineering
Julia Janson, Crop and Soil Science
Ty Johnson, Chemical & Biomolecular Engineering
Emily Koester, Higher Education Administration
Christina Marlow, Psychology
Nathan Oldja, Master of Accounting
Jorden Rabasco, Bioinformatics
Rob Suppa, Horticultural Science
Clara Tang, Microbiology
Phoenix Tiller, Forest Biomaterials
Shannon Wells, Masters of International Studies

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 Dr. Peter Harries, Dean of the Graduate School Mr. Deveshwar Hariharan, GSA President Dr. David Shafer, Assistant Dean of the Graduate School	Area 1
1:30 pm - 4:00 pm	Poster Session and Competition	Area 1
4:15 pm - 5:30 pm	Announcements of Awards and Reception Poster Presentation Winners Outstanding Graduate Faculty Mentor Awards Dr. Peter Harries, Dean of the Graduate School Mr. Deveshwar Hariharan, GSA President Dr. David Shafer, Assistant Dean of the Graduate School	Room 2

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Wilson College of Textiles

NC STATE UNIVERSITY

16th Annual Graduate Student Research Symposium

ABSTRACTS

College of Agriculture & Life Sciences

Mashael R. Aljumaah[1,2,3], Urja Bhatia[4,5], Jeffery Roach[2], John Gunstad[4,5], M. Andrea Azcarate-Peril[1]

Graduate Programs: Plant and Microbial Biology[1]; UNC Microbiome Core, Center for Gastrointestinal Biology and Disease (CGIBD), Department of Medicine, Division of Gastroenterology and Hepatology, School of Medicine, University of North Carolina at Chapel Hill2; Department of Botany and Microbiology, College of Science, King Saud University[3]; Department of Psychological Sciences, Kent State University[4]; Brain Health Research Institute Kent State University[5]

Advisor: M. Andrea Azcarate-Peril

Poster Number: 6

The Gut Microbiome, Mild Cognitive Impairment, and Probiotics: a Randomized Clinical Trial in Middle-Aged and Older Adults

Background: Advancing age coincides with changes in the gut microbiome and a decline in cognitive ability. Psychobiotics are microbiota-targeted interventions that can result in mental health benefits and protect the aging brain. This study investigated the gut microbiome composition and predicted microbial functional pathways of middle-aged and older adults that met criteria for mild cognitive impairment (MCI), compared to neurologically healthy individuals, and investigated the impact of probiotic Lactobacillus rhamnosus GG (LGG) in a double-blind, placebo-controlled, randomized clinical trial. A total of 169 community-dwelling middle-aged (52-59 years) and older adults (60-75 years) received a three-month intervention and were randomized to probiotic and placebo groups. Participants were further subdivided based on cognitive status into groups with intact or impaired cognition and samples were collected at baseline and post supplementation.

Results: Microbiome analysis identified Prevotella ruminicola, Bacteroidesthetaiotaomicron, and Bacteroidesxylanisolvens as taxa correlated with MCI. Differential abundance analysis at baseline identified Prevotella as significantly more prevalent in MCI subjects compared to cognitively intact subjects (ALDEx2 P= 0.0017, ANCOM-BC P= 0.0004). A decrease in the relative abundance of the genus Prevotella and Dehalobacterium in response to LGG supplementation in the MCI group was correlated with an improved cognitive score.

Conclusions: Our study points to specific members of the gut microbiota correlated with cognitive performance in middle-aged and older adults. Should findings be replicated, these taxa could be used as key early indicators of MCI and manipulated by probiotics, prebiotics, and symbiotics to promote successful cognitive aging.

Johnny F. Balidion

Graduate Program: Plant Pathology

Advisor: Marc A. Cubeta

Poster Number: 15

Deciphering the role of water deficit to host vulnerability and pathogen behaivior: the case of Lasiodiplodia theobromae in Cacao

Theobroma cacao has slowly adapted to deal with numerous biotic and abiotic stresses across the different growing regions in the equatorial belt. However, this delicate adaptive balance is threatened due to shifts in global climate patterns related to temperature increases and extreme fluctuations in moisture patterns that favor the incidence of plant diseases. Severe water deficit periods pose serious consequences in cacao diseases caused by the endophytic fungus Lasiodiplodia theobromae during the warm dry season in the Philippines. To evaluate the effect of plant water availability on L. theobromae in cacao, factorial experiments were conducted to examine the influence of plant available water in cacao inoculated with three isolates of L. theobromae. Inoculated plants subjected to water stress had increased disease development resulting to 45% severity related to 57% fungal colonization of the stem. In contrast, inoculated plants at optimum water levels resulted in significantly lower disease severity of 9% associated with 18% fungal colonization of the stem. Despite recovery to optimum water levels, wilting and lower stomatal conductance in inoculated plants previously subjected to water stress remained irreversible in contrast to non-inoculated plants exposed to water stress. Dieback disease incidence was observed at 90% as early as 14-21 days after inoculation (DAI) in water-stressed plants while well-watered plants remained asymptomatic beyond 45 DAI. Microscopic examination of diseased stems showed necrosis of xylem vessels associated with direct fungal colonization and brown discoloration around the xylem vessels ahead of fungal colonization which can be a consequence of the action of plant defense metabolites. Our results demonstrate that water deficit is a major driver of the transition from the endophytic to pathogenic activity of L. theobromae in cacao and reemphasizes the need to evaluate the performance of cacao genotypes to the imposed biotic and abiotic stresses.

Colton D. Blankenship[1], Katherine M. Jennings[1], David W. Monks[1], Stephen L. Meyers[2], David L. Jordan[3], Jonathan R. Schultheis[1], David H. Suchoff[3], Levi D. Moore[4]

Graduate Programs: Horticultural Science[1]; Horticulture and Landscape Architecture, Purdue University[2]; Crop and Soil Sciences[3]; Southeast Ag Research, Inc.[4]

Advisor: Katherine M. Jennings

Poster Number: 19

Effect of S-metolachlor and Flumioxazin Herbicides on Sweetpotato Treated with and without Activated Charcoal Applied through Transplant Water

Flumioxazin and S-metolachlor are widely used on conventional sweetpotato hectarage in North Carolina; however, some growers have recently expressed concerns about potential effects of these herbicides on sweetpotato yield and quality. Previous research indicates that activated charcoal can improve crop safety and reduce herbicide injury in some conditions. Field studies were conducted in 2021 and 2022 to determine whether flumioxazin applied pre-planting and S-metolachlor applied before and after transplanting negatively affect sweetpotato yield and quality when activated charcoal is applied with transplant water. The studies consisted of five herbicide treatments by two activated charcoal treatments. Herbicide treatments included two rates of flumioxazin, one rate of S-metolachlor applied immediately before and immediately after transplanting, and no herbicide. Charcoal treatments consisted of activated charcoal applied at 9 kg ha-1 and no charcoal. No visual injury was observed. There was no effect of herbicide or charcoal treatment on No. 1, marketable (sum of No. 1 and jumbo grades), or total yield (sum of canner, No. 1, and jumbo grades). Additionally, shape analysis conducted on calculated lengthto-width ratio (LWR) for No. 1 sweetpotato roots found no effect from flumioxazin at either rate on sweetpotato root shape. However, both S-metolachlor treatments resulted in lower LWR of No. 1 sweetpotato roots in 2021. Results are consistent with those of prior research and indicate that flumioxazin and S-metolachlor are safe for continued use in sweetpotato at registered rates.

Grant T. Billings[1], Daniel Restrepo-Montoya[2], Ramey C. Youngblood[3], B. Todd Campbell[4], Candace H. Haigler[2], Brian E. Scheffler[5], Jodi A. Scheffler[5], Amanda M. Hulse-Kemp[1,2,6].

Graduate Programs: Bioinformatics[1]; Crop Science[2]; Institute for Genomics, Biocomputing, & Biotechnology, Mississippi State University[3]; USDA-ARS, Florence, SC[4]; USDA-ARS, Stoneville, MS[5]; USDA-ARS, Raleigh, NC[6]

Advisors: Amanda M. Hulse-Kemp, Jeffrey C. Dunne

Poster Number: 18

High Coverage Whole-Genome Sequencing and Field Evaluation of Historical Cotton Cultivars

Allotetraploid cotton (Gossypium spp.) has had an interesting genetic past. The two primary species cultivated today were domesticated around seven thousand years ago and have undergone additional intensive selection for improved traits over the past two centuries. Due to a small number of plant introductions to regions under cotton cultivation, genetic diversity in the cultivated gene pool is limited. How has genetic diversity changed over the past 100 years of breeding, and what implications do these changes have for cotton productivity? To answer this question, we re-sequenced 173 cotton cultivars to 30X coverage and collected fiber quality, yield, and seed composition data from large field trials at 3 locations in 2020. Single nucleotide polymorphisms and small insertions and deletions were identified in this dataset, and a simple method was used to identify read-mapping abnormalities suggestive of larger structural variants for further characterization using long-read technology. Spatial corrections were used to adjust the field trial data for potential soil variability, and the adjusted phenotype values were used for a genome-wide association study. Additionally, we ran an economic analysis to understand how selective breeding has made cotton an increasingly lucrative crop for growers, and to determine which genomic loci are most strongly associated with these changes. Overall, our findings contribute to the understanding of genetic diversity and the impacts of breeding on the cultivated cotton gene pool. The data and results presented here will serve as an important foundational resource in planning how to track alleles in breeding programs as breeders begin to implement genomics technologies for decision-making.

Timothy E. Boston[1], Feng Wang[1], Lin Xi[1], Sung Woo Kim[1], Vivek Fellner[1], Mark F. Scott[3], Amanda L. Ziegler[2], Laurianne Van Landeghem[2], Anthony T. Blikslager[2], Jack Odle[1]

Graduate Programs: Animal Science[1]; College of Veterinary Medicine[2]; Milk Specialties Global[3]

Advisor: Jack Odle

Poster Number: 22

Effects of prebiotic galactooligosaccharide (GOS) on piglet growth and jejunal morphology during the peri-weaning period

In this study, GOS-enriched whey permeate (Milk Specialties Global, Eden Prairie MN) was supplemented to piglets in lactation and nursery phases. To maximize pre-weaning GOS intake, novel gruel creep feeders were utilized. Using a 3x2 factorial design, piglets from 24 litters received either no creep feed (NC), creep without GOS (CG-) or creep with 5% GOS (CG+) followed by a phase 1 nursery diet without (NG-) or with 3.8% GOS (NG+). After one week, pigs were fed common phase 2 and phase 3 diets. At D22 (pre-weaning) and D31 (post-weaning), 6 pigs per treatment were euthanized for intestinal measurements. Pre-weaning, creep fed pigs grew 19% faster than controls ($P < 0.01$) but GOS effects were not detected ($P > 0.1$). In contrast, pigs fed GOS in phase 1 grew 34 % faster than controls ($P < 0.04$), irrespective of creep treatment (interaction $P > 0.1$), and with corresponding greater intakes ($P < 0.06$). These GOS effects were sustained for overall nursery performance. Furthermore, overall ADG of CG+ piglets in the nursery tended to be highest ($P = 0.09$), gaining 361g/d, followed by NC (324 g/d) and CG- (310 g/d) treatments (Table 1). No effects on jejunal morphology were detected at D22, although there was an effect of age with decreased villi length, villus area, villi:crypt ratio and increased crypt depth at D31 ($P < 0.01$). Supplementation of GOS in phase 1 increased villus length (36%) and area (51%) but only in pigs previously fed the control creep (CG-) diet (interaction, $P < 0.01$). We conclude that gruel creep feeding increases weight gain regardless of GOS treatment and that nursery growth and intestinal morphology are improved by post-weaning GOS supplementation.

Qirui Cui, Mingzhuo Li, Tzung-Fu Hsieh

Graduate Program: Plant Biology

Advisor: Tzung-Fu Hsieh

Poster Number: 38

The CXXC domain of DEMETER Is Important for Its Demethylation Function in vivo

The Arabidopsis DEMETER (DME) is a plant DNA glycosylase that demethylates the maternal genome in the central cell and is essential for seed viability. DME specifically demethylates around ten thousand target sites, which contains gene flanking small TEs in euchromatic regions, intergenic sequences, and heterochromatic targets. The C-terminal half of DME, which consists of three conserved regions (Region A, G, B), has been shown to retain both catalytic glycosylase activity as well as targeting function. The region B of DME contains a CXXC domain and is critical for DME function in vitro and in vivo. Our results show that while DME with an impaired CXXC domain has a mild effect on the 5mC excision enzymatic activity in vitro, the CXXC domain is required for a robust and consistent DME function in vivo. Whole genome methylome analysis of dme mutant endosperm complemented with a CXXC-mutated DME transgene revealed that the canonical DME target sites are largely demethylated, indicating that the CXXC domain is needed to ensure efficient demethylation but is dispensable for DME localization to its target sites.

Magdalina J Cummings[1], Sudikshya Paudel[1], River Price[1], Steven L. Young[2], Xiaoqiu Wang[1]

Graduate Programs: Animal Science[1]; Department of Obstetrics and Gynecology, School of Medicine, Duke University[2]

Advisor: Xiaoqiu Wang

Poster Number: 39

Uterine ablation of Tet Methylcytosine Dioxygenase 2 (Tet2) impairs endometrial decidualization and placentation

Age-related alteration in the methylation state of DNA in endometrial tissue during the window of receptivity (WOR) and decidualization is hypothesized as a cause of adverse pregnancy outcomes. The ten-eleven translocation (Tet) family of enzymes are responsible for the oxidizing reaction cascade that ultimately demethylates DNA and one Tet gene, Tet2, is downregulated in many forms of cancer, including endometrial cancer, as well as aged endometrial tissue. Thus, we hypothesize that Tet2 is critical for gene expression during pregnancy and that uterine ablation of Tet2 will compromise these processes similarly to the phenotype seen in aged females. Tet2 alteration was done via qRT-PCR, validating that Tet2 mRNAs were decreased in both the aged deciduoma and the WOR. To investigate the functional role of TET2 in the uterus, mice carrying the Tet2f/fallele were bred to Pgrcre/+ mice to generate Pgrcre/+Tet2f/f (Tet2d/d) mice, which were validated via genotyping. The 6-month breeding trial indicated a significant reduction ($P<0.0001$) in total pups born, total pups per litter, and number of litters to Tet2d/d mothers (n=6) as compared to Tet2f/f mothers (n=4). Interestingly, these Tet2d/d mothers showed a decrease ($P<0.01$) in litter size from their 1st pregnancy to their last. The number of implantation sites at GD 9.5 was not affected by Tet2 deletion; however, these Tet2d/d females exhibited a decrease ($P<0.001$) in the decidual bulb weight as well as a decrease in the size of the labyrinth and junctional zone at GD 9.5. In addition, the ability of the endometrial stromal cells to undergo an artificially induced decidualization was severely compromised ($P<0.01$) in Tet2d/d uteri. These novel results suggest that Tet2 deficiency impairs endometrial stromal cell decidualization, leading to defective placentation and pregnancy loss. Future studies will investigate the relationship between Tet2 and aging, as well as the underlying molecular mechanisms.

Sally Dixon

Graduate Program: Agriculture and Extension Education

Advisor: Travis Park

Poster Number: 45

Historical Context and Current Issues with Extension Programs in Native American Communities

This study is the result of over four years of work within the Federally-Recognized Tribes Extension Program, also known as FRTEP. This USDA-funded program provides 38 out of 574 tribes with extension agents to implement programs in agricultural development, nutrition, and youth development that are culturally-relevant. Extension programs are not new to land-grant institutions. They have been involved with such work since the Smith-Level Act of 1914 allotted federal funds to extension programs. Despite the tenure of traditional extension programs, tribal extension programs have a more recent origination. Historical research methods produced federal legislation, transcripts of Congressional hearings, policy briefs, and personal interviews coded to isolate themes in the concurrent timelines of 1862 land-grant universities and their extension programs, and the struggles of Indigenous communities to thrive on their homelands with locally-available foods. This study discusses the context of land-grant universities and extension programs with Native American communities. Federal legislation that instituted agricultural development programs is compared with legislation that removed Indigenous communities from their culture and traditional homelands. A history of tribal extension initiatives is discussed including implications and current issues due to underfunding and equity considerations.

Peter Ephraim

Graduate Program: Food Science

Advisor: Jonathan Allen

Poster Number: 50

Formulation and Nutritional Composition of Dehydrated Sweetpotato Product Fortified with Protein Ingredients

The prevalence of malnourished children in Sub-Saharan Africa is high. Approximately 15 million children in Sub-Saharan Africa (SSA) are a□ected by severe acute malnutrition (SAM). Ready-to-use therapeutic foods (RUTF) are distributed in the region to help treat malnutrition. While RUTFs are nutritionally dense and an ideal product for treating malnutrition, they are inadequate due to the high cost and unreliable supply. Alternative energy, nutritionally dense, and viable products for local production are needed to best treat malnutrition problems. However, widespread aflatoxin contamination in SSA reduces options for potential crop inclusions. Therefore, this study aims to formulate and evaluate the nutritional composition of a dehydrated sweet potato-based product, fortified with sweetpotato leaf and edible insect powders as protein, vitamins, and mineral sources. Sweet potato flour will serve as a base to ensure smooth processing and high nutritional quality. Sweet potatoes can be grown in SSA, allowing for the production locally of an accepted and familiar crop. Aflatoxin contamination of sweet potatoes is of much less concern than with the current bases used for commercial RUTFs, such as corn or peanuts. Proximate composition, vitamins, and mineral analyses of the ingredients; sweetpotato flour, sweetpotato leaf and edible insect powders will be carried out. The nutritional composition of the formulated product will be customized to match the World Food Programmes's (WFP) requirements. We hypothesize that incorporating insect and sweetpotato leaf powders will increase the system's protein, fats, vitamin, and mineral density for more complete nutrition.

Zachary Everson, Sophia Copeman, Sujan Dawadi, Steve Frank

Graduate Program: Entomology

Advisor: Steve Frank

Poster Number: 52

Mealybug Management on Greenhouse Ornamentals

Citrus mealybug (Planococcus citri) is a greenhouse and nursery pest that was introduced to the United States in the late 1800s. Previous research has shown that most systemic and many contact insecticides have very little efficacy on these pests; our own greenhouse trials showed no significant difference between controls and treated plants. In addition, increasing the concentration of these insecticides for higher efficacy can be harmful to natural enemies, pollinators, and other beneficial insects. To combat these issues, we evaluated the efficacy of multiple biological and traditional insecticides with single-leaf lab assays, both alone and in combination. Afterwards, we compared the most effective combinations to insect natural enemies on whole plants in a greenhouse. The hypothesis we tested was that certain combinations of insecticides and biological control agents will decrease damage from citrus mealybugs more than when used individually. I plan to use this information to reveal commercially viable strategies that growers can use to control mealybugs while minimizing pesticide use.

Jillian C. Ford, Misty D. Lambert

Graduate Program: Agricultural and Extension Education

Advisor: Misty D. Lambert

Poster Number: 53

Exploring SAE for All Implementation in North Carolina

Supervised Agricultural Experience (SAE) is the work-based learning aspect of the three-component model of School-Based Agricultural Education (SBAE) along with classroom instruction and leadership development. The SAE for All model was introduced by the National Council for Agricultural Education as an innovative method of implementing SAE instruction and better serving all students. States have varied on whether and how they have pushed forward the new model for teachers. In North Carolina, the model was rolled out through statewide professional development in 2019 after being integrated into the curriculum. We sought to understand how teachers in NC were implementing the SAE for All model. This phenomenology utilized qualitative interviews with thirteen purposively selected SBAE teachers with various educational backgrounds, single and multi-teacher programs, years of experience, and across those who taught in middle and high schools in urban, rural and suburban communities. Over five hours of data were collected, transcribed, and coded by the researchers. Three themes were constructed. Theme one, what is working, recognized that pieces of the model were quickly adopted, adapted, or implemented, career exploration and employability skills components were valued, and participants were eager to learn more about fully implementing the model. Theme two, what is not working, highlighted the impact of COVID, misconceptions about the model, lack of alignment among multi-teacher programs and award requirements. Theme three, a needed shift in SAE philosophy, showcased lack of buy-in from veteran teachers, the perception that the model is not ag enough, exposure to resources through curriculum, the belief that the new components created a hurdle, the needed desire to try something new, and that teachers must believe it is possible to implement. It is recommended that the various stakeholder groups work to influence implementation through professional development and additional resources and requirements.

Katlyn Foy, Wendy J. Warner, Barbara M. Kirby

Graduate Program: Agricultural and Extension Education

Advisor: Wendy J. Warner

Poster Number: 55

H.O. Sargent: A Founding Father of the NFA

H.O. Sargent played an essential role in improving vocational agriculture and education for African American students in the United States. Through his continuous efforts and role as the regional supervisor of Negro schools in the South, H.O. Sargent along with G.W. Owens was able to establish the New Farmers of America organization. The New Farmers of America encouraged and guided African American boys to choose a career in agriculture and to become established in an occupation that many African Americans were not a part of during that time. The New Farmers of America organization also aided students in learning skills and knowledge in leadership, citizenship, cooperation, and scholarship (Alston, 2021). Over time, the New Farmers of America quickly gained popularity, and groups were established in North Carolina, South Carolina, New Jersey, Alabama, and many other states throughout the south (Moore, 2019c). Due to the efforts of H.O. Sargent and G.W. Owens, the national New Farmers of America organization was officially named and established in 1935 at Tuskegee Institute in Alabama (Moore, 2019c). The establishment of the NFA increased the demand for agricultural and extension education in school systems throughout the south. The NFA also developed concepts that can still be found and implemented in both formal and non-formal educational settings today.

Megan Franklin, Delecia Utley, Melodi Charles, Bri Edwards, Asa Budnick, Lisa David, Manuel Kleiner, Heike Sederoff

Graduate Program: Plant Biology

Advisor: Heike Sederoff

Poster Number: 56

Circular RNAs: Discovering their Role in Plant-Microbe Interactions

To move away from heavy pesticide and fertilizer use and transition to more sustainable agriculture, the application of microbes to improve crop resilience is being explored. Beneficial plant-microbe interactions play key roles in plant growth, from nutrient acquisition to pathogen defense. However, the regulatory mechanisms behind plant-microbe relationships are not fully understood. RNA signals, such as noncoding small RNAs, have been shown to be involved in the regulation of plant microbiomes. Another type of noncoding RNA, Circular RNAs (circRNAs), have gained attention for their emerging regulatory roles in gene expression in all organisms. These single stranded, covalently closed RNA molecules have diverse functions at the transcriptional and translational levels, including miRNA sponging and the sequestering of RNA binding proteins. Though less is known in plants, circRNA research done in mammalian systems shows functional significance of circRNA in human diseases and cancer. Like mRNAs, circRNA expression is responsive to changes in environmental conditions, including plant-microbe interactions. From this we hypothesize that circRNAs play a role in the plant's regulation of its microbiome in concert with other coding (mRNA) and non-coding RNAs. We are currently identifying and characterizing circRNAs in the legume Lotus japonicas in response to the presence of key individual microbes found to be in Lotus root microbiomes. Despite a growing abundance of circRNA discovery in plants, it is quite challenging to identify true circRNAs and characterize their function. These challenges can be attributed to 1) low abundance and 2) having only a small region of sequence around the Back Splice Junction (BSJ) which differentiates circRNA from their corresponding linear RNAs. To address these challenges, we have performed short read and long read RNA sequencing to identify conserved and inducible circRNAs for further functional analysis.This work was supported by the Novo Nordisk Foundation grant no. NNF19SA0059362.

Cassandra Gluck[1], Vivek Fellner[1], Sarah McLeod[1], Sue Stuska[2], Shannon Pratt-Phillips[1]

Graduate Program: Animal Science[1]; Cape Lookout National Seashore[2]

Advisor: Shannon Pratt-Phillips

Poster Number: 62

The use of an in-vitro model of the equine microbiome is beneficial to assess how fermentation differs based on a horse population's habitual diet

The purpose of this study was to determine the fermentation patterns of the microbial community within different populations following a starch challenge. Fecal samples were taken from three populations: horses from the Shackleford Banks, a feral population living on native grasses; horses from the NCSU Equine Educational Unit that are kept on cool season mixed pastures; and privately owned horses that were fed diets consisting of pasture, hay and concentrates. Horses were monitored and fecal samples were collected immediately following a void then stored on dry ice and frozen until analysis. Fecal samples were pooled to form a representative sample for each population and mixed with an anaerobic medium to prepare an inoculum then placed into bottles containing a treatment of alfalfa (A) or alfalfa and starch (AS). Bottles were capped, purged with CO2 and then incubated for 0, 2, 4 or 24 hours. Samples were processed to measure methane and short chain fatty acids using gas chromatography. The Proc Mixed procedure in SAS was used to compare the effects of population, time and treatment. Methane was significantly higher after 24 hours within all populations with AS as the inoculum compared to A (P=0.03). Propionate was higher for AS (molar percentage, mean ± standard deviation; 12.21±4.97%) versus the A treatment (11.95±4.97%, P=0.02). Acetate concentrations were significantly (P<0.001) higher within the A treatment in the Shackleford and NCSU horses (60.31±10.3% and 62.18±11.47%, respectively) when compared to AS (59.09±11.21% and 59.77±8.85%, respectively). Privately owned horses showed similar acetate concentrations when comparing the A treatment (63.42±10.13%) versus AS (63.55±10.77%). Based on the results, it appears that starch fermentation differs between these horse populations, likely due to their habitual diet.

Christopher C. Hayes, Coby Schal

Graduate Program: Entomology

Advisor: Coby Schal

Poster Number: 68

Behavioral interactions of bed bugs with long-lasting pyrethroid-treated bed nets: challenges for vector control

Widespread vector control has been essential in reducing the global incidence and prevalence of malaria, despite now stalled progress. Long lasting insecticide-treated nets (LLINs) have historically been, and remain, one of the most commonly used vector control tools in the campaign against malaria. LLINs are effective only with proper use, adherence, retention and community adoption, which historically have relied on the successful control of secondary pests, including bed bugs. The emergence of pyrethroid resistant bed bugs in malaria endemic communities and failure to control infestations have been suggested to interfere with the effective use of LLINs. Therefore, the behavioral interactions of bed bugs with commonly used bed nets should be better understood. To investigate the interactions between bed bugs (Cimex lectularius L.) and LLINs, insecticide-susceptible and pyrethroid-resistant bed bugs were challenged to pass through two commonly used LLINs in two behavioral assays. We found a significant impact of deltamethrin-treated nets on blood-meal- and aggregation-seeking behaviors of susceptible bed bugs, and no impact of treated nets on resistant bed bugs. Commonly used new LLINs failed to prevent the passage of susceptible and pyrethroid-resistant bed bugs in host-seeking and aggregation-seeking bioassays. Mortality was only seen in the susceptible bed bugs, with significantly higher mortality on deltamethrin-treated nets (63.5 ± 10.7%) than on permethrin-treated nets (2.0 ± 0.9%). Commonly used new LLINs failed to prevent the passage of susceptible and pyrethroid-resistant bed bugs in host-seeking and aggregation-seeking bioassays. The overall low and variable mortality observed in susceptible bed bugs during both assays highlighted the potential of LLINs to impose strong selection pressure for the evolution of pyrethroid resistance. For the first time, we have shown the potential of LLINs in selecting for resistant secondary pest populations and so their potential role in stalling malaria control programs should be further investigated.

Andrew P. Hutchens

Graduate Program: Economics

Advisors: Harrison Fell, Eric Edwards

Poster Number: 76

Electric Vehicles and Where to Charge Them: Analyzing Market and Utility Characteristics' Effect on Gas Stations' Vehicle Charging Market Entry

Electric vehicles (EVs) have been at the forefront of efforts to reduce emissions in the U.S. transportation sector. However, EV demand is tempered by consumers' range anxiety and non-utility firms face regulatory barriers to selling electricity at EV chargers. Recent state and national policies have not assuaged the latter but have still accelerated the transition to a predominantly electrified vehicle market. This reenergized rise in EV diffusion coupled with their reliance on charging infrastructure fuels decreased refueling demand and increased recharging demand. This paper examines the implications of these changes and the electricity sector's regulatory barriers for retail gas stations, which have historically been the dominant force in the refueling market. Gas stations essentially face a market entry or adaptation choice: enter the recharging market (by installing EV chargers) or not. Adaptation incentives and benefits vary across stations due to station, market, and utility factors. To shed light on the importance of these factors for stations' adaptation decision, I estimate discrete-time survival models to analyze the effects of market variables (e.g., number of public chargers) and utility demand charges (the largest charger installation barrier) on stations' probability of adaptation. I then construct a structural model of station recharging market entry with endogenous charging network choice to recover the key parameters of stations' profit functions and analyze counterfactual charging and utility rate structure scenarios. Preliminary results show that a market's number of public chargers and a station's electricity demand charge are the most salient factors for their adaptation decision.

Lydia Jordache[1], Ray Dawood, Michael Hyman[1], Christy Smith[1], Doug Call[1,2]

Graduate Programs: Microbiology[1]; Civil, Construction, and Environmental Engineering [2]

Advisor: Doug Call

Poster Number: 83

Diazotrophic Methanotroph-Containing Mixed Communities for Improvement of Methane-Consuming Bioreactors

Methane is among the most critical greenhouse gasses to global warming, and the majority is anthropogenically produced. Methane-producing industries typically flare emissions, a nonproductive and polluting approach. A sustainable alternative to handling methane are methanotrophic bioreactors. Methanotrophs are microbes that transform methane into valuable side products or biomass, the latter of which can be used for alternative soil nitrogen supplementation. The fixed nitrogen required for bioreactor maintenance (as well as traditional chemical fertilizers) is sourced from the Haber-Bosch process, a chemical reaction accounting for around 1.4% of global CO emissions and consumes 1% of global energy production alone (Capdevila-Cortada, 2019). Interestingly, some methanotrophs can also fix nitrogen, eliminating reliance on the Haber-Bosch process for bioreactor maintenance while removing methane. Critically, nitrogen-fixing organisms (diazotrophs) are highly oxygen sensitive, despite oxygen's association with denser and more rapid microbial growth. To resolve this puzzle, we hypothesize that growing diazotrophic methanotrophs in a mixed microbial community, rather than pure culture, can allow for growth and nitrogen fixation at oxygen levels higher than are typically studied for diazotrophs while maintaining methane oxidation activity. To test this, we evaluated growth, gas consumption, fixed nitrogen accumulation, and microbial community composition of fed-batch bioreactors at low (5%) and high (15%) oxygen concentrations. Cultures at high oxygen levels were found to grow more densely than at low oxygen and accumulate fixed nitrogen despite oxygen concentrations exceeding that which are typically toxic to pure diazotroph cultures. Sequence analysis suggests differential importance between type I and II methanotrophs in these communities among other observations.

Christopher Gillespie

Graduate Program: Plant Pathology

Advisors: Dr.Shuijin Hu, Alex Woodley

Poster Number: 61

The Variable Implications of Reactive N as an Agronomic Resource in Alternative Agroecosystems

Conventional agriculture is characterized by high inputs of synthetic nitrogen (N) fertilizers. These applications augment crop yields, but fail to maximize the potential of soil organic matter to supply crop N. Soils under long-term conventional agriculture are often carbon (C)- and nutrient-depleted. Since N is the most limiting nutrient in agroecosystems, high applications of N fertilizers are required to sustain crop productivity. Since the start of the 20th century, humans have doubled the inputs of reactive N to the environment, which as the climate crisis worsens, poses serious threat to human health and the environment. Our research takes advantage of long-term farming systems at Center of Environmental Farming Systems (CEFS) that have undergone 20 years of periodical measurements for soil and microbial properties, as well as Southeastern U.S soils from differing agroecosystems, to answer one big question: how do alternative agricultural practices (i.e., management, inputs, etc.) affect plant nitrogen-use-efficiency and transformation of N by microbes? Animal and crop production account for ~70% of all human nitrous oxide (N2O) emissions. Our research findings provide evidence that agroecosystems that utilize reactive N directly contribute to the climate crisis by increasing the amount of N that is transformed into N2O, a greenhouse gas with a warming potential that is 265 times greater than CO2. We utilized a myriad of biogeochemical analyses (e.g., microbial incubation, qPCR, arbuscular mycorrhizal colonization, 15N tracing, microbiome manipulation, etc.) to unearth linkages among N-transforming microbes (i.e., bacteria and archaea), soil N dynamics, and soil N2O emissions in conventional and organic farming systems. Our research seeks to provide a holistic understanding of differing agroecosystems to uncover management practices that will: 1) increase nitrogen use efficiency (NUE), 2) empower microbial communities, 3) enhance soil carbon sequestration, and 4) reduce N2O emissions.

Riley Lawson

Graduate Program: Biological and Agricultural Engineering

Advisors: Chadi Sayde, Amy Grunden

Poster Number: 94

Quantifying Enzymatic Enthalpy to Develop Fiber Optic Nutrient Biosensors for Precision Fertilizer Application

Developing a robust food supply chain while employing sustainable resource management is a necessity for the future of agriculture practices. Efficiently using micro- and macro-nutrients critical for plant growth while retaining expected yield will secure reserves and food supply for the next generations. Nitrogen is also a main source of groundwater pollution; controlling its leaching by conserving the amount used in agricultural practices will decrease its infiltration into groundwater. Our research team is developing a novel fertigation-on-demand system which will allow nitrogen-based fertilizer and water to be applied to a crop field only when and where necessary, thus decreasing the use of these resources, reducing the crop production costs, and minimizing overall environmental impact. To apply on-demand fertilizer, a feedback system providing near-real-time soil nutrient level and water content readouts from the field will be required. Our work presents the theoretical background and preliminary concept testing of novel in situ biosensors to detect and monitor soil nitrate and ammonium concentration levels at temporal and spatial resolutions fit for the application. The concept of this biosensor is based on employing the intimate contact between a biorecognition element that interacts with the analyte of interest and a transducer element that converts the biorecognition event into a measurable signal. In our case, the biorecognition element is a specific enzyme that interacts with the desired soil nutrient. In theory, the thermal signal exerted by the enzyme-nutrient chemical reaction is a function of the concentration of the nutrient of interest. Nano-Isothermal Titration Calorimetry (ITC) was employed to characterize the enthalpy change per unit of an enzyme. The enthalpy data were then analyzed in order to assess the feasibility of the sensing concept by drawing a conclusive correlation between nutrient concentration and temperature of reaction. A proof-of-concept lab-scale prototype of the biosensor was developed to test the proper combination of enzyme, reactants, and thermal transducers as well as to confirm the experimental values of reaction enthalpy. Plans to use the prototype with a soil solution, scale it up to a greenhouse application, and develop a theoretical heat transfer model for the reactions are in the development phase. Results from theoretical calculations, experimental calorimetry testing, prototype improvement, and next steps will be presented.

Kelly O'Reilly[1,2], Rachel Vann[1], Dominic Reisig[2]

Graduate Program: Crop Science[1]; Entomology and Plant Pathology[2]

Advisors: Rachel Vann, Dominic Reisig

Poster Number: 115

Can We Reduce Seed Quality Issues in North Carolina Through Mid-Season Pest Management?

Soybean producers in North Carolina have shifted to using early-maturing varieties (MGII-IV) to increase yield. This shift has coincided with more frequently encountered seed damage and purple seed stain, sometimes resulting in dockage at the elevator. Weather is a major driving factor in realized grain quality issues; however, management strategies may play a role in minimizing these issues and have yet to be investigated in North Carolina. To better understand pest management implications, field trials will be conducted over three growing seasons (2021-2023) in three environments across the state annually. The trials are conducted in a split-split plot design with three planting dates, three maturity groups, and five pesticide management strategies. Three planting dates and three maturity groups were used to create various microenvironments at each location where weather may be conducive to grain quality declines. Planting dates are late-March, mid-April, and mid-May. Maturity groups are Group III, IV, and V. Pesticide management strategies include foliar fungicide at R3, insecticide at R3, insecticide at R3 and R5, foliar fungicide and insecticide at R3 and R5, and an untreated group. Data collection includes soybean yield, seed damage, purple seed stain, protein, oil, and pest dynamics. Untreated controls are scouted at R3 and R5 for each planting date and maturity group combination to understand pest pressure. In 2021, mid-season pest management affected soybean yield consistently across environments, planting date, and maturity groups with fungicide and insecticide applied twice protecting yield compared to the untreated control.

Taynara Possebom, Igor Sulzbacher Schardong and Dominic Duane Reisig

Graduate Program: Entomology

Advisor: Dominic Duane Reisig

Poster Number: 125

Within-plant distribution of Helicoverpa zea (Boddie) (Lepidoptera:Noctuidae) eggs on soybeans

Bollworm (Helicoverpa zea Boddie) is a major pest of soybean in the southeastern of United States. Information on the within-plant distribution of eggs is needed to support scouting techniques and to improve insecticide targets. Two soybean varieties were selected, one with a determinate growth habit (5220R2X/S) and one with an indeterminate growth habit (AG52X9). Soybeans with determinate growth habits finish most of their vegetative growth before flowering begins, while soybeans with indeterminate growth habits continue vegetative growth after flowering begins. Both varieties were planted in an early (May 27th) and late (July 7th) planting date during the 2022 season in North Carolina. Adult moths were caged in the field and allowed to oviposit during various soybean development stages (R1-R2, R2-R3, R4-R5, R5-R6) in a factorial design. Soybean plants were divided into upper, medium, and lower parts. The total number of eggs was counted in the upper part of the leaf, the bottom part of the leaf, newly emerged trifoliates, stems, flowers, pods, auxiliary buds, and petioles. Additionally, leaf biomass and leaf area were measured to determine their relationship with egg distribution in soybeans. Most eggs were laid on leaves in the upper part of the canopy. This preference is likely due to the relative abundance of leaf surface area compared to the other tissues. These results will assist our understanding of bollworm sampling techniques, adoption of integrated pest management, and potentially improve control.

Anne-Marie Pullen[1], Imran Khan[1], Charles Hodgens[2], Belinda Akpa[2], Marcela Rojas-Pierce[1]

Graduate Program: Plant Biology[1]; Oak Ridge National Laboratory[2]

Advisor: Marcela Rojas-Pierce

Poster Number: 127

Studying the Regulation of Vacuole Fusion in Guard Cells by (de)phosphorylation of HOPS

As desertification and record breaking droughts continue to rise, understanding how plants regulate water loss becomes an increasingly important area of study. Stomata, which allow for the uptake of CO^2 when open, mitigate water vapor loss by closing. The opening and closing of stomata is regulated in part by vacuole fusion and fragmentation. While vacuole fusion is well studied in yeast, it is less well characterized in plants. In yeast, the homotypic vacuole protein sorting proteins (HOPS) tethers apposing vacuole membranes to allow the SNAREs (soluble N-ethylmaleimide sensitive factor attachment protein receptors) to zipper together into a trans-SNARE complex. Eventually, the HOPS complex dissociates from SNARE to allow complete vacuole fusion. Modeling of plant vacuole fusion events predicted a steady-state of the HOPS:SNARE association prior to fusion, and the rapid progression of fusion after HOPS dissociation from SNARE. We hypothesize that the release of HOPS from SNARE in plants is the result of rapid post-translational modifications including phosphorylation. In support of this hypothesis, we have detected multiple phosphorylation states of the HOPS-specific proteins VPS39 and VPS41 and have identified mutants of candidate kinases with impaired vacuole fusion phenotypes. These results underscore a potential role of protein phosphorylation and dephosphorylation in the regulation of vacuole fusion in plants.

Nur-Al-Sarah Rafsan

Graduate Program: Biological and Agricultural Engineering

Advisor: Praveen Kolar

Poster Number: 128

Physical and Chemical Characterization of Poultry Litter-Derived Biochar with Supercapacitor Application

There is a significant interest in converting animal wastes into biochars for energy and environmental applications. This study aims to characterize the physical and chemical properties of biochar produced from poultry litter by pyrolysis. The raw biochar was formed at 400 - 700°C followed by activation with methanesulfonic acid. Both the raw and activated biochar were analyzed using X-Ray Photoelectron Spectroscopy (XPS), Time of Flight – Secondary Ion Mass Spectroscopy (ToF-SIMS), Scanning Electron Microscopy (SEM), Infrared Spectroscopy (IR), X-ray Diffraction Analysis (XRD), and Point of Zero Charge (PZC) techniques. SEM images indicated the increase of surface porosity and homogeneity with an increase in temperature and activation. The chemical properties were evaluated in terms of the presence of heteroatoms such as oxygen, sulfur, phosphorous, and nitrogen. Sulfur was found to be present in its highest oxidation state (+6) in biochar obtained at higher temperatures. IR spectroscopy confirmed the decrease in nitrogen and an increase in sulfur functional groups after activating with methanesulfonic acid at higher temperatures. The loss of crystalline properties due to temperature effect and activation was observed from XRD analysis. The poultry litter-derived biochar had a positive surface, as its PZC is greater than 9, which means it can adsorb anions. The biochar's ability to attract ions is exploited to design electrode material for supercapacitor. This study is beneficial by assessing a method of converting poultry litter into a value-added substance that can act as an effective tool in poultry waste management.

Andrew W. Ratchford[1], Joshua G. Pierce[2], Lauren V. Schnabel[3]

Graduate Programs: Microbiology[1]; Chemistry[2]; Clinical Sciences[3]

Advisors: Joshua G. Pierce, Lauren V. Schnabel

Poster Number: 130

Lipoxazolidinone Natural Product Derivative Displays Potent in vitro Antibiofilm Activity

Bacterial resistance mechanisms are contributing to an overall lack of antibiotic efficacy among traditional antibiotics, yet many recurring and persistent bacterial infections are tolerant to existing antibiotics through their ability to form biofilms. The existing complications caused by biofilm-mediated bacterial infections warrant investigation into antimicrobial therapeutics with high degrees of activity against pathogenic biofilms. Previous work has shown that the 4-oxazolidinone family of natural products displays high degrees of antimicrobial activity with methicillin-susceptible S. aureus (MSSA) strain ATCC 29213 and methicillin-resistant S. aureus strain ATCC 33591. Our objective was to further characterize the in vitro antibacterial activity of a leading 4-oxazolidinone analog (LO-1) against a wider panel of relevant species and their respective biofilms.In order to assess the activity, we performed minimum inhibitory concentration (MIC) and minimum biofilm eradication concentration (MBEC) assays against a panel of biofilm-forming pathogens of interest (S. aureus, E. faecium, E. faecalis, E. gallinarum, P. aeruginosa, K. pneumoniae). The antibacterial activity of the compound was further assessed in a time-dependent manner against MSSA and MRSA strains in both planktonic and pre-formed biofilm states, with accompanying live/dead fluorescent imaging of treated mature MSSA biofilms.LO-1 displayed a high degree of inhibition against gram-positive species in planktonic and biofilm states, evident by MIC ranges of 0.5 to 2 µg/ml and MBEC ranges of 1 to 64 µg/ml. This activity was not reflected in the gram-negative species tested, as MICs ranged anywhere from 64 to exceeding 256 µg/ml and MBECs exceeded 1 mg/ml. Finally, LO-1 displayed concentration-dependent bacteriostatic activity against planktonic MSSA and MRSA cells, and bactericidal activity against pre-formed MSSA biofilms over 24-hour time periods.These in vitro results indicate that 4-oxazolidinone derivatives are potent inhibitors of gram-positive bacterial species with antibiofilm activity that warrants further investigation as a potential treatment of biofilm-mediated infections.

Vanessa Rondon Berrio[1], William Joe Sagues[1], Amy Grunden[2], Douglas Call[3], Elsa Youngsteadt[4]

Graduate Programs: Biological and Agricultural Engineering[1]; Plant and Microbial Biology[2]; Civil, Construction, and Environmental Engineering[3]; Applied Ecology[4]

Advisor: William Joe Sagues

Poster Number: 134

Formatotroph discovery and evolution for CO2 utilization

Electrosynthesis of formic acid/formate from CO2 is advancing rapidly. Biochemical technologies for microbial assimilation of formic acid are needed to advance the C1 bioeconomy. For the first time, we present the discovery and laboratory evolution of a microbial community isolated from formicine ants for the assimilation of formic acid. Concentrations of formic acid exceeding 3.0 g/L were fully consumed, overpassing the commonly cited formatotroph Cupriavidus Necator. Formicine ants produce formic acid and swallow it with their food to selectively kill pathogens and also allow the beneficial microorganism to colonize their gut. Five different species of formicine ants were taken and microorganisms associated were isolated and propagated in M9 broth supplemented with formic acid (>12.5 mM). Shotgun metagenome sequencing and whole genome sequencing were performed at the highest concentration. Five MAGs (Metagenome-Assembled Genome) were constructed with superior completeness and quality. The third MAG identified as Xanthobacter sp. and presented high completeness of the N10 Formyl- tetrahydrofolate biosynthesis pathways, the first step for activation of the C1 carbon metabolism and L-serine and glycine biosynthesis. No previous report in the literature has been found reporting Xanthobacter as a potential candidate for formic acid assimilation. Fermentation was scaled up to 3 L fermentation, from which protein yield, CHN composition, and amino acid profile were determined. This study concluded that our consortia can use formic acid as the only carbon source and that aeration conditions are required to improve formic acid assimilation.

Abhinav Sharma

Graduate Program: Biological and Agricultural Engineering

Advisor: Celso Castro-Bolinaga

Poster Number: 148

Development of an integrated modeling approach to simulate the propagation of sediment pulses after dam removals

In the last 30 years, over 1500 dams have been removed as part of the river restoration efforts in the US. This trend is expected to continue in the future owing to aging infrastructure, and high rehabilitation costs. However, with less than 10% of the total dam removals closely monitored, and documented, there is a need to develop innovative approaches that enhance our predictive and quantitative understanding of river response to dam removal, and present a realistic picture about the pros and cons of dam removals to stakeholders and general public. In this study, we developed an integrated modeling approach to reconstruct sediment pulses generated after dam removals using machine learning, remote sensing, numerical modeling, and Bayesian uncertainty analysis. The methodology was then critically assessed using the well documented case of Elwha Dam removals. First, Landsat based reflectance data were used to predict turbidity using different machine learning algorithms, and different predictor combinations. Results for the Elwha River showed that Random Forest, and a combination of reflectance band ratios and physically informed Soil Delivery Index (SDI) as predictors yielded maximum accuracy (NSE = 0.75, RSR = 0.5). Second, a physics-based 1D numerical model was setup and calibrated using publicly available remote sensing data for a 2.6km stretch on the Elwha River. Spatial aggregation using the multivariate e-divisive non-parametric method on channel attribute data including width, sinuosity, and slope yielded four segments, simplifying the numerical model setup. Further, a successful calibration (NSE = 0.93, RSR = 0.27) of the hydraulic sub component of the numerical model was then achieved by optimizing Manning's roughness for each of the four segments (0.04 – 0.08). Future work includes calibrating the sediment transport sub component of the 1D numerical model using the Landsat based prediction model, and developing a Bayesian framework to inverse model the upstream sediment supply time series, a dominant factor driving a river's response to dam removal.

Charles B. Sither[1], Renyta Moses[2], Omar Salem[1], David B. Pecor[3], Alec Richardson[3], Yvonne M. Linton[3], Alex Potter[3], John Soghigian[1], Brian M. Wiegmann[1], Michael H. Reiskind[1]

Graduate Programs: Entomology[1]; Department of Cancer Biology, University of Pennsylvania[2]; Department of Entomology, Walter Reed Biosystematics Unit, Smithsonian Institution3

Advisors: Brian M. Wiegmann, Michael H. Reiskind

Poster Number: 152

Insights into mosquito host pattern association through their ecological and evolutionary histories

Mosquitoes are dependent on hosts for blood meals and these host associations play a critical role in the spatial and temporal dynamics of mosquito-borne disease transmission. To better use existing knowledge of the breadth and specificity of host-associations in mosquitoes, we constructed and curated a database containing blood host observations from nearly all available published literature on the subject. The "CuliciHost" database is drawn from 175 publications, containing 280 000 individual blood host observations for over 400 mosquito species spanning 9 of the 11 tribes and 22 genera. We also extracted host species distribution information from the Global Biodiversity Information Facility (GBIF) to incorporate data on animal species availability from which an individual mosquito could potentially feed upon given its location. To account for phylogenetic patterns in the evolutionary history of this ecological trait, we used anchored hybrid enrichment to capture hundreds to thousands of orthologous genes from the genome of mosquitoes. With our intensive species sampling and the availability of extensive blood-host records, we reconstructed a tree of mosquito species found in the United States and Canada. We focused on these two countries because of an abundance data for mosquito species and host distributions that is not present for many other nations or geographic areas. With a more explicit view of the interaction between mosquitoes and blood hosts across their geographic distribution and through time, we can improve our ability to explain patterns in mosquito vector capacity, and improve predictive models of disease transmission.

Crystal Starkes

Graduate Program: Youth, Family, and Community Sciences

Advisor: Harriett C. Edwards

Poster Number: 155

Extension Middle Managers' Perceptions of the Engagement and Value of Young Adults Serving in Advisory Leadership Systems

The role of an extension middle manager is similar to those of corporate leaders. Middle managers serve as the bridge between the top-level management who make administrative decisions and front-line workers who implement the steps and actions to impact their communities within Cooperative Extension. Middle managers and extension educators rely on stakeholders and volunteers to help them make decisions to best serve local citizens while serving in various capacities from 4-H volunteers to advisory council members. Today, many experienced advisory leaders are transitioning to retirement from employment and volunteerism in extension, and younger generations are needed to fill the vacancies within the advisory leadership systems. Limited research is available on middle managers within Cooperative Extension. This research examines the advocacy amongst middle managers for young adults serving on advisory leadership systems and describes the middle managers' perception and views of young adults serving in Extension volunteer leadership roles such as advisory leadership members. The thesis also examines the key competencies and ability of the middle managers when working with young adults as volunteers. Using the Borich method, this study describes the Extension middle managers' perceptions of the importance of and ability to perform the professional competencies for engaging young adults in volunteerism, including Extension advisory leadership roles. The method also reveals the professional development needs of middle managers for engaging young adults in volunteerism. The quantitative study focused on middle managers in the Southern region who work for Cooperative Extension as listed on the Middle Managers Committee of Southern Region Program Leaders Network. Of the 86 middle managers in the population, 30 completed the survey instrument.

Hao Wei Teh, César Xavier, Dorith Rotenberg, Marcé Lorenzen, Anna E Whitfield

Graduate Program: Plant Pathology

Advisor: Anna E. Whitfield

Poster Number: 158

Deciphering the role of a novel planthopper anti-microbial peptide in its interaction with a plant rhabdovirus

Peregrinus maidis, the corn planthopper, is a hemipteran insect pest on maize found in tropical and subtropical regions. It causes extensive damage during feeding and serves as the sole vector of maize mosaic virus (MMV), reducing crop yields and causing significant economic losses, especially in seed corn production. Since the molecular mechanism of MMV transmission is currently unknown, and proper function and interaction of the viral glycoprotein with host proteins is crucial for successful viral entry into cells, we aim to investigate the interaction of the MMV glycoprotein with insect host proteins. By using a membrane-based yeast two-hybrid system to identify Peregrinus maidis proteins that interact with the MMV glycoprotein, we discovered a host protein (PMLgs) that appears to be an ortholog of lugensin, a protein empirically shown to be an anti-microbial peptide (AMP) encoded by Nilaparvata lugens (small brown planthopper). Since PMLgs bound to the viral surface glycoprotein, we hypothesized that this anti-microbial peptide plays a role in antiviral defense. Our next goal was to further characterize PMLgs by using bioinformatics and traditional molecular biology techniques. Bioinformatic analyses performed using Peregrinus maidis genome and transcriptome data paired with 5' rapid amplification of cDNA ends experiments confirmed the transcript sequence of the MMV-G-interacting protein. PMLgs was then expressed in E. coli and purified for use in bacterial growth inhibition assays to investigate its antibacterial properties. Antibodies against PMLgs were generated and validated, identifying a protein of the expected size in immunoblots of crude insect protein extracts and bacteria-expressed PMLgs protein. The high efficiency of double-stranded-RNA (dsRNA)-mediated RNAi in Peregrinus maidis was shown by successfully knocking down target transcripts after hemocoel dsRNA microinjections into adult insects. Determining the role of PMLgs in the virus-vector interaction contributes to our knowledge about the factors needed for successful viral infection.

Ty Thomas[1]; Anna Rogers[10]; Edward Buckler[2, 3, 4]; Shawn Kaeppler[5]; Natala de Leon[5]; Sherry Flint-Garcia[6, 7]; Candice Hirsch[8]; Nathan Springer[10]; Cinta Romay[4]; James Holland[1, 9]; Joseph Gage[1]

Graduate Programs: Department of Crop and Soil Sciences[1]; Agricultural Research Service, US Department of Agriculture, Ithaca, NY[2]; Plant Breeding and Genetics Section, School of Integrative Plant Science, Cornell University[3]; Institute for Genomic Diversity, Cornell University[4]; Department of Agronomy, University of Wisconsin - Madison[5]; Agricultural Research Service, US Department of Agriculture, Columbia, MO[6]; Division of Plant Science and Technology, University of Missouri[7]; Department of Agronomy and Plant Genetics, University of Minnesota8; Agricultural Research Service, US Department of Agriculture, Raleigh, NC[9]; Bayer Crop Science[10]

Advisor: Joseph Gage

Poster Number: 159

Multi-environmental RNA-seq reveals the extent of Genotype-by-Environment interactions for gene expression

Genotype by environment interaction (GxE) is a well known source of phenotypic variation, but there is more to be understood about the degree to which GxE impacts the amplitude of gene expression. Maize data were collected by the Genomes to Fields project resulting in a unique 3' RNA sequencing dataset which includes 576 samples at 5 locations with 27 hybrids. Using the RNA sequencing data, we are able to quantify gene expression and create statistical models to account for genetic variation, environmental variation, and GxE variation on a single gene basis. Models estimate the median of expression variation for genotype, environment, and GxE to be 3.4%, 25.7%, and 6.3% respectively. We found 10, 951, and 43 genes where over 50% of variation in expression is controlled by genotype, environment, and GxE, respectively. We plan to use the Practical Haplotype Graph (PHG) to map reads against a pangenome and assign them to haplotype groups, giving more statistical power and utilizing the breadth of information provided by the pangenome. These models bring novel understanding of individual gene expression as it pertains to GxE in maize and can be used to predict the level of expression a gene will have in a given environment. We are continuing to evaluate the statistical power and suitability of this dataset for testing hypotheses related to GxE and will use our findings to inform the design of future experiments.

Jenna Wagner[1,2], Michael Power[2], Mark Edwards[3], Kimberly Ange-van Heugten[1]

Graduate Program: Animal Science[1]; Nutrition Laboratory, Smithsonian's National Zoo & Conservation Biology Institute[2]; Animal Science Department, California Polytechnic State University[3]

Advisor: Kimberly Ange-van Heugten

Poster Number: 169

Macro nutritional comparisons of Perissodactyla milk to develop more accurate milk replacers

Seventy percent of the Perissodactyla order (tapirs, rhinos, and equids) are threatened, vulnerable, or endangered (IUCN, 2023). Milk is a sole and vital part of a mammalian neonate's diet in early development. As Perissodactyla breeding and conservation programs expand, there is a demand for milk formulas and replacements. Often, formulas are based on the closest domestic relatives. We analyzed milk from 8 domestic horses, 14 rhinoceroses (from three species: Diceros bicornis, Ceratotherium simum, and Rhinoceros unicornis), 5 tapirs (from two species: Tapirus bairdii), and 15 wild equid (from five species: Equus ferus przewalskii, Equus grevyi,Equus quagga boehmi, Equus zebra hartmannae, Equus africanus somaliensis). The archived zoological perissodactyla samples were opportunistically collected from varying institutions (n = 13). Milk samples were analyzed at the Smithsonian National Zoo (NZP) nutrition laboratory for major macronutrients: crude protein (CP), dry matter (DM), fat, sugar, and gross energy (GE). There is a difference particularly in protein content between tapir milk and domestic horse milk (Tapir CP = 5.8%, Domestic horse CP = 1.9%). These findings indicate that more research is needed to ascertain whether equine milk is suitable for related species. In particular, research is needed to ascertain if newborn tapir milk formulas within conservation facilities need revision.

Sarah Watson[1], Haley E. Plaas[2,3], Colleen Karl[4], Hans W. Paerl[3], Ryan W. Paerl[5]

Graduate Programs: Microbiology[1]; Gillings School of Global Public Health, University of North Carolina at Chapel Hill[2]; Institute of Marine Sciences, University of North Carolina at Chapel Hill[3]; Chowan Edenton Environmental Group[4]; Department of Marine, Earth, and Atmospheric Sciences[5]

Advisor: Ryan Paerl

Poster Number: 174

New insight on cyanobacterial diversity and toxin production potential in the Chowan River and Albemarle Sound using metagenomics

Expansion of cyanobacterial harmful algal blooms (CHABs) threaten water quality and environmental health in the Chowan River-Albemarle Sound estuarine continuum. Water samples were taken from NC-DEQ and CEEG stations throughout the Chowan River and Albemarle Sound in Summer 2020 during peak CHAB season with the goal of determining the cyanobacterial community members and their potential to produce cyanotoxins and other secondary metabolites that potentially impact co-occurring organisms. This study represents the first time a large-scale microbial genomic analysis has been done in this system.

A total of 186 high and medium quality MAGs were assembled from Illumina sequencing reads. Results from the Chowan River indicate that the CHAB enera Dolichospermum and Microcystis, especially the prior, were abundant over the course of the study. A larger number of CHAB associated genera occurred in the Albemarle Sound including: Sphaerospermopsis, Nodosilinea, Dolichospermum, Prochlorotrichaceae, Leptolyngbyaceae, Raphidiopsis, and Microcystis. Classes of biosynthetic gene clusters identified in these abundant populations include terpenes, cyanobactins, microviridins, non-ribosomal peptide synthases, polyketide synthases, and lanthipeptides. Putative biosynthetic gene clusters were identified for several cyanotoxins and other noxious compounds, many of which are understudied. These compounds include geosmin, microcystin, saxitoxin, anabaenopeptin, puwainaphycin, nostophycin and more. Interestingly Dolichospermum genomes associated with a large-scale bloom event lacked microcystin genes and microcystin concentrations were low during the bloom event based on LC/MS measurements. Our results highlight high cyanobacterial diversity in the CR-AS capable of producing multiple cyanotoxins and secondary metabolites that are not monitored and have never been assayed to our knowledge.

Jennifer Mahoney Webb

Graduate Program: Youth, Family and Community Sciences

Advisor: Annie Hardison-Moody

Poster Number: 102

“Has Music Saved You?” How Music Aids (in) Adolescent Grief Response

Adolescents who live through a loss experience grief in deep and sometimes traumatic ways that can be insurmountable or potentially stunting to emotional and physical growth. Because adolescents are often overlooked in their grief, they feel alone, inadequate, and unsure how to navigate this uncharted territory. There is a belief that because children are young and appear to be resilient or to not understand the true meaning of loss, they do not need the tools and attention an older individual might seek on their own. Music is increasingly used as a successful treatment or coping mechanisms for a variety of adolescent concerns. Currently, music is only sporadically applied formally in the adolescent grief process.

The purpose of this study is to explore how music aids adolescents experiencing grief during and following loss and to better understand how this vulnerable age group experiences music as healing during grief. Qualitative analysis of semi-structured interviews of five diverse music teachers who teach music to adolescents in a variety of environments support the use of music as a conscious strategy to empower adolescents to manage and move forward through grief. In the instances of grief found in this study, there are circumstances of the sadness of having a hard day to the death of a loved one, the loss of will to live and loss of friendship, romance or relationship as an individual transitions to their more authentic self. A transition to more authentic self can be seen as a transition from one’s given identity to one’s authentic self-identity as in the case of gay or transgender adolescents. The phenomenon being studied is how music aids in the process of adolescents learning to (honor) carry grief following loss.

Gabrielle Whorley, Joseph L. Donaldson, Misty D. Lambert
Graduate Program: Agriculture and Extension Education
Advisors: Joseph L. Donaldson, Misty D. Lambert
Poster Number: 176

Influences on Community College Transfer Students' Career Choices in Agriculture

The students who comprise the community college demographic may be an important resource for the 60,000 highly technical agriculture job opportunities yearly in the United States. By understanding the community college transfer students' career decision-making experiences, academic and extracurricular programs may be tailored to fully embrace this audience. This basic qualitative study in the phenomenological tradition was conducted through two separate interviews with ten students, once at the beginning of the fall semester of 2022 and once at the end of the fall semester. Research shows that choosing a college major and career is influenced by multiple factors including the students' background, preferences, perception of their abilities, and how these factors align with the potential job requirements. Additionally, parental influence, mentoring, curricular, and co-curricular experiences all play an essential role in choosing a career and major in agriculture. Participants explained that their experiences at the community college had made the transition to a four-year university much easier than their peers who came in direct from high school. The participants felt confident in their career choices and their abilities. Their backgrounds as well as their parents and mentors helped to propel them into pursuing agriculture as a career. Lastly, curricular and co-curricular activities seem to play the most significant role in the career choice of agriculture based on the many stories received about how organizations such as FFA, 4-H, or the Animal Science Club or internships and jobs allowed the participants to feel more confident in their career choices. The major recommendations include ways to amplify 4-H, FFA, and other co-curricular activities to enhance career decision making and additional research to understand the distinct role of mentoring for agricultural students. Please note the following features of the above abstract: 1. Department of Agricultural and Human Sciences

College of Design

Alison Armstrong

Graduate Program: Art and Design

Advisor: Marc Russo

Poster Number: 10

Hack-Able: Technoableism and Embodied AI

Artificial intelligence is already ubiquitous, and as a society we are deeply intertwined with technology. We are so interdependent on technology as an extension of ourselves, that we are already cyborgs, or human-technological hybrids. The cyborg represents an emerging reality and a boundary identity that is particularly interesting for those living with disabilities and utilizing technologies to extend the body's functions. The central research focus for this project is on critical disability theory and the emerging concept of technoableism, which is a combination of a bias towards disabled minds and bodies with an uncritical belief in the good of technology. This project explores how medical technologies create an embodied AI and the experience and implications of living intertwined with AI and in a technoableist landscape. Additional research into philosophy of technology, meaning, cyborgian identity, and human-computer interaction also supplement the project. Hack-Able: Technolableism and Embodied AI explores cyborg and disability through interactive storytelling, in the form of a branching narrative graphic novel. The narrative utilizes speculative science fiction and young adult literature to provide an accessible exploration of AI and disability, through a character experiencing the effects of technoablism. Throughout the narrative, users are given decisions on how the character should proceed, creating different narrative paths that lead to alternate endings, providing a first-person perspective to the issue of AI and disability. The creative output of Hack-Able: Technolableism and Embodied AI builds on the history of graphic novels and their ability to address social issues and increase literacy in young readers, and remediates previous interactive narrative precedents such as Choose-Your-Own-Adventure novels and interactive films like Bandersnatch into the comic/graphic novel format.

Jackson Bostian

Graduate Program: Art and Design

Advisor: Justin Johnson

Poster Number: 21

Don't Show. Don't Tell

There's an old writer's adage that says, "Show, don't tell." At its core, the adage encourages writers to make the most of their medium by having their work engage their readers' imaginations. It asks the reader to do more interpretive work, engaging them more deeply in the story's world. But in an inherently immersive and interactive medium like VR, showing is no longer the limit. The audience now has the ability to act within and upon the work. Don't Show. Don't Tell. is a VR horror game that focuses on an approach to media that isn't shown, that isn't told, that is DONE.

In VR, each user's experience is bound to their physical capabilities through the medium's unique capacity for embodiment. The consequent significance of self-efficacy in shaping user experience is shared by horror games, wherein a person's sense that they can handle a present or potential threat moderates their fear.

By creatively preying on the affective impacts of embodiment, new approaches to creating fear can be developed, evolving and furthering the horror genre using VR's unique strengths. This is the ultimate goal of Don't Show. Don't Tell., which exhibits a number of these new approaches in a series of brief, standalone vertical slices.

Marybeth Campeau

Graduate Program: Landscape Architecture

Advisors: Andrew Fox, Madalyn Baldwin

Poster Number: 27

Dredge Ecologies: Climate-Adaptive Strategies for a Changing Island in a Changing Climate

For the past decade, a community coalition has fought to protect Eagles Island, the largest island in the deltaic archipelago at the confluence of the Cape Fear and Northeast Cape Fear Rivers, as a recreational amenity. Through a research process that holistically assessed the island's evolving history through cultural and environmental lenses, this project grounds conceptual design solutions in a systems-based plan. Located 20 miles from the Atlantic coast and nestled between the two most rapidly growing counties in North Carolina, Eagles Island exemplifies the anthropogenic challenges and opportunities faced when analyzing and planning for sea level rise. This project grapples with the 3220-acre island's centuries-long relationship with excavation and earthmoving for capital gain in a dynamic riverine system. The proposed framework of this research project considers the impacts of redistributing remediated dredged sediment with nature-based solutions that support ecological and community wellness. With threats of private development looming, this project provided the local coalition with a compelling and comprehensive vision for the island that embodies the mission of conserving and managing the land's natural and cultural assets and providing compatible educational and recreational activities. The project's conceptual design framework blends multiple levels of meaning to imagine a future that acknowledges and builds upon cultural histories, resulting in a program that fosters resilient, climate-adaptive, ecologically rich, and biodiverse habitats using dredged material. Sediment strategies for habitat include dynamic breakwaters, thin layer placement, marsh mounds placed in avian flyways, remediation research, ecotone ridges, and a pedestrian bridge composed of remediated dredge. The ultimate goal of the project is to make this habitat publicly accessible through a network of elevated boardwalks (greenways) and kayak trails (blueways). Altogether, this project illuminates landscape architects' role in visualizing research-based and site-specific design solutions by engaging with dredged material and bringing together decision-makers facing climate-based challenges.

Austin Caskie

Graduate Program: Art and Design

Advisor: Derek Ham

Poster Number: 28

Knots in Virtual Reality

My thesis "Virtual Reality Knots" is an inquiry in how users interact with virtual reality experiences and how those interactions are affected by the development ecosystem. The widespread use of readymade assets and code packages is accelerating the development of norms in virtual reality design. The project is an exercise in tool creation, and this allows the work to be in conversation with the contemporary practice of using ready made code packages in virtual reality development. By focusing on the action of knot-tying, this project situates itself outside of the common verbal vocabulary of games and virtual reality. By expanding the scope of ready-made code solutions to include new verbs, this project explores the impact of marketplaces on contemporary virtual reality development. The project will make use of the Unity platform and its associated marketplace.

Elizabeth Chen

Graduate Program: Graphic Design

Advisor: Scott Townsend

Poster Number: 30

(D)esign (E)ducat(i)on: Developing more inclusive design pedagogies through course preparation tools

This investigation explores how online course preparation tools could assist design educators in developing more inclusive pedagogies. The resulting studies begin with reviewing language, sources, and perspectives embedded in course preparation materials, then invite instructors to broaden their critical consciousness over time through reflection, suggestions of additional resources, and connections with other like-minded educators.

These studies consider how reflection can be leveraged to aid educators in positioning their social identities to understand their social privileges and disadvantages. Using their social positionality as a framework to focus on building empathy for their social out-groups, this study implores educators to empathize with intersectional identities through an archive of narratives from former students. These narratives may promote the development of course materials that serve intersectional students and motivate the diversification of materials to include diverse cultural perspectives. Further, this study proposes that reflective prompts may guide educators in critically engaging with topics of privilege and discrimination, recognizing potential areas of growth, and encouraging lifelong learning by documenting their experience using the developed tool.

Course preparation and pedagogical practices in design education (such as syllabi and schedule development, project design, and the curation of supplementary materials) often do not explicitly account for social inequities some students face that may affect their academic experience. Having an intersectional identity, or existing at the intersection of contextualized identities (e.g., a Black lesbian non-binary person), heightens the effects of identity-based oppression, discrimination, and/or domination. Thus, intersectional students (specifically students of color) disproportionately experience identity-based oppression that is often not accounted for during class preparation.

Rosario Dominguez-Tapia

Graduate Program: Architecture

Advisor: Bryan Bell

Poster Number: 46

Beyond The Classroom Walls: Community Empowerment Through Access to Education

How can design help improve access to education to increase the opportunities and resources for those who are marginalized?

The focus of this investigation will look at Brunswick County, North Carolina and build a collaboration between the community, experts and the designer to facilitate access to educational resources for marginalized groups. Through the collection of interviews, surveys, and site analysis, a physical design will be proposed to facilitate the needs of this community.

North Carolina's Latinx population has grown by 40% over the past ten years, a faster rate compared the national growth of 23%. (Tippett, 2021). As the population continues to grow, so do concerns with the available resources for the Latinx community. Research on intersectionality and social, economic and political practices has revealed the gap continued by institutions in the creation of educational inequities, especially for historically underrepresented groups. In a paper on educational inequities (Solóranzo, 2005), research found that for every 100 Latina/o students starting elementary school, 52 graduated from high school, 10 from college, 4 from graduate school, and 0.4 with a doctoral degree. In comparison, whites had students graduating more than double the rate in some categories.

Education in this project is defined as the holistic and broader understanding of a community's power through knowledge beyond the traditional classroom setting to encompass all learning that provides skills and information. The "vision of success" of the broader community is to bridge the divide between education and the community through a physical design as information is forthcoming from research. By providing the necessary resources, the action-based research outcome is to increase access to educational attainment for everyone. Growth in

education can make the difference in the life of not only the individual but in their communities as well, creating a pathway of opportunities for generations to come.

Elizabeth Gabriel

Graduate Program: Graphic Design

Advisor: Helen Armstrong

Poster Number: 58

Enriching Access: Improving Web Usability with Assistive Navigational Technologies for Low Vision Users in Information-Seeking and Searching Scenarios

The web is an eminently sight-centered environment, and, consequently, navigating the web as a visually disabled user poses unique and significant challenges. Research has shown that low-vision users spend nearly five times longer inspecting web pages than their sighted counterparts; and while increasingly more elegant and efficient, screen readers and braille displays are often completely resistant to information-rich, complex web pages. To respond to these barriers, low-vision users have developed strategies to circumvent inaccessible interfaces. This presents a rich and urgent opportunity for the design of a tool that is keenly informed by these adaptive strategies and coping mechanisms. Rumelhart's Schema Theory and Wilson's Information-Seeking Behavior Model are combined into a framework that underpins the investigation's studies: a framework that asserts that a series of seamless interventions can re-structure schemas and enhance user perception. Each study uses the context of a digital library interface to explore the affordances of a highly customizable tool that works within the interface to, for example, re-structure content and offer multiple content modalities, improving the usability of digital archives for low vision users.

Daniel Garrett

Graduate Program: Architecture

Advisor: Thomas Barrie

Poster Number: 60

Addressing Veteran Homelessness to Combat Veteran Suicide

Veteran homelessness is a major issue on a national level. Homelessness has been defined as not having a "fixed, regular, and adequate nighttime residence". Veterans account for approximately 7% of the total population, but nearly 20% of the homeless adult population are veterans. Comprehensive studies found major risk factors for veteran homelessness include substance abuse, mental illness, and lack of social and financial support, which are also the main risk factors identified for veteran suicide. With a suicide rate of 81 per 100,000, veterans are an especially vulnerable group, compared to 23 per 100,000 of civilian adults. This research aims to bring awareness, but more importantly to find the connections between both veteran suicide and veteran homelessness. More than four times the amount of Post 9/11 war veterans have committed suicide than have been killed in the Afghanistan and Iraq wars combined. Since the beginning of these wars, there has been a 76 percent increase in suicide rate among 18- to 34-year-old veterans and 79% of veterans experiencing homelessness upon separation from active duty are also under the age of 35. It has been found that these higher rates of suicide and homelessness are caused by multiple factors common to fighting in the Post 9/11 wars, such as exposure to high levels of stress, trauma, and the difficulty of transitioning back to civilian life. Other shared factors, such as the war's unprecedented length and the continued access to firearms continue to fuel these increased rates. This research challenges the current "housing first" ideology, which aims to simply obtain housing for the veterans, and will inform national veteran housing programs with new supportive housing designs to give the veterans a place to rebuild their sense of pride, self-worth and belonging, while utilizing the services necessary to find their path forward.

Masoome Haghani

Graduate Program: Architecture

Advisor: Wayne Place

Poster Number: 63

Innovative, Human-Centric Daylighting System Design: Prismatic Vertical Louvers (PVLs)

Natural light admitted through windows in buildings can provide interior illumination, and reduce lighting electricity consumption. In addition, it can improve 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 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, the sun angles are particularly challenging for causing glare for the occupants. Wise management of daylight penetration indoors is a key factor for sustainable building development which leads to energy conservation and occupants' comfort. Integration of the daylighting system with the other building's design is recommended to create a comfortable indoor environment. Different strategies and technologies have been introduced and applied in buildings to regulate the negative impacts of sunlight by blocking, filtering, redirecting, or transporting radiation. A variety of louvers and blinds in fixed or sun-tracking settings are designed to block sunlight from reaching indoors, however, this also reduces beneficial diffuse skylight. As a result, both interior illumination and the view through the window are negatively affected. This research is focused on an invention currently being patented by North Carolina State University, which is an optical treatment for windows that reflects away around 99% of the beam sunlight while admitting most of the diffuse light from the sky (up to 56%). In this manner, all the positive impacts of natural light are retained, while the negative thermal and glare effects are eliminated. The research reported here is focusing on a version of the invention embodied as prismatic, vertical louvers that rotate about their vertical axes one time over the course of a day. The research report will include optical analysis of the primary material; computer simulations and experimental measurements of the system performance in an office space (in terms of daylight availability and glare occurrence); and testing of user experience in three office spaces outfitted with three window treatments: the innovative Prismatic Vertical Louvers (PVLs), Conventional Vertical Louvers (CVLs), and Conventional Mesh Shading (CMS).

Justin Johnson

Graduate Program: Design

Poster Number: 80

Advisor: M. Elen Deming

Playing Under Electric Trees: The Development of a Virtual Reality Game for Mental Restoration

There is a substantial body of research that suggests exposure to nature and natural environments provide benefits to mental health in the form of positive affect, improvements in mood, restoration of attention, and reductions in markers of stress. (Ulrich 1979; Kaplan and Kaplan 1989; Bratman et al. 2012). Situations arise, however, when people do not have immediate access to natural environments. When nature is out of reach, technology may be able to provide beneficial exposures in the form of virtual nature environments (Litleskare et al. 2020). This study will investigate whether a nature based VR game can be an effective platform for providing some mental health benefits from virtual nature through visual and interactive experiences. This study will aim to draw out connections between environment behavior theories, landscape preference, game play frameworks, and evidence of improvements in mood and positive affect through the development of a VR game with a research through design and qualitative research design

Pegah Mathur

Graduate Program: Design

Advisor: Wayne Place

Poster Number: 104

Design and Assessment of Human-Centric Sunlight Projecting Systems for tall buildings in dense urban environments; Addressing Health in office setting

Exposure to proper light spectra and intensity can contribute to stimulating the pineal gland and the suppression or release of melatonin production while regulating the circadian rhythm. Morning exposure to proper non-visual light results in increased alertness and vigilance. However, providing daylight in the interior core of tall buildings continues to be a challenge for designers. Characteristics of building layout (e.g., area and number of floors) and surrounding environmental factors (e.g., density of city blocks and height of adjacent buildings) can limit the feasibility of quality daylighting. As a result, designers in tall buildings have relied heavily on electric lighting. To address the challenge of daylight provision in high-rise buildings, this study designed and analyzed the characteristics of an innovative daylight system as an alternative façade-mounted device: a double-mirror daylighting system (Sunlight Projecting System_SPS) for projecting beam sunlight into the cores of office buildings in dense urban environments. This prototype guides and reflects daylight onto interior ceilings through mirrors to mimic a sunlit luminaire ceiling. The study explored the characteristics and design parameters of the prototype to analyze its efficacy in providing sufficient visual and non-visual daylight to stimulate alertness without causing glare.

The research also developed innovative methods for simulating reflective materials in such a prototype through computer-aided modeling and daylight simulation engines. The results showed that the double-mirror facade prototype (SPS) can substantially improve the quality of daylight in the core spaces of tall buildings in dense urban environments, enhancing visual and non-visual daylight availability for office employees up to 100% of the time during the conventional working schedule (8AM-4PM) while reducing glare. The experimental study of the physical prototype of this system similarly showed improved healthy daylighting conditions for occupants and decreased daylight deprivation in settings comparable to tall buildings in dense urban environments.

Rosa McDonald

Graduate Program: Design

Advisor: Wayne Place

Poster Number: 106

Architectural Solar Control Assessment: The Impact of Four Strategies on Building and Occupant Factors on the East and West Facades of Office Spaces

There is currently limited knowledge on the effectiveness of solar control techniques on east- and west-facing facades, and there is limited agreement on when and how they should be used. Authoritative sources recommend using the less effective techniques on these sides or to decrease the amount of glazing, but evidence suggests that people prefer having windows for access to daylight and nature, so decreasing glazing amount is also not an ideal solution. Designers need a better understanding of the performance of solar control techniques on the east and west of buildings. The purpose of this research study is to assess the effectiveness of shading techniques on those facades of buildings, taking into account both benefits to the building functionality and benefits to the occupants. Using Ecological Psychology's Theory of Affordances, building-focused and occupant-focused affordances are explored through a mixed methods explanatory sequential methodology consisting of an experiment, simulation, survey, and in-depth interviews. Shading techniques assessed in this study include horizontal louvres, vertical louvres, eggcrate system, and vegetative configurations. The experimental and survey data will be collected in a Rotating Daylighting Laboratory at North Carolina State University, College of Design. This lab allows the examination of every solar altitude and azimuth angle for an entire year, in one day, drastically extending the applicability of the data. This study can provide a baseline for future research in this topic area, contribute methodologically to the exploration of this topic and to the architectural profession, and offer a more holistic understanding of the benefits and drawbacks of solar control techniques on the east- and west-facing facades of buildings by including both instrument measurements and direct perceptions, preferences, and opinions of occupants.

Nick Musarra

Graduate Program: Landscape Architecture

Advisor: Chuck Flink

Poster Number: 113

Midtown Waterfront Park: Investigating the Potential for Raleigh's Next Storm-Resistant Park

This initiative investigates landscape architecture and urban design as a response to stormwater management issues related to urban development. Decades of rapid urbanization have come with the dominance of impervious surfaces, or areas of land where stormwater is unable to naturally infiltrate into the ground. The vast concentration of impervious surfaces in urban areas is recognized as a threat to water quality; water quality in watersheds with greater than 30% impervious surface can be considered degraded. Additionally, impervious surfaces are responsible for a shift of what would be subsurface flow from infiltrated stormwater runoff to surface flow, leading to increased flood hazards. The land adjacent to Crabtree Creek in the Midtown district of Raleigh is a victim of such symptoms of urbanization. The stream continuously experiences flash flooding that renders the greenway and portions of nearby properties unusable and leaves buildings susceptible to over 5.5 million dollars in damages in the event of a 100-year flood. In 2020, the City of Raleigh adopted the Walkable Midtown Plan in which they expressed a desire for a "storm-resistant" park and is seeking design interventions that would create a resilient, floodable park as well as a catalyst for urban development in the area. This first of two phases dives into site inventory and analysis and investigates case studies to discover the potential for a stormwater management solution disguised as a waterfront experience in this area. Through collaboration with city staff, this project will result in design ideations and conceptual development strategies for the Midtown Waterfront Park to inform further work to influence the future of blue-green urban parks in Raleigh.

Brian Sekelsky

Graduate Program: Graphic Design

Advisor: Matthew Peterson

Poster Number: 146

Visualizing Size and Scale: Enhancing Scale Cognition through Interactive Web-based Experiences

Understanding size and scale has been identified as a critical skill for students, especially those in STEM disciplines. Further, the general public frequently misconceptualizes things that are too large or too small to be seen. Accurately visualizing size and scale is difficult in many instances because of the inherent scope involved. For instance, the scale of the solar system cannot be accurately shown on a standard poster because of the extreme differences between the planets' relative distances and sizes. There is ample opportunity for designers to get involved in the creation of new size and scale-related educational multimedia. Utilizing Magaña's Framework for Size and Scale Cognition as well as the National Research Council's Science Education Standards, this investigation explores the role of websites in teaching scale cognition to learners of all ages. Magaña's framework outlines five cognitive processes: generalization, discrimination, logical proportional reasoning, numerical proportional reasoning, and mathematical reasoning which scaffold size and scale cognition. The resulting studies utilize these five cognitive processes to determine specific design features within websites that teach about scale-related phenomena.

Anne M. Spafford

Graduate Program: Design

Advisor: Traci R. Rider

Poster Number: 154

A Landscape Language for Health: The Intersection of Green Infrastructure & Human Resilience

Mental health treatment and services reached a $225 billion in 2019, up 52% since 2009. Surprisingly, only 20% of good health is based on actual health care, while 80% is based on social and environmental determinants. With 68% of the world's population expected to live in urban areas by 2050, this trend should catapult designing for health into a priority for the design of every day landscapes. This research addresses designing for human resiliency and the power of the everyday landscape to mitigate mental health issues. More than simply reducing human stress response, resiliency implies that humans can adapt to cope better when stressful events occur. Current psychology research suggests that when people experience positive emotions such as joy, gratitude, serenity, etc., these feelings encourage actions that also promote skills for showing care, creating social bonds, increasing knowledge, motivation, and creating new worldviews. How can the design of everyday streetscapes—the largest portion of shared public spaces in cities—promote resilience? Climate change is a major driver of landscape architecture projects, but designing for environmental resilience and human resilience need not be mutually exclusive. This environment-behavior study investigates the intersection of positive psychology and green infrastructure. I will compare two streetscapes in Houston, Texas—one with continuous green infrastructure measures such as biodiverse plantings, rain gardens and street trees; the other, a nearby comparable street without green infrastructure measures. Ecological Momentary Assessment (data collection in real time, in situ, and over time) will be conducted via a smartphone app. The assessment will combine existing validated self-rating scales of positive emotional states and perceived resiliency. Original survey questions will tackle experiential aspects of the streetscapes, degrees of environmental awareness and interaction over time. These findings will be valuable in developing a landscape language for health, which can be a resource for practitioners, policymakers, and developers.

Aneshia Tinnin

Graduate Program: Art and Design

Advisors: J Mark Scearce, Chandra Cox, Iyare Oronsaye

Poster Number: 161

From Little Rock to the Chicago Renaissance: The Life of Florence Price

This thesis discusses the persistent lack of diversity found in programmed composers in western orchestras. It explores Florence Price's life, achievements, and the challenges that she overcame as an African American woman during the Jim Crow era in the United States as a lens for that greater discussion of representation. Interpretation of new scholarship will shed light on the significance of her inclusion and celebration of her blackness within her musical works.

The compiled research from this thesis has been organized and tailored into a complementary animated documentary, which features Price's music and is targeted towards adolescents. This thesis will discuss the history and development, as well as common uses, of the rigging technology and related software programs used to create this documentary. It will also summarize the results and conclusions found after using said technology to create the majority of the character animations for the animated documentary.

By using existing animation technologies in new and practical ways, this project strives to show the accessibility of creating similar projects. In conclusion, it will hopefully inspire similar research and projects that focus on the stories of other underrepresented figures in various fields.

Keagan Vargo

Graduate Program: Industrial Design

Advisor: Kelly Umstead

Poster Number: 164

Safe and Efficient Excavation Operations

Insufficient excavation practices persist as the primary root cause of damages in the U.S. In 2019 there were 17k reports of excavators failing to maintain clearance after verifying locators. This equated to over $30 billion in damages due to buried utility strikes. The purpose of this project was to explore issues related to utility survey markings and how excavator operators can better inground obstacles. Excavator operators need a better way to detect and avoid utility lines to prevent collisions and damage. The use of a literature review, market research, and end user surveys and interviews were used to discover insights. Opportunities were identified through specific pain points from stakeholders in the current excavation process. This project is to explore design opportunities on how to allow excavator operators fast, efficient, and accurate location of buried utilities; also having built in avoidance features. This research will help to increase efficiency and safety of excavator operations.

Brian Vaughn

Graduate Program: Landscape Architecture

Advisor: Gavin Smith

Poster Number: 165

Climate Change Retreat is a Regional Land Use Imperative

Employing a climate adaptation policy of "managed retreat", governments acquired the equivalent of two Centennial Campuses of residential land in nine coastal and riverine counties in Eastern North Carolina. The opportunity to create resilient outcomes in "buyout lands" lies at the intersection of available parcels, community organizations with goals, resources, and budgets, and relevant expertise from officials in Emergency Management, the North Carolina Office of Recovery & Resiliency, and land grant universities with extension missions.

FEMA's Hazard Mitigation Grant Program offers some homeowners a voluntary "buyout" for the fair market value of their homes. Restrictions stipulate that the land will be "...maintained in perpetuity as open space for the conservation of natural floodplain functions". This program is a form of 'climate retreat' – and more frequent and intense storms such as Hurricane Matthew further justify the government's response to deliberately remove people from the floodplain. In Lenoir County alone, 1,485 acres of land have been acquired with this program and others like it. Yet no level of government provides dedicated resources to maintain its use as publicly accessible 'open space'.

Buyouts create unintended effects. Thousands of former property owners no longer contribute to county tax revenue, stretching budgets for basic public services thin. Lands in poor environmental health regenerate through natural succession. Yet many of these places become dumping grounds, resulting in costs incurred by local governments—such as hauling trash and installing gates to block decommissioned roads.

In Summer 2022, I served as a 'Design and Resilience Liaison' to Lenoir County. I was supervised by Deputy Director of Emergency Management Samuel Kornegay. Buyout lands served as a 'proving ground' for landscape interventions that address community needs.

Through meetings with a wide range of stakeholders, it became clear that we could develop a partnership with Lenoir County Agricultural Education Teachers to consider a number of open space intervention options and parcels to realize them. Today, we're in the process of co-designing, budgeting, and securing a maintenance plan that is aligned with the needs of the future of Lenoir County: students and their teachers.

Amanda N. Williams

Graduate Program: Graphic Design

Advisor: Helen Armstrong

Poster Number: 177

Virtual Group Conversations for Adults with Sudden Speech Impairment: Utilizing Artificial Intelligence to Facilitate Inclusive Virtual Social Group Conversations for Speech-Impaired Senior Adults

Sudden speech impairment can mentally and physically tax individuals, negatively affecting their quality of life. Most commonly caused by strokes, sudden speech impairment caused by a combination of aphasia, apraxia of speech, and dysarthria affects up to a third of stroke survivors, the majority of whom are senior adults (U.S. Department of Health and Human Services, 2016). Many individuals with sudden speech impairments are self-conscious about speaking in public. Some actively avoid social interaction to hide their impairment (Wray & Clarke, 2017). Speech therapy significantly improves speech impairment, especially impairment caused by stroke. However, there is little discussion about sudden speech impairment's effect on individuals' mental health in conjunction with their ability (both real and perceived) to speak daily with others (Lemmetyinen et al., 2019). The recent introduction of artificial intelligence used within applications for speech and speech therapy practices presents a rich opportunity to encourage and improve virtual social group conversations for senior adults with sudden speech impairment.

Drawing from communication and learning theories and guided by Multimedia Learning Theory Principles, this investigation explores how a personalized AI interface could seamlessly support and facilitate inclusive virtual social group conversations for older adults with sudden speech impairment. The resulting studies examine how personalized gestural, verbal, and auditory cues can combat the heightened and complex challenges speech-impaired senior adults face as speakers and listeners in virtual video group conversations. Improved social conversations can encourage speech-impaired senior adults to continue practicing their speech, potentially improving their mental health, and encouraging life participation-based interactions. These studies focus on situations where speech-impaired adults converse with nonspeech-impaired family and friends through design explorations of turn-taking dynamics, response feedback, adjusting airtime, and active listening.

Marissa Yankello

Graduate Program: Industrial Design

Advisors: Kelly Umstead, Kathryn Wozniak, Tim Buie

Poster Number: 184

Neurodiversity at Work: Optimizing the Remote Working Environment for Neurodivergent Professionals

As most workplaces transition to hybrid models or working remotely following the COVID-19 pandemic, we must re-evaluate our remote working environments and their impact on employee productivity and well-being. Employers and employees alike desire a work environment that allows employees to feel fulfilled in their roles while staying physically and mentally healthy. However, traditional home office environments are often non-ergonomic and lack elements that promote employee engagement and healthy lifestyles. These environments are especially challenging for neurodivergent employees struggling with sensory challenges, anxiety, distractions, and under-stimulation. The term neurodivergent refers to people whose brain thinks, learns, and behaves differently from people who are not neurodivergent. People who identify as neurodivergent typically have one or more of the following conditions: Autism Spectrum Disorder, Attention-deficit hyperactivity disorder (ADHD), dyslexia, dyspraxia, and more.

To understand accessibility in remote work, secondary and primary research was conducted to provide data on the impact of remote work on neurodiverse employees. The primary research study participants include occupational therapists, human resource managers, and neurodivergent remote professionals. Semi-structured interviews and photo diaries were recorded to provide an in-depth understanding of the problems with current remote work environments. The market analysis and primary research results show that traditional workspaces are stagnant and either overstimulating or unstimulating, which negatively impacts productivity and employee well-being. Neurodivergent remote employees need an optimized working environment that allows for movement and sensory integration to improve their ability to focus, think, and feel well.

This research explores practical design interventions for inclusive work practices and accessibility improvements

in remote work environments. The insights gathered from the initial research phase indicated that the proposed solution should encourage the user to move throughout the day, provide sensory stimulation, and should be easily integrated into an existing home office environment.

College of Education

Jerome Amedu

Graduate Program: Learning and Teaching in STEM

Advisor: Karen Hollebrands

Poster Number: 8

Mathematics Teachers' perceptions of the effects of informal learning: A mixed methods study

Although there is a growing research interest in teachers' informal learning and anincreasing acknowledgement of the important role it plays in teacher professional development; the outcomes ofinformal learning are difficult to measure and relatively fewer studies focus on outcomes. This sequential mixed methods study examined math teachers' perceptions of the effects of informal learning on teacher knowledge and practice. Quantitative analysis was based on the analysis of closed-ended survey items to explore relationships between teachers' frequencies of learning through different informal learning activities and their TPACK self-efficacies. The qualitative analysis focused on teachers' perceptions of informal learning based on open-ended survey responses, two rounds of semi-structured interviews, and survey-based journaling of their daily informal learning experiences. Together, the quantitative and qualitative results suggested that informal learning contribute to math teachers' professional growth and practice and is an integral part of their continuous professional development. Collaboration with colleagues (mostly in form of conversations) and referencing of web-based resources were identified as the two most common and useful informal learning activities that math teachers engage in as part of their everyday practice. Teachers' workplace context was found to be central to their informal learning and personal as well as interpersonal factors that affect teachers' informal learning were identified. Implications for policy, research, and practice were also discussed.

Lynn Chesnut

Graduate Program: Learning and Teaching in STEM

Advisor: K.C. Busch

Poster Number: 31

Humanistic Perspectives in Informal Science Education

Museums, in general, do not have diverse audiences (only 9% of visitors identify as non-White). Studies have shown that the factor most responsible for this lack of diversity is the visitor's perception of belonging. There are few studies that examine the cause of those perceptions and how they influence related feelings of inclusion and equity in museums. In school science, there has been a shift away from canonical science content toward a focus on "science as human endeavor," a more student-centered approach. It is thought that this shift improves science literacy by better connecting science to students' everyday lives. Could this same humanistic shift in focus benefit informal science learning spaces? This qualitative study explores the representation of a humanistic perspective in informal science education, specifically science museum exhibit text. Data were collected from six exhibits found in three science centers or museums. Critical thematic analysis was employed to find patterns and themes using both inductive and deductive coding. Several prominent themes have emerged such as Type of Science (Professional vs. Everyday) and Science Discourse (Process vs. Product). Preliminary results find that humanistic perspectives are evident in some exhibits, yet "science as fact" still persists in many others. It is hoped that these results can improve perceptions of belonging, equity, and inclusion in traditionally underrepresented museum visitor groups by challenging the presentation and representation of science.

Caitlin M. Donovan, Katherine Peachey, Crystal Chen Lee, Jose Picart

Graduate Program: Teacher Education and Learning Sciences

Advisor: Crystal Chen Lee

Poster Number: 47

Pursuing Our Truths: Critical Literacy and Positive Youth Development within Community-Based Spaces

In this paper, we examine how writing is a form of pursuing truth about oneself and one's community. In this research, we draw on a three-year qualitative writing project at CORRAL Riding Academy, a non-profit that works with girls in high-risk situations through a holistic program of equine therapy and education. This writing project, The Literacy and Community Initiative (LCI), is a university-community partnership that partners with youth-serving organizations to amplify student voices through student publications, advocacy, and leadership. Within a framework of critical literacy, which posits engagement with textual studies and writing as means of gaining critical consciousness (Vasquez et al., 2019), and positive youth development, we ask: "How does engaging with a critical literacy curriculum in a community-based organization impact how students and staff see themselves and their community culture?"

We used a case study methodology which involves exploring a complex program, event, activity, or group of individuals in depth with a specific inquiry question. We analyzed the writings generated by the youth participating in our curriculum, facilitated two focus groups with student writers, and interviewed CORRAL staff members. We also examined audience members' responses to student writing at public reading events. We then engaged in multiple rounds of coding, beginning with a priori codes from our organization's framework and the 7C Model. In our final round of coding, we collapsed the codes into four emerging themes based on the 7C Model : affirmation, collective advocacy, community culture, and community ethos. Our findings suggest that engaging the writers at this community-based organization with a critical literacy curriculum a) increases awareness of self and others; b) enhances community culture; and c) develops self-efficacious leadership. We see the power of writing within community-based spaces as evidence of self-development and a marker for defining the truth behind youth's experiences.

Justin Egresitz

Graduate Program: Learning and Teaching in STEM

Advisor: Aaron Clark

Poster Number: 49

Think and Do: A Phenomenological Investigation into Student Motivation Toward Making and Doing

Technological literacy for all is the goal of technology and engineering education (T&E) instruction. While this has been the goal for several decades, technological literacy is lacking in the United States. To address this problem the current study investigates student motivation toward making and doing. By understanding student motivation toward this defining feature of T&E instruction, motivation and engagement can be bolstered leading to enhanced technological literacy for students. Using a hermeneutic phenomenological approach, six undergraduate students enrolled in a materials and processes technology course at a research one university in Southeastern United States were interviewed. From these interviews, the researcher found that the making and doing project, feedback and growth, and mental health impacts were all motivators of students toward making and doing. By focusing on these findings while developing curriculum and in-classroom practice, training preservice and veteran teachers, and while conceptualizing and conducting research, T&E professionals can bolster motivation for T&E content and ultimately positively impact the technological literacy of students.

Antonique Jones

Graduate Program: Clinical Mental Health Counseling

Advisor: Breana Parker

Poster Number: 81

The Barriers Black Men Face to Reentry

According to data from the U.S. Census, more than 1.5 million Black men, ages 25 to 54, are currently missing from daily life, with one of the leading causes being incarceration. The current U.S. prison population is approximately 2 million, with more than 1.1 million being Black men – the vast number returning within one to three years after their release. Once released, they face a litany of challenges as they are forced to navigate and confront institutional barriers within the justice system that put them at a disadvantage in reducing recidivism. Black men often return to low-income urban neighborhoods, plagued by substance use and criminal activity, and these neighborhoods are oftentimes the least resourced. Upon returning to communities, systems, and barriers that do not support successful reentry, the likelihood of rearrests and reconviction are high. Removing the barriers for Black men after incarceration is complex and layered due to its roots in systematic racism; current research calls for a holistic approach to reentry services, programs, and tactics. Research also supports the need for more studies to be done to assist formerly incarcerated Black men in successful reentry, as the needs of this population are generally not a part of nationwide health policy efforts.

Zhiqi Liu

Graduate Program: Counseling & Counselor Education

Advisor: Siu-man Raymond Ting

Poster Number: 98

Career Preparation for Master's-level International Counseling Trainees: A Psychology of Working Perspective

Compared with Domestic Counseling Trainees (DCTs), ICTs spend extra time adjusting training due to language barriers, cultural and system differences, and the restricted visa policy. As the community of ICTs grows, preparing for their job search increases demand. In this case, practicum experiences are the first impression of ICTs working as professionals in the United States. Most ICTs come to the United States with zero connections and job experiences in counseling. However, a lack of literature discusses how counselor educators can provide career preparation support for ICTs. This presentation will share reasons career preparation is necessary, how counselor educators can support ICTs, and the career preparation plan based on the Psychology of Working Theory. This presentation will include three reasons for the urgent need to support Master's-level International Counseling Trainees' (ICTs) career preparation, including the growing community of ICTs, challenges because of the lack of resources, cultural barriers, and reverse cultural shock. This research will elucidate how ICTs' lack of career preparation impacts their mental health. Through the analysis, this research will provide approaches based on the Psychology of Working perspective on how to support ICTs for career preparation in the United States as well as their home countries during training. In addition, further discussion will help apply these approaches in active counseling programs with international students.

Joey Marion

Graduate Program: Learning and Teaching in STEM

Advisor: Soonhye Park

Poster Number: 103

Development and Validation of the Relatedness and Autonomy Scale for Human Anatomy and Physiology Students

Many undergraduate students enroll in anatomy and physiology courses with intentions to pursue healthcare careers. According to self-determination theory by Ryan and Deci, three psychological needs of autonomy, relatedness, and competence must be met in order for optimal motivation and learning to occur. The theory also emphasizes the unique natures of each psychological need regarding their interconnections with one another. The current study details the development and two-round validation of an instrument entitled the Relatedness and Autonomy Scale for Human Anatomy and Physiology Students (RASHAPS). Items were adapted or developed from other studies regarding the constructs and population of interest. The first round of validation utilized exploratory factor analysis. Item elimination involved an iterative process through which multiple components were considered including theory, factor loadings, communalities, alpha, and factor strength. The final model utilized oblique factor rotation concluding with a 24-item instrument across three factors: autonomy, sense of belonging – instructor connection, and sense of belonging – peer connection. Factor loadings were strong ranging from 0.49 to 0.97 with no salient crossloadings. Confirmatory factor analysis was conducted for the second round of validation. Retained items demonstrated strong loadings onto their latent variables, and all were significant at the $p < 0.001$ level, including correlations between the constructs. The final model produced acceptable levels of goodness of fit including a comparative fit index of 0.954, a root mean squared error of approximation of 0.057, and a standardized root mean squared residual of 0.043. One major implication for the instrument and its development is further study of the relationship between autonomy and relatedness, an area of research meriting further investigation. Other potential implications include future studies to examine anatomy and physiology instruction, analyze construct magnitudes, make comparisons among students from different backgrounds, and identify barriers for underrepresented students intending to enter healthcare fields.

Jeanne McClure

Graduate Program: Teacher Education and Learning Sciences

Advisor: Shiyan Jiang

Poster Number: 105

Linking Cognitive Engagement to Deep Learning through Linguistic Synchrony in Open Ended Questions

Open-ended questions are used to develop and capture students' cognitive engagement and are linked to an increase in language and aid in assessing aspects of student cognitive engagement. THis research investigates the link between cognitive engagement and deep reading through linguistic synchrony. Using data from StoryQ, a HS AI curriculum, we assessed n= 28 students' open-ended questions of three modules on machine learning practices. We evaluated students' cognitive engagement with a developed coding scheme adapted from two popular cognitive engagement frameworks, Blooms taxonomy and Chi's Integrative, Constructive, Active and Passive (ICAP) theory of Active Learning. Scoring the written responses from 0-2. Additionally, to better understand cognitive engagement and students' literacy across the machine learning modules, we qualitatively analyzed students' responses by cross-recurrence quantification plots. We further compared students' cognitive engagement levels to the relationship between the indices of the cross-recurrence quantification analysis, and completion percentage as predictors. Our results revealed that completion percentage, along with the indices Recurrence Rate (RR), Number of Recurrence Lines (NRLINE), and Average Line Length (L), were significantly related to the student's cognitive engagement at both surface and deep levels. Based on the results from this study, scaffolded reading with engagement tasks, like open-ended questions, in teaching and learning on machine learning practices can produce higher levels of cognitive engagement and linguistic synchrony

Danielle Scharen

Graduate Program: Elementary Education

Advisor: Sarah J. Carrier

Poster Number: 142

Examining Elementary Pre-service Teachers' Use of the Touch-Talk-Text Science Instructional Model: An Exploratory Case Study Analysis

Children begin building a foundation for future learning at a young age as their observations about the natural world spark their curiosity. To foster young students' ongoing learning about the natural world, science instruction in elementary school is a critical part of a full education. However, since the No Child Left Behind act of 2001 led to a greater focus on accountability in literacy and mathematics, there has been a decrease in the amount of time, resources, and support dedicated to science learning in elementary schools. The purpose of this study was to evaluate elementary pre-service teachers' (PSTs') interpretation and application of the components of Touch-Talk-Text science instructional model (Carrier et al., 2021; Grifenhagen et al., 2021), an interdisciplinary approach to teaching science and literacy in elementary school. The model's components include active learning experiences in science (Touch), student-to-student discourse (Talk), and literacy connections in science (Text). This qualitative research used an exploratory single embedded case study design to understand how four elementary PSTs enrolled in an undergraduate elementary science teaching methods course interpreted, planned, and applied the components of the Touch-Talk-Text science instructional model. The data collected during and after the PSTs' science methods course - written lesson plans, reflections, and interviews - were coded and analyzed for recurring patterns and themes to present the PSTs' stories about planning and teaching a science lesson using the Touch-Talk-Text model. The findings from this exploratory case study suggest that the Touch-Talk-Text model may enhance existing science instructional models by intentionally blending science and literacy practices to focus on students' development of science skills, discourse practices, language development, and reading and writing skills. The interdisciplinary instructional practices represented in the Touch-Talk-Text model have the potential to break down the structure of siloed subjects and develop strategies for increasing science learning during a literacy-focused school day.

Erik Schettig

Graduate Program: Learning and Teaching in STEM

Advisor: Aaron Clark

Poster Number: 143

A longitudinal study of active learning on retention and persistence of students in engineering degree and technology, engineering, and design education degree programs

Through the Improving Undergraduate STEM Education (IUSE) project, collected data has shown evidence of active learning modules' positive impact on self-efficacy, mental rotation abilities, and academic success in an introductory engineering graphics course. While these results demonstrate improvement over a semester, longitudinal measures of students who experience active learning in a course have yet to be evaluated. Analyzing data related to a potential relationship between active learning and rates of retention and persistence can lead to enhancing student learning experiences through program developments.

Using an unused data set with institute-specific entries, analysis can occur to identify, if any, the impact that active learning modules may have on retention and persistence. The project will gather institutional data on the students who completed the GC120 course using active learning modules and compare it to a similarly sized sample of students who completed the GC 120 course where active learning modules were not provided. Furthermore, a GC120 course in Fall 2024 will be taught using active learning strategies and interview participating students to gain qualitative measures of student experiences in active learning that can impact retention and persistence.

This research is essential to not only technology, engineering, and design education but other STEM fields because with enhanced STEM learning experiences for students, engineering and other STEM programs can retain students and shape knowledgeable members of the future workforce. Analyzing quantitative and qualitative data for the potential effects between active learning and persistence can enable researchers to establish a foundation for program developments that include active learning within facilitative instructor models.

College of Engineering

Mesbah Ahmad, Orlin D. Velev

Graduate Program: Chemical Engineering

Advisor: Orlin D. Velev

Poster Number: 4

Soft, stretchable and biodegradable films for soft electronics made of glycerol plasticized biopolymers

Soft electronics is becoming widespread all over the world having wide range of applications such as robotics, medical field, and defense. However, introduction of these electronics is posing new perils to the environment mainly due to accumulation of electronic waste. Introducing of sustainable biodegradable materials can largely eliminate this problem. Since substrates constitute the major mass of soft electronic devices, selecting a substrate with suitable biodegradation profile will impact the overall device degradation. Stretchability is an important parameter for substrates that is receiving rising attention for skin-like and biocompatible devices. Agarose and chitosan are natural biodegradable polymers with potential as substrate films for soft electronics. Plasticizers such as glycerol can enhance the functional properties of these biopolymer films by imparting stretchability and flexibility. Consequently, plasticized agarose and chitosan films and their biocomposites have immense potential in replacing the existing synthetic, non-biodegradable fossil fuel-based films. Agarose, chitosan and their biocomposite films were prepared by solution casting method using glycerol as the plasticizer. The mechanical properties of these films were investigated for different ratios of biopolymers and glycerol. With increase in glycerol content, the maximum tensile stress for the agarose/glycerol, chitosan/glycerol and agarose/chitosan/glycerol films was observed to be in the same order of magnitude as of human skin and the elongation at break was recorded to be more than 60%. The thermal stability of the films was also investigated using thermogravimetric analysis, which demonstrated that agarose/glycerol and agarose/chitosan/glycerol films remain stable at elevated temperatures. Additionally, the swelling and the weight loss due to leaching in water were also studied to characterize the films.In this work, plasticization of agarose and chitosan biopolymers were demonstrated as means to reduce stiffness and impart stretchability in the films. The expected outcome of this work is technologies for producing soft, stretchable, and biodegradable substrate films for soft electronics that can transform into industrial scale manufacturing in future. Incorporating plasticized biopolymers and their composites into wearable and implantable electronics is expected to promote the seamless synchronization of electronics and humans.

Khaldoon A. Al-Dawood, Scott P. Palmtag.

Graduate Program: Nuclear Engineering

Advisor: Scott P. Palmtag

Poster Number: 5

LFR versus SFR Fuel Cycle Cost Comparison

Sodium Fast Reactor (SFR) and Lead Fast Reactor (LFR) are both considered Generation IV reactors promising of better safety, sustainability, economic, and proliferation resistance performances compared to the Light Water Reactor (LWR) technology. The significant differences in chemical and physical properties between lead and sodium result in significant differences in the design of LFR vs SFR nuclear island, generally, and the reactor core, specifically. Neutrons have a shorter mean-free-path in lead compared to sodium. This results in a larger neutron leakage component in a sodium-cooled system compared to a lead-cooled system with a similar geometry. However, fuel assemblies in SFR can be designed with a tighter lattice geometry compared to those in a lead-cooled system, which can potentially offer better neutron economy in SFR compared to LFR. Our research attempts to quantify the influence of coolant selection (i.e. lead vs sodium) on the fuel cycle cost. The benefit of this quantification is to help establish research directions for the future development of these reactors. To compare the influence of the coolant selection on the fuel cycle cost, two scenarios were suggested. In the first scenario, a hypothetical comparative model is suggested and used to quantify the influence of the neutronic

differences between lead and sodium cooled systems. The study shows that lead can offer up to 30% better fuel cycle cost compared to that of sodium. In the second scenario, a realistic comparison between LFR and SFR is performed. A Long-life core SFR (LSFR) is designed and compared to the design of the Westinghouse long-life core LFR (WLFR). The LSFR showed a comparable fuel cycle cost compared to that of WLFR.

Jack Almeter[1], James Loveless[1], Seiji Mita[2], Shashwat Rathkanthiwar[1], Will Mecouch[2], Pramod Reddy[2], Ronny Kirste[2], Ramón Collazo[1], Zlatko Sitar[1,2]

Graduate Programs: Materials Science and Engineering1; Adroit Materials2

Advisors: Ramón Collazo, Zlatko Sitar

Poster Number: 7

Growth of Relaxed AlGaN on Native Substrates

The AlGaN material system is a wide-bandgap semiconductor with important applications for ultraviolet emitters, detectors, and power electronics. Non-native substrates such as sapphire and silicon are widely available but result in low-quality crystals, with dislocation densities above 109 cm-2. The increasing availability of native AlN and GaN substrates enables growth of high-quality crystals, but AlGaN layers on AlN and GaN experience compressive and tensile strain, respectively. Compressive strain results in wafer bowing and tensile strain results in cracking, both of which are detrimental to device growth and processing. Since AlGaN substrates are not available, a way to relax this strain is needed. Normal (0001) epitaxy geometrically does not have access to the wurtzite primary slip system, so misfit dislocations (MDs) cannot be generated efficiently at the interface. Semipolar facets have access to the primary slip system but do not make suitable substrates. A maskless overgrowth scheme based on facet-controlled epitaxial lateral overgrowth is proposed to create a semipolar AlGaN/AlN interface to generate MDs while returning to (0001) growth for proceeding layers. First, AlN templates were patterned with a ridge/trench structure on which growth was performed under different conditions to characterize the facet formation. These data were used to select conditions to grow fully pyramid-faceted templates. Next, AlGaN was grown on pyramidal AlN templates. Conditions were selected based on the facet formation data to favor coalescence to a smooth (0001) surface. X-ray diffractometry was used to characterize the structure. The AlGaN layers exhibited full biaxial relaxation. This result provides a template for relaxed AlGaN, paving the way for applications in power and UV optoelectronic devices.

Keerthi S. Anand[1]; Ebrahim M. Kolahdouz[2], Boyce E. Griffith[2], Caterina M. Gallippi[1]

Graduate Programs: Biomedical Engineering[1]; Department of Mathematics, University of North Carolina at Chapel Hill[2]

Advisor: Caterina M. Gallippi

Poster Number: 9

Concurrent ARFI-Atherosclerotic Plaque Imaging and Wall Shear Stress Measurement in Ex Vivo Human Carotid Arteries

Carotid plaque rupture and downstream stroke are predicted by vulnerable plaque features and high diastolic wall shear stress (WSS). We have previously demonstrated high framerate multi-angle plane wave (PW) Acoustic Radiation Force Impulse (ARFI) log-Variance of Acceleration (log(VoA)) ultrasound imaging techniques for identifying plaque features. Here, we combine those methods with 2D vector Doppler (VD) blood flow measurement to simultaneously assess plaque features and WSS using a single data acquisition, with WSS validation by a staggered grid immersed interface method (IIM) solver. A human cadaveric carotid artery from a 68-yo was pressurized to 80 mmHg at 300 mL/min flow rate and imaged with combined ARFI + VD multi-angle PW sequences at various ultrasound transmission and processing schemes using an L7-4 transducer and Verasonics ultrasound research scanner. Geometric data from a volumetric aCT scan of the pressure-fixing carotid was used to generate structural surface meshes for fluid structure modeling applying a staggered-grid immersed interface method solver. Model-predicted 2-D flow and WSS were compared to those experimentally measured by VD, which were displayed together with ARFI log(VoA) images of plaque composition. Overall, results support that 2D vector flow and WSS results may be obtained alongside plaque structural information. Given the high frame rate of this unified approach, we also present accurate tracking of temporal and volumetric changes in flow and wall shear stress from prescribed pulsatile flow in a tube, which may be extended to associate dynamic changes in WSS to plaque rupture potential.

Rachel A. Broughton[1], Alexis Payne[1], Hao-Cheng Thong[2], Jacob L. Jones[1]

Graduate Programs: Materials Science and Engineering1; Materials Science and Engineering, Tsinghua University[2]

Advisor: Jacob L. Jones

Poster Number: 25

Bayesian Refinement of Full Profile X-Ray Diffraction Patterns for Uncertainty Quantification: Case Study of Ferroelectric Potassium Sodium Niobate

X-ray diffraction characterization techniques provide the ability to examine the atomic structures of crystalline materials. Diffraction patterns collected from these techniques are commonly analyzed through Rietveld refinements using least-squares fitting routines to obtain information about the atomic structure, lattice, and sample parameters of a material. Recently, an alternative Bayesian statistical framework has been applied to fitting full profile diffraction patterns. With this method, prior information on the diffraction model parameters is incorporated and the resulting posteriors display distributions of solutions. This Bayesian representation provides descriptive insights to the uncertainties in the model parameters and fits that reflect the inherent uncertainties within all material systems. In this work, a case study exemplifying one application of the novel Bayesian approach is presented for the ceramic material system potassium sodium niobate, K0.5Na0.5NbO3 (KNN). KNN is a promising lead-free ferroelectric system because of its excellent electromechanical properties. However, the applications of KNN are limited by poor reproducibility and material inhomogeneities that occur during synthesis. In this study, Bayesian refinements are performed on in-situ heating x-ray diffraction patterns of bulk ceramic KNN during calcination to monitor the formation and homogenization behaviors. The Bayesian results provide a map of the structural changes that occur in the system with increasing temperature. Enriched uncertainty information is obtained from the resulting descriptions of the lattice parameters. Ultimately, this approach provides an intuitive representation for the evolution of this inhomogeneous material system and a more informed determination of the homogenization temperature for KNN.

Jason M. Cox[1], Katherine R. Saul[2], Jacqueline H. Cole[1]

Graduate Programs: Biomedical Engineering[1]; Mechanical and Aerospace Engineering[2]

Advisor: Jacqueline H. Cole

Poster Number: 36

Trabecular Bone Organization in Rat Models of Brachial Plexus Birth Injury: Differential Impacts by Injury Location

Brachial plexus birth injury (BPBI) causes passive muscle contractures, joint dysplasia, bone microstructural deficits, and limb disuse in infants. Sequelae vary by injury location, with lower muscle mass deficits and greater shoulder contracture and joint dysplasia for postganglionic than preganglionic injury. BPBI alters loading on developing bone, but little else is known about underlying factors driving these outcomes, such as load-driven trabecular bone remodelling. Trabecular organization partially determines bone mechanical competence, with distinct roles for plate-like and rod-like trabeculae. Plates align with principal loading axes, imparting structural stiffness, and rods orient transversely, preferentially accumulating damage. Plate-rod organization therefore indicates ongoing bone adaptation to support external loads, yet how it is affected by BPBI has not been examined. Our goal was to characterize trabecular plate-rod organization in rat models of BPBI using our new quantitative metric, the structural organization index (SOI). Micro-computed tomography images of sub-glenoid trabecular bone from rats with unilateral injuries mimicking preganglionic (Pre) and postganglionic (Post) BPBI and a Sham case were analysed for injured and uninjured limbs. Among Pre, and Post groups, SOI was lower, reflecting less organization, for the injured versus uninjured limb. SOI was also lower for Post, but not Pre injured limbs versus Sham injured limbs. These findings suggest that glenoid dysplasia due to altered joint loading following BPBI is also reflected in sub-glenoid trabecular bone organization. Indeed, differences in the severity of glenoid dysplasia following Pre and Post injuries may be tied to differences in load-driven trabecular bone remodelling. Marked contracture following Post injury is known to deflect joint loads, which may encourage trabecular bone reorganization and concomitant development of glenoid dysplasia, whereas a lack of contracture following Pre injury cannot produce the same result. We conclude that SOI may be useful for developing and validating treatments to ameliorate joint dysplasia following BPBI.

Morgan Dalman

Graduate Program: Mechanical Engineering

Advisor: Katherine Saul

Poster Number: 40

Computational Modeling of Glenohumeral Contact and Translation

Altered humeral head translation (HHT) and glenohumeral contact forces (GHCFs) are key features underlying shoulder injury and disability such as rotator cuff tears and osteoarthritis. Accurate predictions of HHT and GHCF are essential for improving tendon repair, joint replacement, and physical therapy. Direct measurement of HHT has been achieved using techniques such as in vivo fluoroscopy and cadaveric models. However, loading at the joint is not available in vivo except using instrumented prostheses which is uncommon in the shoulder. Modeling provides an opportunity to capture joint translation and estimates of loading. However, current models use an inherently stable definition of the glenohumeral joint as a ball-in-socket which only allows for three rotational degrees of freedom around a fixed rotation center. While this decreases model complexity and computational demand, it simplifies the motions and prevents the study of glenohumeral translation and, as a consequence, the stresses induced at glenohumeral joint.Therefore, this research focuses on augmenting an existing upper limb musculoskeletal model to include GH contact and evaluate predicted HHT and GHCFs. Simulations were successful and were able to produce abduction over the whole range of motion. Simulations produced reasonable translations that followed a superior to inferior trajectory consistent with experiment. And overall displacements were also consistent with experimental results, with all simulations translating inferiorly about 4-6 mm. Results suggest individual variability in morphology may be important in evaluation of shoulder translation. This work provides an initial framework by which GHCF and HHT can be simulated and predicted in the shoulder. The outcomes of this work represent a critical step in understanding the interactions among musculoskeletal properties, muscle and joint loading, and shoulder function.

Meghna Das Chaudhury, Abinash Sahoo, Srinath V. Ekkad, Venkat Naranswamy

Graduate Program: Mechanical Engineering

Advisor: Srinath V. Ekkad

Poster Number: 41

Experimental and Numerical Study of Premixed Ammonia/Methane/Air blends in a Swirl Stabilized Gas Turbine Combustor

Rising levels of greenhouse gas emission has been primarily responsible for the observed shift in our climate and its various detrimental consequences. Reportedly, from 1990 to 2019, there was a 45% increase in the total warming effect due to greenhouse gases, and carbon dioxide alone was responsible for 36% of this increase. In this context, there is a worldwide resurgence of interest in alternative fuels for power generation that would minimize or totally cut-down carbon emissions leading to a sustainable future. Ammonia, containing 17.8% of Hydrogen by mass and having an already well-established production and distribution network seems to be a potential candidate in this regard. In our present work, an attempt was made to study the: 1) Emission Characteristics and 2) Combustor liner/wall heat transfer characteristics of premixed Ammonia-Methane-Air flames with a sustained Methane pilot using both numerical and experimental techniques at Reynolds number=50000 in a swirl-stabilized gas turbine combustor. The operating conditions and flow rates scaling close to industries and an attempt to stabilize the flame using both Methane pilot and an Industrial Swirler makes the work novel and unique and to the best of the authors' knowledge hasn't been done so far. For the numerical work, CONVERGE CFD and the ANSYS Chemkin software was used and for the experimental work, Infrared Thermography technique was used. Estimation of wall heat flux is extremely important with regards to industries as this would help in determining the expected cooling air requirements for the new fuel and the combustor liner material. Determining emission characteristics both with and without heat load is of practical importance too as this would help in ascertaining whether the effort to introduce an alternative fuel is plausible. In the future, our aim would be to study the flow characteristics and features of the flame using the Particle Image Velocimetry technique.

Mostafa Hamza

Graduate Program: Nuclear Engineering

Advisor: Mihai A. Diaconeasa

Poster Number: 64

Human Reliability Analysis of Multi-Module Advanced Reactors: Expectations, Challenges, and Solutions

Human interventions are an integral part of any system through design, operation, or maintenance. Although human intervention in safety-related actions in advanced reactors is reduced or completely replaced by automated actions, nuclear power plants require human actions throughout their lifecycle. Hence, the impacts of all operator actions are required to be captured and incorporated into the probabilistic risk assessment of the modeled plant. Furthermore, a risk-informed design expects that a PRA model, including human reliability analysis (HRA), is developed from the early design stages and used to inform all design iterations. However, due to the lack of details during the early design stages, HRA is often postponed until the design is mature enough. Conducting HRA in the final design stages comes short of informing later design iterations. Moreover, due to most HRA methodologies being developed utilizing operating experience of existing light water reactors, limited guidance is available to the applicability of different HRA methodologies during early design stages.

Hence, this study presents an investigation of the applicability of different HRA methodologies during the early stages of the design. The structure of nine HRA methodologies is assessed against the available procedures within different design stages. Furthermore, these different HRA methodologies are assessed based on the availability of guidance on how to use their results to risk-inform the design in an iterative design process.

Moreover, this study. presents a framework -OpenPHI- to include HRA during the design's early stages. OpenPHI provides a process for the screening of inconsequential operator actions and the identification of all key operator actions that are critical to the safety of the design. The results of the framework are then used to risk-inform following design iterations. Then, using information from the updated design, this framework can be reapplied to investigate the impact of the design update on human reliability.

Anna Iskhakova

Graduate Program: Nuclear Engineering

Advisors: Igor A. Bolotnov, Nam T. Dinh

Poster Number: 78

Toward Affordable Engineering-Scale Multiphase Simulations using Data-Driven Approach

Boiling is an effective method for heat transfer that is widely used in industrial applications including electronic devices, nuclear power plants, chemical reactors, etc. Although extensive knowledge and databases are established based on numerous theoretical, experimental and computational studies, prediction of boiling behavior in new settings remains challenging. Boiling is a naturally stochastic phenomenon that is greatly influenced by multiple parameters such as surface roughness and contact angle, local temperature gradients and imperfections in manufacturing processes, etc. To improve our understanding of physics that govern boiling heat transfer, significant efforts have been made at the Nuclear Engineering Department over the last two years. Boiling predictive capability combined with forced convection has been verified and validated for complex geometries with offset fins using a finite-elements code PHASTA. Even though such numerical studies become available, they are very computationally expensive even for a few millimeter-sized channels. Thus, a new data-driven approach is proposed that allows to use such modern machine-learning technics as super resolution and Fourier Neural Operator to improve coarse-grid PHASTA simulations. Once validated, such workflow would allow to obtain computationally affordable predictions of boiling dynamics for engineering-scale applications with much higher accuracy compared to existing methods.

Mahe Jabeen[1], Victoria Karakis[1], Vaishnavi Purusothaman[3], Steven Young[4], Adriana San Miguel[1], Balaji Rao[1,2]

Graduate Programs: Chemical Engineering1; Golden LEAF Biomanufacturing Training and Education Center2; Department of Obstetrics and Gynecology, School of Medicine, University of North Carolina at Chapel Hill3; Department of Obstetrics and Gynecology, School of Medicine, Duke University4

Advisor: Balaji Rao

Poster Number: 79

A 3D model with chemically defined synthetic matrix enables studies on the interaction between human cytotrophoblast and uterine stromal cells

One of the first events that must occur in pregnancy is the blastocyst implantation into the maternal endometrium. Defects in implantation and placentation often result in numerous pregnancy complications. Trophoblast stem cells give rise to the other tissues of the placenta. Molecular mechanisms underlying early human trophoblast development are still poorly known due to ethical limitations on research involving human embryonic and fetal tissues as well as mechanistic distinctions between human and animal models. Our research here employs a multidisciplinary bioengineering approach to develop a 3D culture model with a synthetic extracellular matrix (ECM), gelatin methacrylate(GelMA) based hydrogel and enables mechanistic studies on in-vitro trophoblast differentiation to invasive extravillous trophoblast (EVT). EVT cells anchor the developing placenta from the fetal end into maternal decidua. The present 2D and 3D in-vitro culture models for EVT invasion widely use poorly defined matrigel as ECM, derived from tumor tissue, and do not recapitulate the molecular pathways governing EVT differentiation in-vivo. With our micro-engineered quantitative and chemically defined 3D model, we can study the crosstalk between maternal stromal cells and trophoblast cells. Our results show that in presence of decidualized stromal cells, EVTs are less invasive compared to non-decidualized stromal cells. Also, our previous 2D in-vitro study showed the critical role of laminin protein in differentiating trophoblast stem cells(TSC) to EVTs. However, in 3D culture, we observed that initiation of EVT differentiation occurs even in the absence of laminin. Moreover, 2D and 3D cultures show different roles of TGFβ inhibitors in EVT differentiation. Presence of TGFβ inhibitor results in decrease in HLA-G+ invasive EVT cells. In 3D culture model, greater invasion is observed with TGFβ inhibitor. Thus, by combining knowledge from both 2D and 3D in-vitro models, this work will aid in understanding molecular mechanisms in normal and pathological trophoblast endometrium interaction during early placenta development.

Satyanarayana Konala, Ian Crawford, Thomas Batchelder, Ola Harrysson

Graduate Program: Industrial Engineering

Advisor: Ola Harrysson

Poster Number: 90

Analysis of Geometric Characteristics and Performance of Flexsplines Manufactured using Additive Manufacturing

Strain wave gears, used in high precision applications offer zero backlash, high torque transfer capability and a compact way of coaxial transmission. Currently, the high cost of the gears is in part due to the expensive manufacturing processes used and the amount of material wasted during machining. While additive manufacturing (AM) can be used to cut down manufacturing and material costs, the tolerances and surface finish demanded by the strain wave gears are outside the scope of traditional AM technologies available today. This study aims to characterize the effects of build orientation, heat treatment and various surface finishing operations on the dimensions and surface roughness. Additionally, various laser exposure parameters are being explored to improve part quality and density. Ultimately, this study aims to assess the functionality of a strain wave gear with a flexspline and a circular spline that have been manufactured using AM.

Yosra Kotb, Orlin D. Velev

Graduate Program: Chemical Engineering

Advisor: Orlin D. Velev

Poster Number: 91

Hierarchically reinforced biopolymer composite films as multi-functional plastic substitute

The excessive production and consumption of petroleum-based plastics have created ominous environmental and ecological impacts which is driving increased interest in developing biodegradable, renewable alternatives. We will report a new class of naturally derived biopolymer composites, which are envisioned as multi-functional biodegradable substitutes for polymer films. These films are based on nano and micro-scale reinforcement using our group's recently discovered soft dendritic colloids (SDCs). The SDCs are highly branched polymeric particles surrounded by a nanofibrillar corona produced from polymer precipitation in a turbulently sheared nonsolvent medium.The biocomposite films are based on an agarose (AG) polysaccharide matrix reinforced with chitosan (CS) SDCs. Owing to the entanglement network of hierarchically branched SDCs fibrils, the films acquire outstanding properties such as mechanical robustness and hydrophobicity. The excellent mechanical performance is attributed to a strong interlayer adhesion as well as an effective load transfer between the two networks. Due to a dense network formation and intermolecular interactions between the positively charged SDCs and the negatively charged matrix, the films become hydrophobic, which may overcome two challenging limitations to bio-derived functional materials – sensitivity to water and permeability by air. The intra- and intermolecular hydrogen bonding interactions between the SDCs and the matrix, arising due to the abundance of polar functional groups along both AG and CS molecules, were characterized using infrared spectroscopy. Morphological analysis showed that SDCs are well incorporated in the films indicating good spatial distribution in the matrix with no obvious signs of agglomeration. The characterization of the swelling of the films and their oxygen and water vapor permeability showed synergistic effects due to the SDCs inclusion. These films can find applications as next-generation functional biodegradable materials with properties that are comparable or superior to the current petroleum-based systems.

Kejun Li

Graduate Program: Industrial Engineering

Advisor: Hong Wan

Poster Number: 97

A Fluid Mean-Field Equilibrium of the Bitcoin Blockchain System

Bitcoin, the first and the most famous cryptocurrency leveraging the novel blockchain technology, has caught much attention from academia and industry in recent years. This work mainly investigates the dynamics of repeated mining games in the Bitcoin blockchain network. A mining policy is computed for each individual miner in the system. With constrained monetary budget and mining power capacity, we consider dynamic interactions among different types of miners and explore Nash equilibrium for the Bitcoin network. For tractability, we introduce two essential approximations: a fluid-level formulation to approximate a large number of mining games; and a mean-field approximation of many-player mining games. Under these two approximations, we solve for the fluid mean-field equilibrium (FMFE) and obtain the consequential FMFE-based mining strategy.

Varun Madathil

Graduate Program: Computer Science

Advisor: Alessandra Scafuro

Poster Number: 100

Privacy-preserving transactions for cryptocurrencies

Cryptocurrencies are inherently public, enabling anyone to observe transactions made by users, which provides public verifiability and enhances trust in the system, but also reveals users' personal and financial information to the public. Our research aims to address this challenge by developing algorithms for privacy-preserving transactions while maintaining their verifiability.

There are two types of cryptocurrencies - UTXO-based and account-based. While privacy-enhancing techniques have been proposed for UTXO-style cryptocurrencies like Bitcoin, there is currently no solution for full privacy in the account-based setting, such as Ethereum. All known solutions only provide a weaker form of anonymity, where the sender and receiver are anonymous within a small group of users, and to achieve full anonymity, the transaction size would have to be the order of the total number of participants, making it an impractical solution.

Our research solves this problem by achieving full privacy in the account-based setting with constant-sized transactions using cryptographic primitives, such as fully homomorphic encryption and zero-knowledge proofs. We are the first to demonstrate that full privacy is possible in account-based cryptocurrencies, and hope that our research serves as a starting point for further developments in the field.

Austin Mituniewicz[1], He (Helen) Huang[1], Michael Lewek[1,2]

Graduate Program: Biomedical Engineering[1]; Division of Physical Therapy, University of North Carolina at Chapel Hill[2]

Advisor: He (Helen) Huang

Poster Number: 110

Real Time Trip Prediction in People Recovering From Stroke

People recovering from stroke experience falls from internally generated trips during walking, where the foot does not fully leave the ground (or returns prematurely), at higher rates than age matched peers. Although training strength, balance, and specific reactive responses can reduce fall prevalence in otherwise healthy older adults, the presence of altered voluntary muscle control in people post-stroke limits the potential benefit of these interventions. Instead, our solution is to predict gait-related trips before they happen, thereby allowing for preventative strategies.

Accomplishing this task requires several steps, pun intended. First, we recorded the movements of people post-stroke as they walked on a treadmill and the forces they exerted on the treadmill with each step. As they walked wearing a safety harness, participants also performed various cognitive tasks that diverted attentional resources and increased the likelihood of a trip. Given the scarcity of trips (< 1 per 50 strides) and data set size (> 6000 strides), we developed an algorithm to detect the presence of abnormalities from the force data after toe-off was expected, ensuring identification of all potential trips and reducing the team's burden. Next, we will use an unsupervised machine learning algorithm, likely a one-class support vector machine, to examine the affected lower extremity's kinematics for anomalies found only in trips. After testing with the existing dataset whether subject specific tuning is needed or a general formulation can be composed, the results from the anomaly detection will then be used in a predictive algorithm. By controlling an assistive device such as a functional electrical simulator placed on an affected side muscle (e.g., tibialis anterior, hamstrings), this algorithm may preempt trips in real time.

Sarah E. Morgan[1], Morgan L. Willis[1], Carwynn D. Rivera[1], John J. Mahle[2], Gregory W. Peterson[2], Gregory N. Parsons[1]

Graduate Program: Chemical Engineering[1]; U.S. Army Combat Capabilities Command Chemical Biological Center, Aberdeen Proving Ground, MD2

Advisor: Gregory Parsons

Poster Number: 112

Rapid, Benign, Roll-to-Roll Metal-Organic Framework Fabric Production for Chemical Warfare Agent Protective Gear

Metal-organic frameworks (MOFs) are an emerging class of materials with wide reaching impact in catalysis, viral remediation, carbon capture, toxin filtration, and more. MOFs are composed of metal nodes coordinated by organic linkers notable for their high surface area and rich available chemistries. Yet, advances in MOF technologies have largely been limited by their powder form. MOF-fabric composites can overcome many challenges associated with powders by combining the chemical properties of MOFs with the flexibility and robustness of fabrics. However, MOF-fabric synthesis methods often heavily rely on harmful solvents, long reaction times, low yields, and batch processing. This work introduces a new, vapor-based approach for producing MOF-fabrics utilizing environmentally conscious solvents, rapid reactions, and semi-continuous processing. To produce MOF-fabrics, a starting fabric is first soaked in a precursor solution containing all components needed to form the MOF. The soaked fabric is then removed from the precursor solution and heated in the presence of a vapor to enable precursors diffusion and MOF crystallization on the fiber surface. This process is adaptable to roll-to-roll processing and achieves near total heterogenous MOF yield. Our MOF-fabrics are specifically developed for integration into chemical warfare agent (CWA) protective gear, and the MOFs chosen for this study are capable of adsorption and neutralization of organo-phosphine CWAs. We show that our materials greatly outperform activated carbon cloth, the current standard for CWA protection. For example, after 24 h, carbon cloth shows limited neutralization of nerve agent soman (20% degradation) whereas our material fully neutralizes the soman (100% degradation). Overall, this work presents an industrially relevant method to produce MOF-fabrics of which development is needed now more than ever due to the increase in global tensions including the Russo-Ukrainian War threatening both soldiers and civilians living in war torn regions.

Sneha Narasimhan

Graduate Program: Electrical Engineering

Advisor: Subhashish Bhattacharya

Poster Number: 114

Current Source Inverter for Medium Voltage Motor Drive Applications

The annual energy consumption in the US is mainly due to motor drive systems used in the industrial, commercial, residential, and transportation sectors. However, most motor drive systems are not controlled using variable speed drives (VSDs). The market barriers are high capital cost, large footprint, and limitations due to Silicon devices, i.e., low switching frequency and high losses. With the emergence of wide-bandgap (WBG) technology, using SiC and GaN devices is a step towards addressing these market barriers. Current source inverters (CSIs) are typically used for high-power medium voltage (MV) applications. However, the CSI technology has not been widely used for varied voltage and power ranges. WBG technology has led to the re-emergence of CSIs for varied applications. High-speed machines (HSMs) have rapidly grown in the past years. The motor needs to be connected to the high-speed machines through a mechanical gearbox with Si-based drives, reducing efficiency and power density. However, with WBG devices, the switching frequency can be increased; therefore, the inverters can operate at a higher fundamental frequency greater than 60 Hz. My research investigates the potential of MV-based CSI inverters with SiC-based devices for motor drive applications and HSMs. Studies on how the converter will be protected during fault operations are studied, thereby improving the system's reliability.

Sharda Pandit, Pritha Agarwalla, Yevgeny Brudno
Graduate Program: Biomedical Engineering
Advisor: Yevgeny Brudno
Poster Number: 117

Multifunctional scaffold platform for T cell engineering

Chimeric Antigen Receptor (CAR) T cell therapy has produced revolutionary success in hematological cancers. However, widespread use of these therapies in solid tumors is limited by extensive manufacturing procedures, therapeutic toxicity, limited in vivo persistence, and inability to achieve long-term therapeutic efficacy. Herein, we describe the use of implantable macroporous alginate scaffolds - 'Drydux' - for the generation of tumor-specific CAR T cells with accelerated manufacturing and improved cell function. These CAR T cell-generating scaffolds can be implanted within 3 days of T cell isolation, significantly reducing time, cost, and labor associated with current CAR T cell manufacturing. Drydux scaffolds demonstrated sustained cell release and produced functional CAR T cells in vitro and demonstrated enhanced efficacy compared to equal numbers of conventionally generated CAR T cells in animal models of systemic lymphoma, intraperitoneal ovarian tumor, metastatic lung cancer, and in an orthotopic model of pancreatic cancer. Additionally, scaffold-generated CAR T cells demonstrated improved in vivo persistence and maintained a less differentiated phenotype compared to conventionally generated CAR T cells providing long lasting antitumor effects. Drydux CAR T cell generation has the potential to transform CAR T cell therapy by producing highly functional and persistent CAR T cells without elaborate manufacturing, enhancing patient access to this revolutionary, but costly, therapy.

Andrew Martin[1,2,] Alana M. Pauls[1,2,] Boyce Chang[2,] Chuanshen Du[2,] Manish Kumar[2,] Peter C. Collins[1,] Sid Pathak[2,] Martin Thuo[1,2]
Graduate Program: Materials Science and Engineering1; Materials Science and Engineering, Iowa State University[2]
Advisor: Martin Thuo
Poster Number: 121

Energy Landscape Inversion

Materials surfaces and interfaces are pseudo-equilibrated components that are mass and energy dissipation fronts hence can be exploited to engineer the energy landscape of a material system. We demonstrate this ansatz by exploiting thin passivating oxides to stabilize an undercooled state, followed by photo-perturbation of the near surface order to induce convective Marangoni flows, edge-coalescence, and solidification into a metastable solid bearing asymmetric composition between the near surface and the core of formed particle. Particle size increases by up to 60 folds albeit with <0.1 the modulus of the native alloy. By tuning the size, composition, and orientation of the particle, we create high entropy high fidelity messages that can be decoded at different security levels.

Anna Phillips[1], Gabriela Torres[1], Doreen Steed[2], Melissa C. Caughey[1], Jasmin Merhout[2], Shanah R. Kirk[2], Terry S. Hartman[2], Cherie M. Kuzmiak[2], Emily M. Ray[3], Caterina M. Gallippi[1]

Graduate Program: Biomedical Engineering1; Department of Radiology, University of North Carolina at Chapel Hill2; Department of Oncology, University of North Carolina at Chapel Hill3

Advisor: Caterina M. Gallippi

Poster Number: 122

Breast Lesion Diameter in VisR Imaging Differs Between Malignant and Benign Masses in Women

Breast cancer is the most common cancer for women, and accurate screening is crucial for survivability. Ultrasound techniques like strain elastography (SE) have improved discrimination of malignant and benign breast lesions compared to mammography alone. In malignant cases, lesions typically appear larger in SE than in B-mode, whereas in benign cases, they appear smaller. This is quantified as the ratio of SE over B-mode lesion diameter (E/B ratio). However, SE is impacted by user error as it often involves manual tissue compression. For more consistent interrogation of tissue stiffness, we employ Viscoelastic Response (VisR) ultrasound, which estimates relative elasticity and viscosity of tissue based on acoustically induced displacements. Using VisR, analogues to E/B ratio using peak displacement (PD), relative elasticity (RE), and relative viscosity (RV), can be obtained. We hypothesize that VisR-derived lesion diameter ratios differentiate benign and malignant breast masses in vivo. Patients with BIRADS-4 or higher ratings were imaged at the UNC breast clinic. Lesion diameters were annotated on the B-mode, PD, RE, and RV images using Matlab. The VisR-derived diameters were divided by B-mode diameter to obtain lesion diameter ratio. Data included 32 malignant and 80 benign images from 28 women. Lesion diameter ratio using PD, RE, or RV significantly (Wilcoxon test, $p<0.0001$) discriminates benign and malignant breast masses. Interestingly, RE and RV had better separation than PD, possibly because PD is influenced by both elasticity and viscosity. Additionally, a logistic regression model using PD, RE, and RV as predictors classified lesions as benign or malignant with AUC of 0.92, better than each predictor individually. Sensitivity and specificity of the model were 0.93 and 0.81. The mechanism behind lesion diameter ratios differentiating malignant and benign cases is unknown, but results suggest that both elasticity and viscosity of the lesion boundary are impacted.

Ricky Pimentel[1], Lindsey Trejo[2,3], Gregory Sawicki[2,3], Jason R. Franz[1]

Graduate Program: Biomedical Engineering1; George W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology2; School of Biological Sciences, Georgia Institute of Technology3

Advisor: Jason R. Franz

Poster Number: 124

The interaction between biological tendon and ankle exoskeleton stiffnesses on walking metabolic cost

Passive-elastic ankle exoskeletons (EXO) facilitate ankle push-off and reduce walking metabolic cost by releasing elastic energy. EXO storage and return of elastic energy is governed in part by spring stiffness (kExo) which could interact with tendon stiffness (kT). Biological kT largely affects walking economy and changes considerably across the population. Objective personalization is necessary to successfully deploy EXOs. Prolonged device testing and tuning burdens both the users and prescribing professionals. Musculoskeletal modeling provides an opportunity to streamline EXO prescription by identifying a candidate kEXO that most favorably interacts with kT to reduce walking metabolic cost. Our purpose was to estimate individual-muscle metabolic costs across a range of simulated kT during walking with EXOs at various kEXO. We hypothesize that ankle EXOs will yield optimal benefits when balancing kT and kEXO. One older (OA) and one younger (YA) adult walked in a pair of Dephy Exoboots at 1.25 m/s for all trials. The EXOs emulated passive-elastic devices at kEXO=1200, 3600, & 4800 Nm. After >60 minutes of EXO habituation, we recorded motions, forces, torques, and metabolic cost during walking. We added a point mass with EXO inertial properties to the model and supplied simulation torque bilaterally to each ankle. We scaled personalized models for each subject and, because we couldn't explicitly change kT, we altered tendon strain ($\varepsilon 0$) for all 92 muscle-tendon units across a biological range ($\varepsilon 0$ = 2, 4, 6, & 8% strain at max force) and at each subject's measured $\varepsilon 0$ (OA: 6.7%; YA: 3.4%). We found that kT($\varepsilon 0$) appears to affect walking metabolic cost to a larger extent than kEXO. Additionally, OA & YA seem to have opposite reactions to kEXO, showing a potential group-specific interactions. We continue to interpret our outcomes to objectively define the metabolic landscape via kT-kEXO interaction to inform EXO prescription.

Prasanth Prabu Ravichandiran, Paul D. Franzon

Graduate Program: Electrical Engineering

Advisor: Paul D. Franzon

Poster Number: 131

3D-OoO-PNM: 3D Out-of-Order Processing Near Memory Machine Learning Accelerator

Data-intensive tasks like machine learning with little data reuse are constrained in performance due to memory bottlenecks. One solution is to move the computations closer to the memory with processing near memory (PNM) or near-memory computation (NMC) techniques. The 3D-stacked memories are a great enabler of PNM and NMC as they expose the total available bandwidth of the 3D memory through TSVs, reducing memory access latency, and thus improving overall performance.We propose an architecture that is dynamic/programmable for adapting to many machine learning (ML) workloads like Generative Pre-trained Transformers (GPT), sparse Convolution Neural Network (CNN), Deep Neural Network (DNN), Multi-layer Perceptron (MLP), and Long Short-Term Memory (LSTM). The architecture leverages innovative out-of-order partial production accumulation, rank-interleaving, and dynamic elimination of inconsequential computations/memory accesses techniques to reduce data movement. These improve the performance and power efficiency of the commonly used machine learning computation units like matrix-multiplication, convolutions, dot-product, normalization, activation functions, and pooling. The architecture scales to memory efficiently with an array of 3D-sub-system-column (3D-SSC). These 3D-SSCs form a mesh network, allowing for load-sharing within them to maximize the utilization and reducing thermal hotspots. The high-level simulation of this architecture shows promising results over the normalized prior state-of-the-art accelerators, especially in the training without any inference degradation. The computation latency improvements are 13.29x, and 17.6x for a 32x32 training matrix multiplication and 256x256 convolution respectively. Similarly, the energy consumption reduction improvements are 12.93x, and 16.88x for a 32x32 matrix multiplication and 256x256 convolution respectively. These results provide a promising outlook in efficiently accelerating inference and training of the upcoming ML workloads like GPT. This architecture addresses the challenges of prior prominent accelerators with adaptability, scalability, thermal management to efficiently process the workloads.

Erik Rosenstrom

Graduate Program: Operations Research

Advisor: Julie S. Ivy

Poster Number: 135

Identifying Individuals at Risk of Vision Threatening Diabetic Retinopathy

Diabetic retinopathy (DR) is a complication from diabetes which can become vision threatening (VTDR) and cause blindness. In the US, an estimated 899,000 diabetic adults have VTDR despite it being preventable with timely treatment. VTDR is difficult to catch due to the slow progression and dependence on patients' care seeking behavior. Here we address these challenges by leveraging 20+ years of electronic health records to construct and extend ensemble classifiers to (i) identify patients that will develop VTDR within the next year and (ii) to identify those that will develop DR in the next year. We can achieve high recall (>80%) for both classification tasks. In practice this classifier can personalize care coordination to improve utilization and timing without any additional patient actions.

Mahe Rukh, Runxia Cai, Kunran Yang

Graduate Program: Chemical Engineering

Advisor: Fanxing Li

Poster Number: 136

Isothermal CO2 separation enabled by redox-active mixed oxide sorbents

Reducing anthropogenic greenhouse gas emissions, especially CO2 emissions, has been the focus of many government and industry projects in recent years. A rapid transition to net zero emissions could be facilitated by rapidly scaling up low-carbon sorption-enhanced hydrogen production among other low-carbon initiatives. There are several different broad categories of proposed materials to separate CO2 from the pre-combustion gas mixture. The most widely available sorbent, CaO has the operating temperature in the range of 600-700 °C for carbonation and 850-950°C for calcination which is prone to capacity loss due to sintering. Alkaline ceramic metal oxides such as Li4SiO4 cycles between 500-600 oC for carbonation and >700oC for regeneration however is limited due to slow kinetics. The sorbents are regenerated in a strongly endothermic calcination reaction which requires notably high heat requirements causing low grade heat as output which is inefficient from second law perspective. In this paper, we demonstrated a different process for CO2 capture by utilizing oxygen partial pressure swing between the carbonation and regeneration cycles. Incorporating sorbents that undergo phase transitions with reaction condition shifts enable us to tune the operating temperatures even further. Perovskite oxides are such phase transition sorbents which have shown to be effective in both non-isothermal and isothermal systems. Synthesizing and testing all possible materials is not feasible, and therefore it is desirable to develop an easy-to-use screening methodology without using much computational power to identify the most promising candidates for the target application. Hence, we propose a design/screening methodology for PTSs for preferred H2 yield/purity based on thermodynamic assessment.

Tripti Samal

Graduate Program: Computer Science

Advisor: Rudra Dutta

Poster Number: 138

Communication in a Drone-Platoon using Geographic Routing

Aerial networking has been the subject of growing research with the rising possibility of Unmanned Aerial Vehicles or drones being used in a broad variety of contexts and a broad range of environments. Package delivery companies such as Amazon and UPS have invested heavily in UAS capabilities, and many other military, government, and consumer applications of UAS have attracted major attention, e.g. by Google, Boeing, and Uber, among others.

While these UASs are each expected to embody an agent with significant computing capability, and capable of a good deal of autonomy, the need for connectivity to/from such agents remains paramount, for application-level coordination with other computers on the ground (for image-analysis in a core or edge computing cloud, for example). Further, when a particular application requires a platoon of UASs rather than a single one (such as urban roadway traffic monitoring, air quality sensing, etc.), there is a need for intra-platoon communication. Therefore, routing for internal communication within a platoon of drones has been considered an important problem, in the face of time-varying and large range of possible positioning of various drones within a platoon. Single-route approaches, whether proactive or reactive, are susceptible to voids, as well as dynamic topology variation. Drawing on previous work, we investigate the applicability of geodiffuse pathsets, a type of geographic routing, in the aerial context.

In this poster, we discuss the applicability of such a routing approach (called Petal Routing), and its variations in the drone-platoons. Our results from this investigation confirm that our approach is a promising one for further study and application in drone platoon networking considering the combination of fast-changing platoon topologies and bulk data transfer.

Harry M. Schrick[1], Somayeh Kashani[2], Ali Altaqui[3], Jeromy Rech[4], Wei You[4], Lee Richter[5], Michael Kudenov[3], Harald Ade[2], Brendan T. O'Connor[1]

Graduate Programs: Mechanical Engineering[1]; Physics[2]; Electrical Engineering[3]; Chemistry, University of North Carolina at Chapel Hill[4]; Materials Science and Engineering, National Institute of Standards and Technology[5]

Advisor: Brendan T. O'Connor

Poster Number: 144

Polymer semiconductor alignment enabling single pixel polarization and multispectral sensing

In-plane alignment of polymer semiconductors leads to anisotropic optoelectronic properties that can be exploited for multiple applications including polarization sensitive photodetectors, light emitting devices, and thin film transistors. Seeing as performance metrics improve as the degree of alignment increases, maximizing in-plane alignment is highly desirable. We leveraged the unique thermomechanical properties of a semiconducting polymer PBnDT-FTAZ to achieve record in-plane alignment, reaching an optical dichroic ratio of nearly 40. To better understand the mechanisms behind this striking film alignment we conducted a comprehensive analysis on the aligned film using a combination of in situ and ex situ spectroscopy, X-ray scattering and dynamic mechanical analysis. Our investigation uncovered a thermotropic liquid crystal mesophase in the PBnDT-FTAZ, not observed through calorimetry. The exceptional alignment wass attributed to templating from ordered seed crystals just prior to the onset of liquid crystal isotropization. These findings not only demonstrated a polymer semiconductor with exceptional polymer alignment but also uncovered phase behavior with broad implications for process-structure-properties relationships in these materials. We utilized the high alignment of PBnDT-FTAZ in a blend with P(NDI2OD-T2) for a bulk heterojunction activlayer in semitransparent polarization sensitive photodetectors. The blend film reached optical dichroic ratios of over 18, and photocurrent ratios surpassing 15 when under orthogonally polarized light, representing the most polarization sensitive organic photodetectors to date. Inspired by the mantis shrimp, which features up to 16 photoreceptor cells capable of perceiving light ranging from UV to far-red as well as polarized light, we combined the polarization sensitive detectors with folded polymer retarders for spectrally dependent polarization rotation to realize single pixel polarization and multispectral sensing. We demonstrated detection of four spectral channels with a spectral resolution of up to 16.9 nm while simultaneously measuring the linear polarization state of light, representing significant advancement in spectral and polarization imaging.

B. Sekely1, P. Barletta[1], G. Allion[1], M. Cerullo[1], C. Haber[2], S. E. Holland[2], J. F. Muth[1]

Graduate Program: Electrical Engineering[1]; Lawrence Berkeley National Laboratory[2]

Advisor: J. F. Muth

Poster Number: 147

Fast Timing With Silicon Carbide Low Gain Avalanche Detectors

The next generation of particle detectors at the Large Hadron Collider at CERN will need improved sensitivity and time resolution.[1] Current silicon strip and pixel detectors are limited to a few nanoseconds. Future generation silicon Low Gain Avalanche Detectors (LGAD) and AC-coupled Low Gain Avalanche Detectors (AC-LGAD) can be faster with 10's of picosecond resolution. However, Silicon detectors will need to be operated at cryogenic temperatures and may have limited life due to radiation damage. Our approach is to explore the use of 4H-SiC as an alternative to silicon due to the wide bandgap and radiation resistance that potentially allow higher operating temperatures, higher timing resolution, and more durable detectors. While SiC is expensive compared to Silicon, the increased availability, and lower costs of SiC wafers and epitaxy due to strong industry interest in using SiC for high-power devices and electric vehicles are enabling the development of SiC devices for niche applications. The ability to operate at higher temperatures and with improved radiation resistance can also lower the overall detection system cost.

Comparing the material properties of Silicon Carbide with Silicon, we expect:

- Lower leakage currents due to wide bandgap (3.3 eV), allowing room temperature operation.
- Better time resolution due to higher mobility of drift carriers (μn = 800-1000 cm2/V*s).
- Higher breakdown voltages and breakdown fields (3.5 MV/cm2) allowing for a higher bias voltage to support the gain layer.
- Higher thermal conductivity (370 W/m*K) contributing to better heat transfer and device lifetime.

- Higher atomic displacement energy threshold (22-35 eV) resulting in better radiation resistance.
- Higher saturated electron velocity (2.7x107 cm/s) leading to faster signals.

The development of a process flow to fabricate a SiC LGAD devices with preliminary fabrication and electrical characterization and device simulation will be presented. [1]DOE Basic Research Needs Study on Instrumentation for HEP, https://science.osti.gov/hep/Community-Resources/Reports

Darpan Shukla, Yong Zhu

Graduate Program: Mechanical Engineering

Advisor: Yong Zhu

Poster Number: 151

Eco-friendly Screen Printing of Silver Nanowires for Flexible and Stretchable Electronics

Screen printing is a promising route towards high throughput printed electronics. Currently formulation of nanomaterial based conductive inks involves complex formulation with often toxic surfactants in the ink's composition, making them unsuitable as an eco-friendly printing technology. This work reports the development of a silver nanowire (AgNW) ink with a relatively low conductive particle loading ink of 7 wt%. The AgNW ink involves simple formulation and comprises a biodegradable binder and a green solvent with no toxic surfactants in the ink formulation, making it an eco-friendly printing process. The formulated ink is suitable for printing on diverse range of substrates such as polydimethylsiloxane (PDMS), polyethylene terephthalate (PET), polyimide (PI) tape, glass, and textile. By tailoring the rheological behaviour of the ink and developing a one-step post-printing process, a minimum feature size of 50 µm and a conductivity as high as 6.70×106 S·m-1 was achieved. Use of a lower annealing temperature of 150 °C makes the process suitable for plastic substrates. A flexible textile heater and a wearable hydration sensor were fabricated using the reported AgNW ink to demonstrate its potential for wearable electronic applications.

Mariam Sohail[1], Tahira Pirzada[1], Charles Opperman[2], Saad A. Khan[1]

Graduate Programs: Chemical Engineering 1; Entomology and Plant Pathology2

Advisor: Saad A. Khan

Poster Number: 153

Sustainable Material Platforms as Controlled Delivery Vehicles for Agricultural Actives

Achieving food security for an exponentially growing global population is one of the major challenges faced by the world today. While agriculture sector is largely dependent on the use of various agrochemical active ingredients, their environmental footprints raise considerable concerns. Additionally, increased use of agrochemical actives results in the development of pest resistance, which in turn necessitates larger number of applications thereby continuing the cycle. While the complete discontinuation of agrochemical usage is not possible considering their utility in the food supply network, their use can be minimized through the development of sustainable controlled release platforms. Our research revolves around this premise, where we investigate the use of biodegradable cellulose-derived materials to develop various controlled release formulations for agricultural actives. We develop particles from environmentally benign cellulosic materials from an easily scalable solvent evaporation process, incorporating the particles in both aqueous dispersions and emulsion-based formulations. While aqueous dispersions are ideal for use as foliar AI sprays, emulsions can potentially be used in both foliar and root-based applications. Our work includes an overall fundamental and applications oriented approach, where we progress from understanding the material synthesis process from an elementary level to modulating the control parameters to achieve the required performance benefits. We have evaluated the compatibility of the synthesized formulations with both synthetic agrochemical actives and plant growth-promoting microbes through a rigorous spectrum of tests including release profile evaluation via HPLC and bio-assays, as well as viability and rainfastness studies. Our proposed formulations open a window of opportunity to achieve controlled active release and minimize their use, thus enabling the achievement of sustainable crop protection

Abhinaya Srividhya Balaji[1], Aafaq Sabir[1], Anupam Das[1], Vanessa Volpe[2]

Graduate Programs: Computer Science[1]; Psychology[2]

Advisor: Anupam Das

Poster Number: 137

Protego Totalum: Mitigating Harassment in Virtual Reality

An uptick in incidents of harassment in Virtual Reality (VR) has accompanied the increased adoption of VR in recent years. To prevent these experiences, VR apps have introduced safety controls such as mute, block, proximity settings, quick travel, and safe zone. However, they are not standardized across the VR ecosystem, and highly differ in their implementation in the context of social, gaming, and streaming VR apps, even if they offer the same functionality. In our work, we focus on understanding the availability, accessibility, and effectiveness of these safety controls in VR. We also investigate the strength of the reporting mechanisms employed in popular VR apps and headsets. We derive our insights based on our semi-structured interviews of VR users with experiences of harassment on VR platforms. Based on our systematized knowledge and analysis of the participants' responses, we classify the various safety strategies in VR, identify those that are effective, and highlight innovative design considerations that might lead to more effective harassment controls in VR.

Brent Vizanko[1], Leonid Kadinski[2], Avi Ostfeld[2], Emily Berglund[1]

Graduate Program: Environmental Engineering[1]; Civil and Environmental Engineering, Technion, Israel Institute of Technology[2]

Advisor: Emily Berglund

Poster Number: 166

Water distribution infrastructure changes caused by COVID-19 prevention behaviors

The COVID-19 pandemic dramatically changed daily routines for people across the globe due to the adoption of social distancing measures, such as working from home and restricted travel. Changes in daily routines created new water demand patterns, and the spatial redistribution of water demands in urban water distribution system networks affects water age, nodal pressures, and energy consumption. A range of factors influence individuals' social distancing decisions including demographics, risk perceptions, and prior experience with infectious disease. This research develops a comprehensive modeling framework to capture decisions to social distance, the effect of social distancing on water demands, and the effects on the performance of water infrastructure. First, Bayesian belief network (BBN) models are developed to simulate social distancing decision-making based on publicly available survey data describing COVID-19 risk perception, social distancing behaviors, and demographics. Feature sets are developed from a set of participant characteristics using forward selection and Naïve Bayes classifiers to predict behaviors, including working from home. BBN model output is used within an agent-based modeling (ABM) framework to simulate how individuals interact within a community and dynamically adopt social distancing behaviors based on communication and transmission of infection. Agents represent individuals who transmit COVID-19, communicate with each other, decide to social distance, and exert water demands at residential and non-residential locations. COVID-19 transmission among agents is modelled using a susceptible-exposed-infected-removed (SEIR) model. Finally, the ABM is coupled with a water distribution model to simulate how changes in the location of demands affect water distribution metrics. The model is applied for a virtual city, Micropolis, to explore how varying population characteristics can affect water infrastructure. This research provides a new framework to develop and evaluate water infrastructure management strategies during pandemics.

Venkata B. Vukkum[1], J. Christudasjustus[1], Ahmed A. Darwish[1], Steven Storck[2], R. K. Gupta[1]

Graduate Program: Materials Science and Engineering[1]; Research and Exploratory Development Department, Applied Physics Laboratory, Johns Hopkins University[2]

Advisor: Rajeev Gupta

Poster Number: 168

Enhancing the corrosion resistance of additively manufactured 316L stainless steel via feedstock modification

Laser powder bed fusion (LPBF) is a popular additive manufacturing (AM) technique used to fabricate complex 3D components layer-by-layer processes. The parts produced by LPBF are often reported to have lower build densification due to stochastic porosity, which negatively influences the corrosion performance of AM Materials. In order to minimize porosity, and meet the requirements of superior corrosion behavior, optimization of LPBF processing parameters and/or post-processing are conducted. However, including post-processing ultimately increases the cost and time to deliver AM components and is desired to avoid. Therefore, this research presents a feedstock modification strategy that can improve the corrosion performance of LPBF-316L, help streamline the workflow, and eliminate expensive post-manufacturing steps. The feedstock modification is carried out by ball milling of specific additive and 316L stainless steel powder, and the collected composite powders were laser powder bed fusion printed. Different additives have been explored that can improve the corrosion performance of LPBF-316L. Additives that could not distribute themselves in the 316L alloy matrix were segregated and showed localized galvanic corrosion. In contrast, the additive that distributed itself showed significantly improved corrosion performance, as evidenced by a high breakdown and repassivation potential and the absence of metastable pitting. The improved corrosion performance of LPBF-316L-additive was correlated with microstructural changes, modified chemical composition, and passive film characteristics.

Yifan Zhao

Graduate Program: Computer Science

Advisor: Ranga Raju Vatsavai

Poster Number: 186

Multi-modal Data Fusion for Remote Sensing Cloud Imputation With User Preference

For more than five decades, remote sensing imagery has been providing critical information for many applications such as crop monitoring, disaster assessment, and urban planning. Unfortunately, geoscience records show that more than 50% of optical remote sensing images are contaminated by clouds. As a result, valuable information is hidden under the clouds. Historically, cloud imputation techniques were designed for single-sensor images, thus existing benchmarks were mostly limited to single-sensor images. However, single-sensor cloud imputation has a limited amount of effective data, practical use, and performance, since it precludes design and validations on multi-sensor data. However, thanks to recent advances in remote sensing instruments and the increase in the number of operational satellites, we now have petabytes of multi-sensor observations covering the globe. Our work aims at extending the state-of-the-art of cloud imputation to the multi-sensor and multi-resolution, together referred to as multi-modal, frontier. In this work, our contributions are as follows: (1) a new benchmark data set that fills an important gap in the existing benchmark datasets, which allows the exploitation of multi-sensor spectral information from the cloud-free regions of temporally nearby images; (2) a new multi-stream deep residual network (MDRN) that addresses imputation using the multiresolution data with newly proposed components of multi-stream fusion and composite up-sampling structure; (3) a novel instance normalization technique inspired by the style transfer problem in the regular computer vision (CV) area, that exploits the style information from the cloud-free regions to reduce the style differences between the target and predicted image patches.

College of Humanities and Social Sciences

Ellen Atterbury

Graduate Program: Spanish Language & Literature

Advisor: Greg Dawes

Poster Number: 13

El recuerdo y el olvido: Una recreación del pasado desde la perspectiva de la mujer en Voyager (2019) de Nona Fernández

Voyager (2019) de Nona Fernández es una historia de rechazo y aceptación que trata de reformar la historia del pasado chileno de la dictadura de Augusto Pinochet (1973-1988). Voyager es un libro que trasciende las fronteras entre ficción y realidad para darnos una historia nueva de lo que es la historia y en qué consisten las memorias humanas. Dentro de este ensayo, se desarrolla una aproximación de la realidad que viene de la experiencia de las mujeres chilenas del pasado y del momento actual. Esta realidad se basa en el uso de las experiencias personales de la autora y su madre y abuela, las víctimas y la astronomía, relatos que construyen el pasado y promueven el sentido de aceptación de lo que pasó, enfatizando la importancia de recordar. Lo especial del libro es el enfoque en la experiencia de las mujeres de una memoria colectiva que constituye el tema principal de la obra de Fernández. La autora impone un cuestionamiento de la historia oficial divulgada por el régimen y participa en la nueva ola de escritores se llama "literatura de los hijos" que buscan reconocimiento y justicia por su trauma. Este libro cuenta la historia de resiliencia humana, pero también, explora las relaciones institucionales y hegemónicas que invaden la experiencia humana y la lucha contra ellas. Las mujeres juegan el papel de mediadores de la reclamación de la memoria colectiva de la dictadura, y el libro de Fernández muestra un paso adelante en esta lucha.

Raiza D. Báez Calderón

Graduate Program: Public History

Advisor: Alicia McGill

Poster Number: 14

Updating Heritage: Spontaneous Commemoration Practices in Times of Revolt

During the summer of 2019, hundreds of thousands of Puerto Ricans took the streets of Old San Juan, a 500-year-old historic town, demanding the departure of Puerto Rico's governor Ricardo Rosselló. As a result, and for the first time in the island's modern history, the governor resigned. Although the protests were, for the most part, peaceful, historic buildings were vandalized. Also, protesters changed the historical names of some streets to memorialize the importance of the moment and to reinterpret the meaning of Old San Juan streets. For example, Calle Fortaleza (Fortress Street) became Calle Resistencia (Resistance Street). However, opposition to these changes grew and the street names reverted to their official ones. Opponents argued that these changes damaged the heritage of Old San Juan. This paper examines the public debate that this issue provoked between the city government, heritage organizations, and other conglomerates, to problematize the role and weight of these groups in today's commemoration and public history interpretation practices in Puerto Rico. I argue that this conflict reflects how some of the most important Puerto Rican public and private heritage organizations still follow the traditional paradigms of the conservation field and fail to recognize the importance of spontaneous commemoration practices, especially the ones on behalf of current disruptive events.

Krista M. Baker, Rachel J. Donovan, Christina M. Franke, Olivia E. Meyerhoffer

Graduate Program: Social Work

Advisor: Paige L. Moore

Poster Number: 77

Trauma-Informed Care and the Criminal Justice System

An estimated 223.4 million adults and 45 million children have experienced a traumatic event in their lifetime resulting in an increased likelihood of Criminal Justice (CJ) involvement. Involvement in the CJ system further serves to traumatize individuals due to lack of trauma-informed care (TIC) training and competence among judges and legal professionals. As interdisciplinary collaboration and evidence-based interventions are integral for mitigating the risk of retraumatization within the CJ system and improving diversion program utilization, this evaluation explores how trauma-informed knowledge for CJ employees impacts mental health deferrals. This quantitative study addresses the research question posed through a Qualtrics survey of Public Defenders and Defense Attorney office professionals to assess existing knowledge of TIC, knowledge of the Wake County Mental Health Deferral Program (MHDP), and the impact of this knowledge on the number of deferrals.With previous research serving as evidence supporting the value of TIC training on mental health deferrals, we hypothesize that providing legal professionals with TIC will increase the utilization of MHDP. This study aims to inform future social work and legal collaborations, improve diversion program development and utilization, and support the dignity and safety of CJ-involved individuals by decreasing the risk of retraumatization and future involvement.

Cristin Boswell, Alissa Childress, Lauren Hales, Sierra McAroy, Arianna Morgan, Emily Pulley

Graduate Program: Social Work

Advisor: Eric Tucker

Poster Number: 1

Hope Services Evaluation Plan Abstract

The number of school-aged children, ages five to seventeen, treated for mental health concerns is continuing to increase with 93% of educators reporting high concerns regarding students' mental health (Moon et al., 2017). Hope Services School-Based Mental Health program serves the Johnston County public school system, working with school-aged children to address various mental health issues. Currently, the American School Counselors Association recommends a 1:250 counselor-to-student ratio (Demissie & Brener, 2017), yet Hope Services currently utilizes approximately a dozen school-based mental health clinicians to service 37,000 students (Guillory, 2021). There are no current plans to expand the number of school-based mental health clinicians at Hope Services. This study will examine current school-based mental health clinicians' experiences with Hope Services, including burnout and patient quality of care, as well as their perspectives on youth mental health and the need for additional clinicians, specifically within the public school system.

Jason Boan

Graduate Program: Public History

Advisor: Frederico Freitas

Poster Number: 20

When Plural Histories Collide: Podcasting Context

Memorials and monuments of all kinds require context to have meaning. When public installations lack context, visitors are left to interpret the spaces, structures, and images and assign meaning. All histories are plural in nature. Not providing context creates space for incorrect histories to be applied, challenges to motivations, conflicting perspectives, and calls for removals. What happens when public interpretation weights historical aspects differently than the installation designers, challenging why a historical individual or event was selected for public memorialization? How can public historians use digital history to navigate and present plural histories in cases where stakeholders disagree about content, meaning, and intention? Interviewing stakeholders and creating topical podcast series allow digital public historians to present the history in question while also creating a place for all perspectives to contribute, in their own words and voices, to the histories moving forward. To demonstrate how publicly accessible podcasts are an ideal medium to provide accurate historical context alongside open and honest conversations from multiple perspectives I use the case of a student-led effort challenging the NCSU College of Design's installation of a terrazzo floor mosaic in the Allred Gallery. The installation is reflective of and bears the signature of Le Corbusier, a highly influential architect and problematic historical figure. Though Le Corbusier made many contributed to modern architecture, he was also an anti-Semite and fascist. There is no context in the space to acknowledge either aspect of his history, nor a justification of why time, space, and capital were devoted to such a debatable figure. Through interviews with relevant stakeholders- journalists, students, and faculty, the Historical Distortions Podcast presents the plural history of the Le Corbusier terrazzo floor installation.

Stephen Creech

Graduate Program: English

Advisor: Barbara Bennett

Poster Number: 37

Politically Deconstructing QAnon through Nick Pizzolato's True Detective

On January 6th, 2021, far-right radicals organized under an ideology broadly labeled as "QAnon" attacked the US Capitol. The QAnon conspiracy alleges that countless high-profile individuals secretly partake in violent Satanic rituals. Although uniquely alarming because of its followers' widespread belief, QAnon is not the first narrative to imagine the powerful as a Satanic cabal. Nearly a decade prior, Nick Pizzolato's True Detective (2014) uses this cultic worship trope to represent the societal anxieties of rural poverty and corrupt government. Numerous scholars have recognized and responded to the show's treatment of social, political, and philosophical themes like toxic masculinity and trauma, environmental justice, and even philosophical concepts like Nietzsche's eternal return. However, scholarly response to the show has yet to sufficiently examine the political ramifications of the cult and its actions. Pizzolato provides a strong warrant for this examination, as protagonists follow an obscure series of clues which ultimately posits elected officials, law enforcement, and religious leaders as participants in depraved cultic actions involving child abuse and human sacrifice - clearly aligning with details of the QAnon conspiracy. The show's predictive discussion of this type of conspiracy suggests that Pizzolato identified an underlying societal fear: a distrust of social power structures caused by the dominant class's indifference to inequality and suffering. Both QAnon and True Detective imagine the wealthy and powerful as a monstrous cabal which feeds on the suffering of the downtrodden. True Detective grounds this fantastic, grotesque imagination within realistic depictions of rural and urban poverty, including exploitation, addiction, pollution, and abandonment. Thus, by examining the show's horror and Southern Gothic elements through the lens of these recent current events, we may better understand the broad social anxieties underlying the radical populism of the Trump years.

Anne Doyle

Graduate Program: Communication

Advisor: Victoria Gallagher

Poster Number: 48

A Visual Analysis of Prescription Drug Advertising Imagery on Instagram: Circulating a Charming, Consequence-Free Vision of Mental Health Drugs

The shift toward a more positive reception of discourses of mental illness has enabled many people to seek help, such as beginning therapy or medication(s). However, this has also led to an increase in psychopharmaceutical consumption, and therefore, a significant financial opportunity for pharmaceutical companies. In the last decade, social media has increasingly become a facet in everyday life, as well as a platform used to share and discuss mental health. Conversations about mental health on social media help to spread awareness and acceptance of many mental health conditions with which people struggle. However, social media also has the potential to do harm in many different ways regarding communication about mental health. The spread of misinformation can be incredibly harmful to populations who do not have other resources for obtaining information, which can lead people to make choices about their mental health that may not be healthy. Although medication can safely and effectively help treat mental illness, when medication is marketed to consumers who are not sufficiently educated about the potential side effects and risks, the chance of harm is multiplied. This study, informed by visual rhetoric and the rhetoric of mental health, examines direct-to-consumer prescription advertisements, how they function, and with what consequences. Outcomes of this research reveal what can be changed about direct-to-consumer advertising in order to better promote people's health and safety and speaks to the larger issue of why the visuality captured in direct-to-consumer prescription drug advertisements and posts about mental health are important, worthy of examination, what the significant consequences of it are, and how it contributes to ongoing conversations within the field of visual rhetoric.

Madison T. Harmon

Graduate Program: English

Advisor: Barbara Bennett

Poster Number: 66

Queering Shirley: Understanding the Construction of Queer Horror in the Gothic Works of Shirley Jackson

The type of work I will complete for this project will consist of critical analysis of Shirley Jackson's six novel length works: The Road Through the Wall, Hangsaman, The Bird's Nest, The Sundial, The Haunting of Hill House and We Have Always Lived in the Castle. My methodology will consist of contemporary queer theory, psychosexual analysis, Freudian analysis and feminist theory. I will rely on the theoretical frameworks of scholars, such as George Haggerty, Paulina Palmer, Eve Kosofsky Segwick and Nancy Chodorow. The ultimate goal is to create a discourse that highlights how Jackson's rendition of the Gothic can be interpreted as Lesbian Gothic through examining the intersection between her materialization of horror and queerness. Another goal of this project is to create a space for Jackson to be added to the growing conversation around Queer American Modernism and how her work aligns with other mid-twentieth century contemporaries within that discourse. Jackson's body of work is deeply saturated with queer subtexts that lend her female protagonists to embodying the lesbian experience. Jackson's 'lesbians,' in her earlier works like Hangsaman (1951) and The Bird's Nest (1954), are only emblematic of individual psychosis but eventually become vessels for homicidal rage, as seen in a later protagonist in We Have Always Lived in the Castle (1962). Thinking of these novels as queer narratives and then applying a Freudian lens to each novel houses the potential for not only offering a different interpretation of Jackson's Gothic style but also contextualizes how the relationship between the Gothic and the Freudian uncanny mirrors that of the relationship between queerness and the Gothic—the inherent 'other.' The relationship between the uncanny and queerness consists of shared motifs, such as doubling, compulsion, liminality and underlying gendered forces. When it comes to Jackson's work, these same motifs are woven into the characterization of her female protagonists. The unsettling domestic spaces, the daunting Mother figure and the uncanny "double" all factor into the materialization and subsequent abjection of queerness within the Gothic works of Shirley Jackson.

James Seth Harper

Graduate Program: Liberal Studies

Advisor: Doug Gillan

Poster Number: 67

Being and How it Appears to Nothing

Everyone experiences. Our experience consists of both an internal and external existence; that is, we are all a presence in the world. Each of our individual experiences are unique; if for no other reason than, simply because two people cannot occupy the same point in spacetime simultaneously. However, our experiences are all similar in the sense that they are human experiences. What constitutes a human experience and how we define its borders remain unanswered questions that have been explored for centuries – for example, by Kant in Critique of Pure Reason (1781) and Sartre in Being and Nothingness (1943). Kant and Sartre consider the distinction between reality as it is in-itself and how it appears to us consciously, or, that is, how we experience reality vs how it is independent of our experience. Kant holds in the Critique that we can only know about reality as it appears to us, but that we can never know anything at all about reality as it is in itself other than that it exists. Sartre ostensibly argues that reality, independent of our experience, and how we experience it are indistinguishable. He believes we have access to being in its fullness. More recently, Hoffman, in The Case Against Reality (2019), applies an evolutionary approach to the evaluation of our perceptual experience. Hoffman uses evolutionary game theory and genetic algorithms to claim that evolution by natural selection favors perceptual systems that reveal fitness relevant information as opposed to offering veridical perceptions of reality. This "interface theory of perception" makes bold predictions reminiscent of ones made by Kant nearly 250 years earlier. The goal of the present research is to synthesize and reconcile the accounts given by Kant, Sartre, and contemporary cognitive scientists regarding the relationship between reality and how human beings experience it.

Cecelia Henderson, Yingchen He

Graduate Program: Psychology

Advisor: Yingchen He

Poster Number: 70

Screen Reader Voices: Effects of Pauses and Voice Changes on comprehension

This study seeks to investigate the effects of manipulating aspects of a text-to-speech (TTS) voice on the learning and comprehension of a short passage, as well as detection of aspects of the passage such as its organization and key information. Pauses and pitch changes were used to demarcate this type of information. Participants listened to the passages and answered a series of cued and uncued recall questions to measure comprehension and learning, followed by a task to identify header structure. Preliminary results show trends that adding pauses might be beneficial, but more participants are needed to provide conclusive evidence. This study will contribute to the body of research surrounding technology adoption, assistive technology, and how to improve AI voices for the purposes of learning, as well as our understanding of how we process auditory information.

Rachel Hirshman[1], Shavone Hamilton[2], Melissa Walker[2], Noel Ivey[3], Dana Clifton[3]

Graduate Program: Social Work[1]; Department of Case Management and Clinical Social Work, Duke University Hospital[2]; Hospital Medicine Program, Duke University Hospital[3]

Advisor: Alan Ellis

Poster Number: 72

Opioid Use Disorder and Medical Records: Understanding Healthcare Provider Use of Language

Stigma within the healthcare environment limits access to treatment and medication for opioid use disorder (MOUD), even as opioid use results in significant morbidity and mortality worldwide (Wakeman & Rich, 2018). Provider language documented in the electronic health record can affect both patient experience and future care through the transmission of either stigma or positive regard (P. Goddu et. al., 2018, Park et. al., 2021). Currently, we do not know what language providers use when documenting patient encounters related to opioid use disorder (OUD) within the medical record.

Project COMET (Caring for Patients with Opioid Misuse through Evidence-Based Treatment) is a service piloted at Duke University Hospital to improve care for patients hospitalized with OUD. To explore provider language, we will review the charts of Project COMET patients. Focusing our evaluation on this group will allow us to determine how providers use language when interacting with patients at high risk of experiencing stigma in the healthcare environment. Understanding patterns of both stigmatizing and affirming language in the medical record will help us to identify areas for intervention to address stigma toward patients with OUD and improve quality of care for this population.

Erica Hobbs

Graduate Program: Psychology

Advisor: Mary Haskett

Poster Number: 73

Exploring Potential Disruptors of the Preschool to Prison Pipeline: Examining the Links Between the Racial-Ethnic Identities of Preschoolers and Teacher-Perceived Behavior Problems

Research has shown that Head Start programs impact children in various domains related to their social, emotional, and cognitive development (Welsh et al., 2010). To support development in those domains, Head Start programs provide children with opportunities to learn through play and structured peer activities (Bulotsky-Shearer et al., 2011). When children play and engage in activities with their peers and teachers, there can be minor conflicts that bring frustration, anger, and other emotional challenges. For many children, these conflicts provide opportunities for teachable moments, while for other children, these moments begin the criminalization of their behaviors (Wesley et al., 2017). Moreover, statistics consistently show disparities in the experiences of young racially and minoritized children in early learning settings, including how teachers perceive and respond to their behaviors (Gilliam et al., 2016; Bryan, 2017). This study is designed to examine two factors that might exacerbate or mitigate the association between preschool children's racial and ethnic identity and their teachers' perception of their externalizing behaviors. First, many may believe that more money in a household should bolster all children in how their behavior and skills are perceived or developed. However, research is lacking in this area, especially when examining income's influence on how teachers view racially and ethnically minoritized children's behaviors. A second factor that might influence the association between preschool children's race and ethnic identities and teachers' perceptions of their behavior is the presence of a high-quality student-teacher relationship. A multiple regression analysis will be employed to explore these moderators. The broad purpose of the study is to provide implications for prevention approaches that will disrupt "waiting to fail" approaches relating to the preschool to prison pipeline. The sample drawn for the present study comprises 4-year-olds (N=1358) who are racially and ethnically diverse [Black (non-Hispanic) (484), Hispanic (639), White (non-Hispanic) (235)].

Shima Hosseininasab

Graduate Program: Public History

Advisor: Tammy Gordon

Poster Number: 74

The Story of Two Breaches (and a Beheaded Bust): (Re)shaping Public Memory by Radical Interventions in Monuments

In 2006, artist Maggie Smith and landscape architects Reynolds and Jewell reshaped Oak Grove Freedman's Cemetery into a Memorial. The cemetery has been a burial ground for free and enslaved African-Americans since 1770. The designers proposed a symbolic opening, a breach, in the 1855 stone wall that separated white and black burial sections. The designers sought to symbolically and literally reunite the segregated communities while preserving the historical footprint. In the Netherlands, a similar preservation effort was undertaken in 2010. The Dutch Government service for land management appointed architecture studios of RAAAF and Atelier de Lyon to recover a World Heritage-nominated Bunker. The designers questioned the conventional UNESCO policies on cultural heritage preservation and created a breach in the middle of the concrete mass. Through intentional destruction, the designers aimed to connect monuments' past, present, and future histories. These changes, however, are only feasible when they are initiated by authorities and performed by experts. People's unauthorized interventions such as those in Cecil Rhodes' bust in Cape Town, SA, are quickly restored. In my research, I compare these cases, and I bring attention to the active revision of the built environment as part of the heritage process and the recreation of space for alternative readings of the past. This comparison allows us to question if the new plural and progressive heritage discourse is only lip-service to maintain authorities' control over heritage in the new political agenda. Through archival research, field observation, and conducting oral histories with different stakeholders, I hope to open new ways for community-expert relationships. This study provides community members, organizers, and officials with examples of creating inclusive memoryscapes through the incorporation of various voices. A historical analysis of case studies demonstrates that built heritage must be transformed according to community voices in order to reflect future aspirations and mobilize social change.

Khawar Latif Khan

Graduate Program: Communication, Rhetoric, and Digital Media

Advisor: Stacey Pigg

Poster Number: 87

Jhalak and Raaz: Mapping violence against women and children in Pakistan

According to a 2020 report by the Aurat Foundation, a total of 2,297 cases of violence against women were reported in Pakistan. Similarly, in the year 2020, a total of 2,960 cases of child abuse were reported throughout the country. This number, however, is nowhere near the true statistics. Because of under-reported cases, no privacy of survivors, violence by intimate partners and other family members, and the thought of preventing family's 'honor', a big number of cases, and hence such issues, get conveniently ignored. So much so that even talking about rape, harassment, and pedophilia is considered taboo. The general public's attitude toward this pressing matter can be changed by developing an information network to highlight the issue. In the existing social structure, oblivious to the problems of women and children, there is a need to use the existing technological tools, push them beyond their limits, and create safe networks. With this thought, I attempted to create something new in the form of this project.

This project consists of two parts: the StoryMap "Jhalak" and the mobile application "Raaz". Both artifacts work together with the aim of creating awareness about violence against women and children in Pakistan. The StoryMap, created using ArcGIS, consists of news stories from leading English newspapers in Pakistan. These stories, accompanied by media elements, help in highlighting the gravity of the situation, thus serving as a knowledge network. The prototype of the mobile application, created using Marvel, promises a safe platform using which survivors of sexual assault can report such incidents without sharing any personal identifiers. The map grows as new cases are reported, thus building the information network along the way. In the patriarchal system of Pakistan, this project can help in acknowledging the problems of rape, assault, harassment, and pedophilia.

Savanna Kindley

Graduate Program: Foreign Languages and Literatures

Advisor: Jim Michnowicz

Poster Number: 88

Palatalization of /s/ in Mexican and Central American Spanish

Although /s/ is perhaps one of the most studied sounds in Spanish, particularly with regards to its behavior in coda position (Walker et. al., 2014; Brown and Cacoullos, 2001; Lipski 2011), very little has been said about its tendency to be palatalized in certain dialects and phonetic contexts. The present study aims to add to our understanding of variation in this sound among speakers of Mexican and Central American origin by analyzing differences in center of gravity (COG). COG has been shown to be a reliable measure of differences in point of articulation of sibilants by various studies across many languages (Al-Tamimi and Ghada, 2011; Blake, 2019; Renwick and Cassidy, 2015). Palatalized /s/ will be associated with a lower COG as compared to the canonical alveolar variant. The data for the present study come from a corpus of sociolinguistic interviews conducted in North Carolina with 25 participants who were either first generation immigrants or heritage speakers, and of either Mexican or Central American origin. Using PRAAT (Boersma and Weenink, 2022) a total of 26,015 tokens were extracted, COG was measured, and all tokens were coded for phonetic context. Additionally, data will be coded for perceptual categorization of each token to confirm the relationship between COG and palatalization as perceived by a listener.

Initial statistical analysis (R Core Team, 2021; Wickham, 2016) shows that the most significant predictors of COG are position within the word (initial, medial, or final) and following phoneme. While heritage speakers did have lower mean COG (an indication of increased palatalization) a mixed-effects linear model shows that the difference between first generation immigrants and heritage speakers was not significant, lending support to the idea that this is a language-internal phenomenon, rather than the result of language interference. This study offers initial insights into a previously unstudied phenomenon of variation. Potential directions for further research include more detailed investigation into sociolinguistic variables which predict /s/ palatalization, clarifying the relationship between this apparently language-internal phenomenon and language interference in bilinguals, and comparisons with more dialectal regions of the Spanish speaking world.

Manushri K. Pandya

Graduate Program: Communication, Rhetoric, and Digital Media

Advisor: Andrew Johnston

Poster Number: 118

Digital Interface Design and Risk Communication: A comparative analysis of COVID Alert NJ and Aarogya Setu apps

With the spread of COVID-19, governments created mobile apps for contact tracing, vaccination, and information sharing (Sato, 2020; O'Neill et al., 2020). These apps were designed to investigate outbreaks, increase public health prevention measures, and understand risk factors in everyday life (Pandit et al., 2022). While such apps are a source of information, they also raise questions about the nature of digital interfaces and the kinds of data collected and presented to the users. In this poster, I present a comparative analysis of two mobile apps: COVID Alert NJ (by the government of New Jersey) and Aarogya Setu (by the government of India). Both apps provide updates about the number of cases, deaths, recoveries, and hospitalizations. The users can also record their vaccination status using these apps.

A comparative study of both apps -- serving the same purpose but for different geographical regions -- can reveal the similarities and differences in certain design decisions. Since all "artificial things are designed" (Norman, 2013), it is important to understand the cultural, social, and political factors in the design choices (Baotong, 2016). The importance of such an analysis gets more pronounced when dealing with risk communication situations in which populations may depend on the design of digital interfaces for their well-being. This poster builds on Winner (1980) and Selfe and Selfe's (1994) argument about the politics of artifacts and interfaces, and identifies these apps as actants in a transcultural communication network (Ding, 2014). In addition, this poster seeks to explore the intended and unintended implications of design decisions, particularly when they are implemented quickly. An overall goal of this poster is to bring South Asian perspectives on digital interface analysis to the conversation, thus adding value to the literature on communication design.

Aidan Paul

Graduate Program: Anthropology

Advisor: Dru McGill

Poster Number: 120

An Archaeological History of Forbush Creek and the Piedmont Village Tradition-Mississippian Frontier

Forbush Creek is a Pre-Colombian archaeological site located in the Yadkin River Valley of the North Carolina Piedmont. Salvage excavations targeted the site in 1957 and 1972. Since, the Forbush Creek collection has been the subject of research projects covering lithic, basic ceramic, bioarchaeological, and archaeobotanical analysis. Furthermore, the site, seemingly the largest Pre-Colombian settlement in the valley, has played an important role in recent interpretations of the valley's Pre-Colombian history. However, interpretation is inhibited by lack of adequate chronological control and the fact that most of the ceramics remain unanalyzed or unreported. The primary objective of this research was to establish improved chronological control in order to better understand how Forbush Creek fits into the historical-evolutionary trajectory of Pre-Colombian Yadkin communities. Thousands of ceramic sherds and vessels were recorded, and in combination with previously gathered data, a new database including 15,000+ sherds and at least 259 partial ceramic vessels was compiled. Nonmetric multidimensional scaling was utilized to seriate the ceramic assemblage, and three new radiocarbon dates were run on undated contexts. Evidence indicates a minor Yadkin Phase (~200 B.C - A.D. 800) occupation by foragers, a larger occupation during the Uwharrie Phase (A.D. 800 - 1200) in which the site was a village sustained by a mix of agriculture and foraging, and a small occupation during the Dan River phase (A.D. 1200-1400). Analysis of complicated stamped ceramics suggests sporadic but potentially significant interaction with nearby Mississippian communities. Synthesis of ceramic data, other remains from the site, and research on sites from the rest of the valley and surrounding areas reveals new dimensions of regional frontier dynamics between A.D. 1000-1500 and suggests that events at Forbush Creek may indeed have played a significant role in a shift in settlement patterns occurring near the end of the Uwharrie phase.

Gracie Phillips

Graduate Program: Communication

Advisor: Elizabeth Craig

Poster Number: 123

The Impact of Calorie Tracking Apps on Individuals with Eating Disorders: Full Cup Self Care App

While calorie tracking apps serve to be incredibly helpful in building self-discipline and teaching users how to develop healthy eating habits for some, for others they can become addictive. Upon receving my first smart device at the age of 12, I soon discovered these calorie tracking apps at a fragile age. I became reliant on these platforms and developed an eating disorder within the next year. Through conducting a content analysis of existing calorie tracking apps and reflecting on personal experiences and journal entries, I was inpired to create a prototype for an app that will act as a space for the user to track aspects of their mind or body that does not involve quantification.

Full Cup Self Care functions as a space for users to create photo albums, find and record self-affirmations, journal thoughts and feelings, find guided medtations, plan upcoming priorities, and find a community to seek support within. Through this, users can record deadlines, feelings, thoughts, and accomplishments, all without obssessing over numbers.

Luke Priest

Graduate Program: Psychology

Advisor: Adam W. Meade

Poster Number: 126

Forced Citizenship? Interactions Between Organizational Citizenship Behaviors, Counterproductive Work Behaviors, and Abusive Supervision

While organizational citizenship behaviors (OCBs) and counterproductive work behaviors (CWBs) are negatively correlated, the nature of this correlation suggests that some individuals perform both types of behaviors. This study assessed impression management OCB motivation and abusive supervision as potential explanatory mechanisms. Impression management motivation was significantly related to OCB, but not CWB or abusive supervision. However, it was also found that abusive supervision significantly moderated the relationship between OCB and CWB, such that as ratings of abusive supervision increased, the relationship between OCB and CWB became more positive. Future directions for research into OCB, CWB, and abusive supervision are discussed.

Andrea Restle-Lay

Graduate Program: Liberal Studies

Advisor: Michael Garval

Poster Number: 133

Open Food Certification - Empowering Sustainable and Socially Equitable Purchasing Choices through Point-of-Sale Engagement

My project's goal is to directly engage the public with the impact of individual food choices using QR Codes and a website when shopping or dining. This certification will allow consumers to efficiently locate various products and services produced in a way that aligns with their belief systems while encouraging retail establishments to provide sustainable products with fair labor practices over those that prioritize low prices and maximum profit. Uniting computer science concepts of open data and data visualization with environmental and social justice philosophies, I plan to produce compelling stories with simple visualizations that quickly communicate important information about food choices. This project combines computer science, social and environmental justice, and visual rhetoric into a practical application to effect community change. To accomplish this, I plan to analyze the ingredients and explain their origin and production techniques, specifically focusing on environmental sustainability and labor practices.

The reality is that when we spend money, we have little visibility into what labor practices or damage to our environment we may inadvertently cause, regardless of our intent. Examples abound, from engagement rings made with 'conflict diamonds' to the impact of 'fast fashion' on the environment and workforce of distant countries most of us will never visit. Tracking the vast array of our unintended consequences is impossible in a single semester, so I have limited the scope to a single "Open Food" certification pilot.

Jonathan S. Sánchez Collazo

Graduate Program: Foreign Language and Literatures

Advisor: Jim Michnowicz

Poster Number: 140

An exploratory study on the patterns of /s/ elision in Puerto Rican Spanish

This research aims to explore whether there is a retention pattern of plural marker [s] or [h] at the beginning of the noun phrase and its elision in a secondary position. For example: Los carros / Lo[s] carro[0] / Lo[h] carro[0]. Historically, the weakening of /s/ has been attributed to the Andalusian influence on Caribbean Spanish. However, the possible influence of African languages on Caribbean Spanish has recently begun to be studied. For example, marking the plural only at the beginning of a noun phrase could be influenced by Congo-Nigerian languages spoken by enslaved people brought to the Caribbean. To analyze whether there is a pattern of elision of the plural marker in the second position in the noun phrase, we interviewed four people from Puerto Rico. We used PRAAT to classify 40 tokens per participant in the context of /s/ at the end of a word before a vowel or consonant as retained [s], aspirated [h], or elided [0].

The results show that the elision of /s/ in nouns occurs much more frequently in a non-initial position in the noun phrase. In contrast, the aspiration [h] is more common in the initial position, either in a determiner or an initial noun. Preliminarily, these results present sufficient evidence to establish a relationship between the elision and retention of /s/ and the position of the word in the noun phrase. We will continue to expand this data to see if the results hold up throughout the study and compare it to interviews done in other parts of the Caribbean and Spain (Andalucía) to see if this characteristic is unique to Caribbean Spanish and if the thesis of Congo-Nigerian language influence holds up.

Mar Scardua

Graduate Program: Communication, Rhetoric, and Digital Media

Advisor: Andrew Johnston

Poster Number: 141

Navigating “Calmaria”: The Institutional App at the End of the World

Calmaria (in Portuguese, “calmness”; alternatively, “doldrums”) is a digital prototype that seeks to contemplate how the lack of institutional resources to combat individuals’ helplessness is not a bug, but a feature. It is an interactive experience that imagines a daily management app developed for graduate students in a fictional United States university. Its structure is simple: the user clicks links that refer to the different functions of the app, and the more they interact with the program, the more the program responds with increasingly demanding reminders and tasks. The idea behind Calmaria is to expose the strategic inefficiency employed by institutions by showing a microsystem of that attitude. To that end, I employed the concept of the management and mental health apps that already exist in the market. Referencing Julian Bleecker’s concept of Design Fiction (2009), I set to imagine a fictional US university app that would be made mandatory to all graduate student workers (that is, teaching assistants, research assistants, and department employees), under the guise of assisting them with work and class schedules. Unlike Bleecker’s inspiration in science fiction, however, I draw inspiration from actual apps that manage those tasks separately, such as Google Calendar, bank apps, and several apps built by universities for their population’s use, and simply imagine a narrative where they are amalgamated. The goal of that design choice is to make the user, a graduate student worker, feel comfortable and less suspicious of an institutional tool of control. By roping the user with a friendly environment and useful purposes, Calmaria gains their trust. As a game, Calmaria starts automatically “playing” the student, with new items on the to-do list, class chores, and spendings being added without their direct input. While that accelerates the process of appreciation of the project, it also accentuates the lack of control experienced by student workers throughout their months and years in school. Calmaria is a useful, friendly-looking, calming tool that offers to aid student workers; but as a part of the institutional system, it is not willing or able to help the system to be threatened. Once the user stops acting in an intended optimal way that makes them useful to the university, Calmaria stops being helpful.

Jenna N. Scott, Julie K. Wesp

Graduate Program: Anthropology

Advisor: Julie K. Wesp

Poster Number: 145

Add to Cart? The Ethical Landscape of Buying Bone in the United States: A Case Study of the NCSU Human Skeletal Remains Collection

This project examines the ethical landscape of the acquisition and curation of human skeletal materials for teaching purposes using the NCSU Human Skeletal Remains Collection as a case study. The human bone trade and the historical development of human skeletal collections perpetuate centuries of structural violence and exploitation of marginalized people in the pursuit of academic instruction and research. The lack of legislation in the United States regarding the sale of human remains has allowed various organizations and individuals to become primary distributors in the market for human skeletal materials. Additionally, differences in the quantity and effectiveness of the legislation for foreign vs. domestic human skeletal remains perpetuate scientific racism as a result of differential availability and frequency in the trade of human skeletal remains. This is only amplified by the use of technology and social media platforms, which have provided increased exposure and have broadened their influence in the marketing of human remains, exacerbating the bone trade and its monetary value. This thesis focuses on the NCSU Human Osteological Collection which is comprised of 20 individuals, through acquisitions made over the course of decades. Detailed analysis of the collection identified common issues, like isolated bones being replaced with ones from a different person in order to sell a 'complete' skeleton or ethically questionable practices to avoid legal issues. While access to real bone can benefit students learning osteology, purchasing cast material may be a more ethical choice given the lack of regulation regarding the bone trade in the United States. With the reevaluation of the NCSU Human Osteological Collection, the goal of this research is to build upon the current era of ethics in archaeology by making efforts to decolonize the research, methods and institutions of archaeology, advancing curation efforts to promote the preservation of collections, and exploring alternative solutions through technological advancements.

Shawna Sheperd

Graduate Program: Communications, Rhetoric, and Digital Media

Advisor: Andrew Johnston

Poster Number: 149

Pain spots, productive sites, and why don't you believe me?

Analyzing glitches and errors cultivated by the 3D scanner, Polycam, are useful in creating an understanding of how the technology works. By unveiling the black box of this accessible, mobile 3D scanner, I investigate how this technology can be used for art activism, benefits, or limitations of this technology, and how leaning into the technology's faults and glitches can initiate and perpetuate social change. In my research, I created a video entitled, "Pain spots, productive sites, and why don't you believe me?" The video is an autoethnographic speculation on my invisible disabilities capturing a compilation of 3D scans taken while I was enduring a pain flare. I aimed to embrace the faulty, messy, glitch-filled rooms and scans I created, defamiliarizing my familiar comfort spots. Further, while scanning during a pain flare, I aimed to remap my physical form, in an expression of reworking spatial-desires and embodiments that serve to subvert geopolitical presumptions about where and how my body should move in certain spaces at certain times. The video acts as a détournement of automation that explores the glitches from transparent, reflective, or moving objects scanned within my working environments to create a visual representation of my invisible disabilities and the conflation I experience between self-care, societal definitions of productivity, and ideas of performativity.

Scarlett Taraschi

Graduate Program: English

Advisor: Josie Barth

Poster Number: 157

The Monstrous Bishōnen: Abject Bodies and Desire in Sweet Pool

Ever since Julia Kristeva's landmark essay, Powers of Horror, the concept of the abject has been a thriving topic of discussion in studying horror. The abject disgusts on a visceral level, but also fascinates and induces desire in the spectator. This description perfectly encapsulates the ero guro (lit. "erotic gore") art movement seen in Japanese media. This art often proliferates in a more niche audience, and it's often found its way into the visual novel (VN) sub genre of video game, or more specifically within eroge, Japanese erotic games. A lesser known guro VN comes from Boys' Love (BL) publisher Nitro+chiral; the erotic-horror VN Sweet Pool. In this game, the player takes on the role of Youji Sakiyama, a sickly boy who is finally returning to school after a year long absence. However, he'll soon discover that his body is undergoing horrific changes as he begins to experience a "female puberty," menstruating through his anus and discovering that he's now the sexual target for multiple men at his school. This project seeks to analyze Sweet Pool in regards to its abject content and its connections to themes of motherhood, puberty, and birth as seen in Barbara Creed's The Monstrous Feminine. It also takes into consideration the largely female audience of BL content, and how that may influence the way we can understand a story that largely focuses on men. This media provides women with a space for exploring gender and its role in society by seeing it defamiliarized through queer male characters. At the same time, the ability of the VN to provide multiple paths and endings for the player to explore generates a multifaceted way of these monsters coming to life and creates new and alternate potentialities for the audience.

Sarah Wagoner

Graduate Program: English

Advisor: Kenneth Zagacki

Poster Number: 170

Uprooting the Static Notion of Renovation: Visual Rhetoric Case Studies of Spatial Renovations in the North Carolina Research Triangle

My project explores the issue of function and identity tethering to space/place through a visual rhetorical analysis of two cases studies of renovation in the North Carolina Research Triangle area. The first of these case studies is of downtown Raleigh's Cotton Mill Condos, an 1800s mill recently converted. This case study of renovation acts as an orientation tool for the reader to exemplify the typical rhetorical moves that are enacted in traditional physical renovation projects (such as a justification of historical significance and a consideration of the digital presence paralleling it), where the physical space is physically and permanently altered in efforts to regain an atmosphere similar to that which existed in the past rather than constructing a new space from the ground up. In contrast, the second case study explores a nontraditional form of renovation at work within the example of Bright City Church in Durham and the "uprooting" of aura they embrace in situating their services into a local working movie theater. Building the comparison of these two analyses on the foundation of Greg Dickinson's framework from his "Memories For Sale: Nostalgia and the Construction of Identity in Old Pasadena" article, I expand his focused themes of nostalgia, identity, and performance to include those of simultaneous use of space and habitus. Through exploration of how Bright City establishes itself with material artifacts, locational situatedness, and digital paralleling of ideals, I conclude that this example of uprooting aura can benefit us moving out of the coronavirus pandemic era in other situations like justification for continued working from home and distanced learning. The idea of aura becoming untethered from a space originally constructed with its specific function in mind offers a significantly interesting idea of freedom for us to consider moving forward in studies of visual rhetoric.

Davion Washington

Graduate Program: Sociology

Advisor: April Fernandes

Poster Number: 173

Racial Threat & Racially Motivated Hate Crimes on College & University Campuses

Despite the wave of interest in issues of diversity following the events of the summer of 2020, including the police murder of George Floyd and the civil unrest that would follow, colleges and universities exhibit familiar patterns that mask racialized histories, structures, and systems. While institutions of higher education paint a portrait of advancement and innovation, racially motivated hate crimes on college and university campuses persist. Hate crimes stifle advancement and innovation and replicate the historical racial hierarchy in the United States. This reinforces a status quo that positions Black, Indigenous, and other students of color and ethnic backgrounds as the racialized other. Using Blumer (1958) and Blalock's (1967) Racial Threat Theory, this study assesses group threat effects as the presence and/or representation of marginalized groups, non-white leadership, and Diversity, Equity, and Inclusion (DEI) offices and resources increases on a university campus. The Racial Threat Theory suggests that racialization and racist backlash in the form of punitive policy , restrictive social organization, and even hate crimes by white Americans increases as a growing marginalized population creates a perception of a threat to the disproportionate power that white Americans have (Blalock 1967; Manza and Uggen 2004; King and Wheelock 2007; Monterosso 2009). With colleges and universities serving as a microcosm of the greater American society (DeKeseredy, Nolan, and Hall-Sanchez 2019), Racial Threat Theory may consider how the increase of a minority student population, as well as an increase in minority leadership on a college campus might increase the number of hate crimes targeting racial and ethnic minorities, no matter how random and infrequent they may appear (US Dept of Justice, Community Relations Service, and United States of America 2003; Wessler and Moss 2001). Through the coding of campus racial characteristics within publicly available hate crime data, this study intends to engage with the hypothesis that racially motivated hate crimes will be more prevalent in institutions with racial characteristics that show growing minority presence in student population, leadership, and resources.

Mandy Weih

Graduate Program: Social Work

Advisor: Alan R. Ellis

Poster Number: 175

Evaluating Suicide Screenings by Mental Health Clinicians in a North Carolina Level 1 Trauma Center Emergency Department

In North Carolina, there were 5,281 self-inflicted injury visits to emergency departments (ED) from January - June 2022 (North Carolina Department of Health & Human Services, 2022). The accessibility of emergency departments positions them as the first point of care for patients in need of immediate treatment following self-harm or suicide attempts (Simpson et al., 2021). The Colombia Suicide Severity Rating Scale (C-SSRS) is considered the gold standard in screening for acute suicidal ideation or behavior. Artificial intelligence has been suggested as a potential opportunity for identifying predictive trends and providing additional insight.

One such application is Clairity, a linguistic processing algorithm developed by Clarigent Health. Clairity was introduced in 2022 to a North Carolina Level 1 Trauma Center through their Mental Health & Well-being department to support mental health care. This evaluation will compare Clairity suicide risk scores to the C-SSRS, and subsequent clinician interpretation of suicide risk. Based on literature review, this evaluation hypothesizes deviations in suicide risk assessment between Clairity and the Colombia Suicide Severity Rating Scale, which could influence treatment recommendations. This evaluation is a unique opportunity to examine impact and treatment fidelity from the beginning of process implementation. Clairity has exciting potential in enhancing the efficacy of suicide screenings in the ED, leading to more comprehensive and supportive mental health treatment.

Matthew Wood

Graduate Program: Liberal Studies

Advisor: Kenneth Zagacki

Poster Number: 179

The Discursive Formation of Austerity: Elite Rhetoric in Times of Social Change

The Black Lives Matter protests of 2020 sparked nationwide conversations about the systemic roots of racial inequalities and calls for structural changes to the institutions that produce these inequalities. The conservative movement responded by manufacturing a moral panic against critical race theory and "woke ideology" and introducing legislation in nearly every state to ban the discussion of systemic racism in schools and workplaces. This reaction follows a familiar pattern of progress and backlash in American history. After Reconstruction era governments made progress toward multiracial democracy and fostered political alliances between freed slaves and poor whites, wealthy elites used the rhetoric of fiscal conservatism to win support for Jim Crow laws among poor whites concerned about rising taxes. The progress of the Civil Rights movement was thwarted by law and order rhetoric and racially coded, anti-government appeals to justify mass incarceration and the decimation of the social safety net, respectively. Each of these historical moments represent critical junctures in which support for systemic changes to the political, legal, and economic institutions that produce inequalities was high. I argue that the colorblind rhetoric employed by elites in these times of social change belongs to the discursive formation of austerity. My paper will take an interdisciplinary approach to the analysis of the "rules of formation" by which the crusade against critical race theory belongs to the discursive formation of austerity, including: a critical discourse analysis of the post-truth discursive landscape within which it emerged; a genealogy of conservative media, particularly Fox News, as the authority by which austerity is delimited; and a narrative analysis of the free-market ideology that undergirds common conceptions of American history. This research will illuminate the communicative practices by which elites maintain their wealth and power in the face of widespread support for the expansion of multiracial democracy.

Sree Yallapragada

Graduate Program: Technical Communication

Advisor: Huiling Ding

Poster Number: 181

"Let's Light This Candle" - Readability and Social Media Sentiment Analysis of Press Releases on NASA's Artemis Program

Federal agencies like NASA utilize various means to communicate recent innovations and discoveries, mission updates, and other complex, scientific knowledge to a large audience with differing levels of comprehension and subject-matter expertise. NASA routinely uses openly accessible, media resource pages and a large social media presence to highlight its efforts in human space flight and scientific research, including current progress on the Artemis Program. The November 2022 launch of Artemis I showcases the agency's initial attempts to not only reestablish a human presence on the moon, but to also bring back substantial enthusiasm for space exploration that defined the Apollo and Space Shuttle eras. While the agency does not rely entirely on public opinion for the success of its endeavours, it seeks to increase awareness of the importance of scientific and technological achievement in space and inspire the public through continuous reporting on current missions like Artemis.

This poster presentation focuses on understanding the role of social media in public science and aerospace communication, the importance of readability in communications on federally-funded projects, and public perception of current progress in the Artemis Program. This study will present a synthesis of current literature that highlights the role social media plays in science and aerospace communication, a readability analysis of NASA's current methods of outreach, and a sentiment analysis that explores public reaction and perception to news being shared on Twitter and Reddit on the Artemis I mission and other progress within the multiple-mission program. Results of this analysis will examine the balance of positive and negative sentiments, in an attempt to understand how federal agencies can potentially use sentiment analysis as a new, experimental metric for measuring success and increasing goodwill in the public's engagement and dissemination with science and aerospace communication.

College of Natural Resources

Mirela A. Artner[1], Ashley P. Rocha[1], Daniel B. Sulis[2], Jack P. Wang[2], Melissa A. Pasquinelli[1], Nathalie Lavoine[1]

Graduate Programs: Forest Biomaterials[1]; Forestry and Environmental Resources[2]

Advisors: Nathalie Lavoine, Melissa A. Pasquinelli

Poster Number: 12

Biomass feedstock optimization for cellulose nanofibril (CNFs) production

The potential of biomass as a low-cost and sustainable alternative to petroleum-based polymers has increased interest in cellulose nanofibrils (CNFs). CNFs can be obtained through mechanical defibrillation of biomass. Their widths are in the range of 5-30 nm for an aspect ratio usually greater than 10. (ISO / TS 21346 : 2021). The high-energy consumption and cost of CNF production remain significant barriers to their commercialization as low-cost, large volume commodities, such as packaging. It is possible to reduce energy consumption by chemically modifying the biomass; however, this process can be costly. Alternatively, studies have shown that chemical composition of biomass, i.e., its content in cellulose, hemicelluloses, and lignin can influence the energy consumption of CNF production.

This study investigated the influence of the chemical composition of woody biomass on the mechanical defibrillation process and the properties of subsequent CNFs. Different chemical compositions of CRISPR-Cas genome-edited poplar woods were evaluated with the goals to reduce energy consumption and improve the performance of CNFs films. The presence of a high hemicellulose content contributed to lowering the energy consumption of the mechanical production route, while a higher lignin content improved the surface tension of CNF films, suggesting an enhancement in their water repellency. For the first time, we provide valuable insights into optimizing feedstock by CRISPR-edited biomass for CNF production. This approach can potentially overcome barriers to commercializing CNFs for packaging applications by using tailored biomass feedstock.

Nelson Barrios[1], Jose Parra[1,2], Lucian Lucia[1], Richard Venditti[1], Lokendra Pal[1]

Graduate Programs: Forest Biomaterials1; Department of Chemistry, University of Carabobo2

Advisor: Lokendra Pal

Poster Number: 16

Unveiling the Nanocellulose-Water Interactions Through Computational Simulations

Significant efforts are required to mitigate the negative effects of climate change. Cellulose, as the most abundant and readily available polymer on Earth, is the most promising and suitable polymeric building block to substitute petroleum-based feedstocks. One of the main challenges to be addressed prior to a complete adoption of cellulosic materials is to reduce the energy consumption for drying of lignocellulosics. Several experimental and theoretical approaches have been applied to unveil the cellulose-water interaction but a complete understanding of the phenomenon remains elusive. In this research, Molecular Dynamics (MD) simulations were employed to provide further insights into cellulose-water interaction. To that end, computational tools were used to build a Iβ-cellulose microcrystal containing different Miller indices (lateral: {010} and {020}, inferior and superior: {100} and {200}). To estimate the forces between atoms within the crystal, the CHARMM36 potential energy model was employed. The water molecules were described using the TIP3P and OPC models, and two different systems containing 683 and 2780 water molecules were evaluated. An NVT ensemble, five different temperatures and two different heating approaches were used to determine the final configurations. Calculations of Potential of Mean Force (PMF), hydrogen bonding, density profiles and molecular orientation of the water molecules on the cellulosic surfaces, show changes in cellulose-water interaction at different temperatures, with decreasing cellulose-water interaction at increasing temperatures. Remarkably, for the systems with higher water concentrations the changes are clearly visible, while at lower water levels are difficult to distinguish. The results show conformational and energetic changes, that occur at the different temperatures evaluated, providing new understanding into the cellulose-water interactions with temperature and contributing to developing new approaches to reduce energy consumption for drying of lignocellulosics.

Justin M. Beall[1], S. Brent Jackson[2], William R. Casola[2], M. Nils Peterson[2], Lincoln R. Larson[1], Kathryn T. Stevenson1, Erin Seekamp[1]

Graduate Programs: Parks, Recreation, and Tourism Management[1]; Fisheries, Wildlife, and Conservation Biology[2]

Advisors: Lincoln R. Larson, M. Nils Peterson

Poster Number: 17

Self-reported participation in outdoor and nature-based recreation before and during the COVID-19 pandemic supports psychological health and well-being

Restrictions associated with the COVID-19 pandemic significantly altered daily lives and affected human health and well-being. Outdoor and nature-based activities could potentially mitigate some of these negative impacts. To assess the impact of the COVID-19 pandemic on outdoor recreation and subjective well-being, we combined two samples of U.S. adults collected from April 30th - June 15th, 2020 and from August 7th - August 26th, 2020 (total n = 2178) using Qualtrics XM. During the pandemic, participation in outdoor activities declined by 35%, participation in nature-based activities declined by 33%, and subjective well-being declined by 24%. Participation in outdoor activities and nature activities prior to the pandemic and during the pandemic predicted smaller declines in subjective well-being. Results highlight the importance of outdoor recreation for building resilience to changes in subjective well-being before and during global crises like the COVID-19 pandemic.

Kat Deutsch[1], J. Aaron Hipp[1], Yu-Fai Leung[1], Semra Sebnem Ahiska King[4]

Graduate Programs: Parks, Recreation, and Tourism Management[1] ; Industrial Engineering[2]

Advisors: J. Aaron Hipp, Yu-Fai Leung

Poster Number: 44

Prioritization of Facility Projects for Recreation and Park Planning: A Data Envelopment Analysis Approach

Leisure and recreation organizations spend billions of dollars each year on facilities, programs, and services to support the driving demand of resources. Effective planning of these spaces is crucial in ensuring that these expenditures produce desired outcomes of the agency, policies, and the general public. The need for specific planning guidelines is exacerbated with the recent trends of growth in population, changing lifestyles, and increased desire for broader leisure activities (US Census Bureau, 2021). Prioritization, or placing activities or projects into a list prior to the realization of parameters (Lall, V et al., 2012), is a critical component of effective recreation planning, but is noticeably missing from previous research and development of planning approaches and tools. The Data Envelopment Analysis (DEA) approach is the application of a linear programming technique through a data-based mathematical model to measure relative efficiencies of different options involving multiple variables, constraints, and data (Charnes et al., 1978). This approach has a large base in research, but has not been applied in a state parks setting as a prioritization tool for facility projects. This study applied the DEA approach in a case study of North Carolina State Parks to examine the effectiveness of the tool. The methodology included a survey to determine the evidence measures deemed important for decision making with XX individuals from North Carolina State Parks. These results were then applied in a DEA model in addition to five other model variations following differing planning approaches or a lack of planning approach. We compared correlations between each of the models to determine any relationships in the data used and functionality. Broad findings concluded that the DEA approach is an effective tool for prioritizing but does have limitations due to the sensitivity of the selection of measures.

Ryen Frazier[1], Ramon Vera[1], Keren Vivas[1], Naycari Forfora[1], Guillermo Reyes[3], Orlando Rojas[3], Hasan Jameel[1], Ericka Ford[2], Joel J. Pawlak[1], Ronald W. Gonzalez[1]

Graduate Programs: Forest Biomaterials[1]; Textile Engineering[2]; Bioproducts and Biosystems, School of Chemical Engineering, Aalto University[3]

Advisor: Ronalds W. Gonzalez

Poster Number: 57

Can Agricultural Residues be the Future of Textiles? A case study on wheat straw filament spinning by ionic liquids

As our global population continues to grow, the demand for textiles increases as well, putting pressure on manufacturers to produce more fiber each year [1], [2]. Synthetic fibers such as polyesters (PET) can be manufactured quickly and cheaply, but these petroleum-based products are detrimental to our environment. Each year, over 100 million tons of textiles end up in landfills [3] and millions of microplastics enter our oceans, negatively affecting marine ecosystems. Cotton is a highly demanded natural fiber and a good option for replacing synthetic fibers, but it is expected that its production will not fulfill the future market needs, especially if cotton plantations are replaced by food plantations. Due to this and the environmental issues associated with its traditional cultivation, replacing synthetic fibers with cotton would not be the most suitable option [1], [2]. On the other hand, natural manmade cellulosic fibers (MMCF) have proven to have potential in the market against synthetic fibers, and their demand has also increased with population growth. With growing efforts to encourage transparency and create a more circular textile economy, the adoption of natural alternatives must be considered. This work discusses the existing condition and future possibilities of the regeneration of cellulose fibers from non-wood alternative feedstocks such as agricultural residues. The research focuses on selecting the most suitable and promising feedstocks and processes while minimizing environmental impact. Both conventional and emerging conversion technologies for producing suitable and spinnable textile-grade fibers are discussed. Existing work related to the spinning of alternative natural fibers is covered, along with suggestions of the most promising feedstock and technology combinations. An experimental study conducted by the authors in which wheat straw was converted to textile filaments is described.

Jared Jones, Jason N. Bocarro, J. Aaron Hipp, KangJae “Jerry” Lee

Graduate Program: Parks, Recreation & Tourism Management

Advisors: Jason N. Bocarro, J. Aaron Hipp

Poster Number: 82

Reassessing Physical Activity Promotion and Health Partnership: North Carolina Public Parks and Recreation Directors’ Perceptions

Regular physical activity is widely considered by public health and parks and recreation scholarship as a key determinant of individual and community health and well-being. Communities and local government managers believe public parks and recreation departments are vital to increasing physical activity, yet some communities do not have sufficient political support for funding. Parks and recreation departments vary in number of resources, maintenance of facilities and staff size, often congruent with the size of the city or county they are located in. Building strong, sustainable partnerships with organizations addressing public health issues can help parks and recreation departments shift public support for resource allocation. There are benefits and challenges associated with collaborations, as community size can both positively and negatively affect health partnership practices. This thesis investigated the perceptions of North Carolina public park and recreation directors about physical activity and health partnership practices in their communities. Around 240 city and county parks and recreation departments were surveyed in Spring of 2022 to determine 1) effort allocation and future priorities in promoting physical activity, 2) challenges associated with promoting community physical activity, 3) director attitudes about the role of their department in increasing physical activity and correlation with partnership participation, and (4) the influence of director and departmental demographics (e.g., gender, professional certiciation, department location) on effort allocation and partnership behaviors. Participant responses are compared to results from a 2007 study of NC public park and recreation directors to shine a light on the nature of physical activity promotion and health partnership in a post-recession, post-COVID-19 environment.

Maccoy Kerrigan

Graduate Program: Forestry and Environmental Resources

Advisor: John King

Poster Number: 86

Ecosystems in Transition: An Assessment of Plant Community Change and Standing Carbon Stores in Pond Pine Pocosins in Coastal North Carolina

Forested ecosystems along the central Atlantic coast of North America are at risk to degradation resulting from chronic hydrologic stress in the form of sea level rise and acute stress in the form of saltwater inundation introduced by storm events. This rapid degradation has led to the formation of "ghost forests"– recently transitioned shrub and grass marshes with still-standing dead trees overhead as plant communities change over the span of just a few years. Such rapid transition has made it difficult for researchers to maintain current estimates of community composition, stand structure, and standing carbon stores. This study aims to resample historic plots established by previous research as well as establish new permanent plots for future study with the intent to assess community composition and standing carbon stores. Thirteen plots composed of pond pine pocosin in the northern area of the Alligator River National Wildlife Refuge in Dare county, North Carolina, were sampled, three of which were sampled in 2003 and five of which were sampled in 2015. From this data, allometric equations were used to estimate standing carbon stores within each plot, the values of which were compared to their historic states. Additionally, the Guide to the Classification of the Natural Communities of North Carolina (4th Approximation) was used to determine the different community types present across the northern area of peninsular Dare county. As forest conditions are expected to further degrade as climate change continues to impact the globe, this study is intended to allow future research within these permanently marked plots and to allow for more regular assessment of these ecosystems in transition. Sequential data from these ecosystems could then potentially be used to predict the trajectory of other coastal forests at risk to previously mentioned hydrologic stress and subsequent transition.

Brit Laginhas

Graduate Program: Geospatial Analytics

Advisor: Ross K. Meentemeyer

Poster Number: 92

Evaluating the Impact of Simplifying Pest-Host Interactions on the Forecast Skill, Uncertainty, and Management Decisions for the Highly Polyphagous Spotted Lanternfly

Invasive pests pose a major threat to economies and ecosystems worldwide, causing an estimated $70 billion in damages and management costs annually. Near-term forecasts of pest spread are crucial for effective pest management strategies, and accurately representing the mechanisms driving pest spread is essential for reliable and transparent predictions. Host availability and preference play a significant role in pest spread, particularly for highly polyphagous pests such as Spotted Lanternfly (Lycorma delicatula; SLF). However, including all pest-host interactions for such pests in a model is infeasible and inefficient, leading to the need for simplification (reducing host species and ignoring host preference). This simplification introduces errors into the forecast that must be accounted for to prevent overly confident predictions. This study systematically reduces the complexity of SLF pest-host interactions in the Pest or Pathogen Spread (PoPS) model and then evaluates the impact of these errors on the SLF spread forecast's skill, uncertainty, and ability to inform management decisions. The results of this study provide a practical approach for incorporating complex pest-host relationships into a pest spread model that also maintain transparency and reliability in the forecast as a decision support tool.

Catherine Lerose[1], M. Nils Peterson[1], Lincoln R. Larson[2], William Casola[3]

Graduate Programs: Fisheries, Wildlife, and Conservation Biology[1]; Parks, Recreation, and Tourism Management[2]; School of Forest, Fisheries, and Geomatics Sciences, University of Florida[3]

Advisors: M. Nils Peterson, Lincoln R. Larson

Poster Number: 95

Comparing Double-Bounded and Open-Ended Contingent Valuation Models for Non-Market Valuation in Zoonotic Disease Management Contexts

Non-market valuation represents a critical tool for managing emerging zoonotic diseases. Most studies in this context use open-ended contingent valuation prompts to determine how much stakeholders will pay to mitigate risks posed by emerging diseases. While this method is easy, economists argue it introduces additional bias, and double-bounded dichotomous choice assessment models are needed. In this case study, we compare open-ended and double-bounded methods for assessing willingness to pay for management of chronic wasting disease (CWD) in deer. CWD has posed a challenge for wildlife managers since the 1960s and continues to spread across the United States. Agencies in CWD-prevalent regions have adopted costly testing and carcass disposal practices to mitigate the spread of this fatal and highly-transmissible disease. Knowing how much hunters are willing to financially contribute to CWD management will assist wildlife agencies in implementing costs for testing and disposal that are acceptable to the hunting community. We conducted 300 phone surveys to hunters of North Carolina and asked them how much they are willing to pay for CWD testing and disposal. We assessed their WTP using both double-bounded and open-ended questions. Of the hunters we sampled, 151 (50.3%) of them were willing to pay a fee for testing and 142 (47.3%) for disposal. Of the hunters willing to pay anything, we found that the predicted mean WTP for the average respondent was $25.08 for testing (SE = $1.13) and $25.13 for disposal (SE = $1.10) using the double-bounded questions and $23.11 for testing (SE = $16.43) and $22.84 for disposal (SE = $15.86) with the open-ended questions. This research suggests that relatively easy and cost-efficient open-ended WTP methods produce results almost indistinguishable from the more complex and costly double-bounded methods. Although additional research is needed to confirm this finding, our preliminary research is encouraging, and could provide environmental managers a scientifically defensible and more efficient tool for improving valuation estimates for adaptive management of emerging zoonotic diseases.

Ian R. McGregor[1], Josh M. Gray[1, 2]

Graduate Programs: Geospatial Analytics1; Forestry and Environmental Resources2

Advisor: Josh M. Gray

Poster Number: 107

As soon as possible (ASAP) or as accurate as possible (AAAP)?The importance of trade-offs between detection time and accuracy for multi-source deforestation monitoring.

Detecting deforestation quickly and accurately has long been a focus of remote sensing, and with the large availability of satellite data, methods have continuously improved. To simultaneously decrease temporal latency and increase accuracy, a growing number of studies have pursued multi-source approaches. For instance, in areas of persistent cloud cover, using synthetic aperture radar (SAR) may be the only source of observations. Typically, near real-time (NRT) monitoring approaches have used retrospective change detection methods to maximize an accuracy metric like the F1 score. Much less attention has been paid to potential parameter trade-offs: Can faster detections be achieved, and at what cost to accuracy?

We developed a novel NRT approach that monitors Landsat-8, Sentinel-2, and Sentinel-1 SAR time series in northern Myanmar. After combining standardized residuals of sensor-specific models, we converted an exponentially-weighted moving average (EWMA) to a disturbance probability. We explored how altering the EWMA sensitivity affected detection accuracy (F1) and latency (days until detection) using training data manually identified from PlanetScope in the study region. For a moderate parameterization, the algorithm detected disturbances within a median of 2-3 observations (or 4-7 days), with an overall F1 score of > 90%. We found two main trade-offs. The most sensitive inputs detected quickly (median 2-5 days) compared to the conservative inputs (median 8-11 days) at the expense of accuracy. Also, even though including Sentinel-1 increased time series density, the results were not significantly improved, primarily because of its lower signal-to-noise ratio.We anticipate that as more data becomes available (e.g. NISAR L-band SAR), the method will give faster detections with higher accuracy. Overall, our novel, multi-source approach clearly advances NRT deforestation monitoring by providing a quick, simple, and effective way of combining multi-source satellite data.

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Graduate Programs: Parks, Recreation, and Tourism Management[1]; Geospatial Analytics[2]; Wageningen University & Research[3]

Advisors: Yu-Fai Leung, Kathryn Stevenson

Poster Number: 132

Guided towards ambassadorship: Exploring the dimensions of protected area ambassadorship with Antarctic tour guides

The Antarctic Ambassadorship program is a tenant of the Antarctic tourism experience, utilized mainly in an effort to engage visitors with pro-environmental behavior. The focus on visitor behavior has resulted in an oversight in understanding more broad applications of the concept and other populations that act as ambassadors. Polar tour guides are such a population that serve a prominent role in shaping the experiences of guests and working towards the protection of Antarctica. This study aims to define and expand the dimensions of protected area ambassadorship by testing the applicability of a conceptual model developed through an initial literature review, using empirical data collected from Polar tour guides through qualitative interviews. 15 semi-structured interviews were conducted with guides recruited through snowball sampling within the Polar Tour Guiding Association. Interviews were conducted over Zoom, then analyzed using deductive coding in NVivo software. Qualitative analysis confirmed the existence of four major dimensions of protected area ambassadorship: place attachment, duty/responsibility, capacity, and community, with 13 related sub-themes. The conceptual model was then revised to represent the interconnectedness of the dimensions and the iterative process by which individuals move through ambassadorship levels. The conceptual model seems to be applicable across different types of protected areas, including the polar regions, and could be used to better understand the link between values and actions for a variety of populations. Tour guides are already engaging in ambassadorship behavior, often without recognition or adequate resources to take advantage of their influential roles. The alignment of these responsibilities may contribute to the increasing importance that tour guides play in the conservation of protected areas, specifically in the polar regions. The results may also inform the future use of the ambassadorship label in park stewardship programs.

Felipe Sanchez[1,2], Jason A. Galvis[2], Nicolas Cardenas[2], Cesar A. Corzo[3], Chris Jones[1], Gustavo Machado[1,2]

Graduate Programs: Geospatial Analytics[1]; Population Health and Pathobiology[2]; Veterinary Population Medicine Department, College of Veterinary Medicine, University of Minnesota[3]

Advisor: Gustavo Machado

Poster Number: 139

Identifying areas and farms at greater risk for porcine reproductive and respiratory syndrome virus (PRRSV) transmission is pivotal for targeted surveillance and disease control strategies.

The objectives of this study were to i) define the maximum spatial distance at which the risk of PRRSV transmission from infected to susceptible farms is increased, ii) describe how risk is distributed across different farm types, and iii) identify variables associated with the risk of PRRSV local transmission. For this study, we used PRRSV status, geographical coordinates, and production type from 2,293 farms between the years 2018 through 2020 in the Southeastern U.S. An adaptive kernel density estimation approach was used to determine the maximum spatial distance of PRRSV local transmission, identify areas of significant risk, and estimate relative risk among the different farm types. We then used a Bayesian spatiotemporal hierarchical model to investigate the association between six environmental variables, six between-farm contact network metrics, three farm biosecurity features, pig density, and farm density with PRRSV local transmission. Our results indicate that the maximum spatial distance for which the risk of PRRSV transmission increased was 15.3 km in 2018, 17.6 km in 2019, and 18 km in 2020. Areas of significant risk were identified and consisted mostly of uninfected finisher farms (24.9%), and infected sow farms (6%). Relative risk estimates showed that sow farms consistently had higher relative risk values (27.8% - 32.7%), and finisher farms had the lowest (62.4% - 63.8%) among the different farm types. Variables found to be associated with PRRSV local transmission included out-degree (OR 1.11), line of separation access points (LOSAP) (OR 1.03), and the number of days of temperatures between 4°C - 10°C (OR 1.01). This study addresses an important gap in the understanding related to the spatial range of PRRSV local transmission by identifying the maximum distance at which PRRSV relative risk is increased, which can be used to inform targeted surveillance and disease control strategies and calibrate future PRRSV transmission models.

Chisom. C. Umeileka, Karthik Ananth Mani, Nathalie Lavoine

Graduate Program: Forest Biomaterials

Advisor: Nathalie Lavoine

Poster Number: 163

Improving the water vapor barrier properties of paperboard using bio-based polymer emulsion coating

The demand for sustainability has generated increased attention in bio-based packaging due to environmental concerns associated with fossil-derived products. Fiber-based packaging i.e., paper and paperboard-based packaging, are attractive substitutes to non-recyclable synthetic plastics. However, their hydrophilic nature and porosity are limitations to their usage in high-barrier packaging applications. Commercialized fiber-based food packaging – are commonly coated with a thin layer of petroleum-based plastics to achieve liquid and gas barrier properties but this strategy makes it challenging or even impossible, to recycle these composite materials. Previous research has thus exploited other bio-based resources, such as cellulose, protein and starch, to endow paper/paperboard with higher gas and liquid barriers, but the performance of the final products remains limited at elevated and changing humidity conditions. Herein, we propose a novel approach to overcome the inherent moisture sensitivity of paperboard. Bio-based oil-in-water emulsions were formulated, exploiting the inherent hydrophobic profile of lignin and soy lecithin, (oil phase) and the amphiphilic nature of cellulose nanocrystals (water phase). These emulsions, once coated on paperboard (ca. 8 g/m2 in coat weight), led to a ≥11 % reduction in water vapor transmission rate (WVTR) which could be further reduced when using a multilayer coating approach. This study provides insights into the potential of bio-based polymer emulsions as barrier coating for sustainable fiber-based packaging development.

Richard J. von Furstenberg[1], Lincoln R. Larson[1], Nils Peterson[2]

Graduate Programs: Parks, Recreation, and Tourism Management[1]; Forestry and Environmental Resources[2]

Advisor: Lincoln R. Larson

Poster Number: 167

Social identities of U.S. college students reveal potential conflict and common ground for wildlife conservation

"Conservationist" and "environmentalist" are two prominent social identities within American wildlife conservation that are increasingly at odds with one another. The conservation movement focuses on wise use of natural resources and centers hunting as a tool for population management. Environmentalism connotes a broader consciousness around issues such as air and water pollution, climate change, and preservation of nature. While these groups have differing philosophies, their beliefs may overlap with potential for collaboration. However, wedge issues (e.g., animal rights, gun rights) could further polarize these groups and trigger conflict. Characterizing these identities on college campuses will provide natural resource managers with insight on this future generation of stakeholders, and highlight issues that build consensus or further divide environmentalists and conservationists.

We explored the social identities among college students across 22 U.S. states (n = 14,999) from 2018-2020 to investigate their links to wildlife value orientations (WVOs), conservation, and hunting. We first asked students the extent to which they self-identity as a conservationist or environmentalist. Students who identified strongly as a conservationist or environmentalist were grouped as such, those as both (pluralists) and neither (nature-haters). We found a strong association between identity groups and demographic factors; environmentalists group being the most diverse, and conservationists the least. Students in the conservationist group tended toward dominionistic WVOs, while those in the environmentalist group were more mutualistic. Despite opposing WVOs, conservationists and environmentalists scored equally high on the conservation caring scale. Moreover, there was broad approval of hunting for altruistic reasons (e.g., ecological benefits) among all groups. Our results suggest that although unique social identities regarding wildlife and the environment exist and appear starkly different at first, there may be opportunities to bridge divides based on common ground (e.g., conservation caring, altruistic motivations) and work toward a more unified future for wildlife conservation.

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Graduate Programs: Geospatial Analytics[1]; Parks, Recreation, and Tourism Management[2]; The Nature Conservancy[3]; Civil, Construction, and Environmental Engineering[4]

Advisor: Jelena Vukomanovic

Poster Number: 185

A Tool for Assessing Electric Vehicle Infrastructure Resilience across Emergency Evacuation Scenarios

Electric vehicles can play an important role in reducing diffuse greenhouse gas emissions and increasing the energy security of the United States. However, as the frequency and intensity of extreme weather events increases over time with climate change, so too does the need to think strategically about the future of fueling infrastructure for battery electric vehicles (BEVs). BEVs take much longer to refuel than conventional internal combustion engine vehicles, and thus they represent a unique challenge when thinking about resilience and evacuation planning. To address this planning challenge, we created the Alternative Fuel Infrastructure Resilience Model (AFIRM), an agent-based, traffic flow model that accounts for electric vehicle charging along routes and implemented the model along a critical evacuation corridor - Interstate-40 from coastal Wilmington, NC to the Interstate-95 inland highway interchange. The model returns a count of vehicles that are waiting for a charger at each interstate exit in each time step, which serves as a useful metric for understanding how robust a given infrastructure configuration is to varying evacuation scenarios. The model also reports back energy demand profiles at each exit, which could be of use to electrical grid system operators tasked with ensuring grid reliability. Given the model's capacity to explore different infrastructure configurations under varying evacuation scenarios, it is well equipped to compare the reliability-contributions of varying candidate infrastructure sites, and future sensitivity analyses with the tool could provide data-driven guidance on best practices for building out future electric vehicle charging infrastructure.

College of Sciences

Conor Artman

Graduate Program: Statistics

Advisor: Alyson Wilson

Poster Number: 11

Reinforcement Learning for Social Good Applications

In the Data Science for Social Good (DSSG) movement, researchers have produced a large portfolio of projects that illustrate how artificial intelligence (AI) technologies can help nonprofits, social enterprises, and government agencies work toward their missions. Nearly all of these projects, however, have not moved beyond the initial illustration stage because these organizations may lack the resources to integrate and maintain bespoke technological solutions. This work discusses the development of a single restless multi-armed bandit algorithm that technologists are responsible to maintain and deliver as a service.

Maxwell Bowles, Molly Carter, Meric Trombley

Graduate Program: Chemistry

Advisor: Caroline Proulx

Poster Number: 23

Exploring the Reactivity of Azapeptides Through Late-Stage Functionalization

Site selective late-stage functionalization of peptides is a highly sought-after method used to create therapeutically relevant peptides. Although examples exist, the ability to modify the peptide backbone is especially difficult and requires the advancement of novel methods. Azapeptides are unnatural peptide mimics in which one or more α-carbon is substituted for a nitrogen. This substitution has been shown to improve protease stability, restrict the conformation of the peptide backbone, and perturb the acidity of the surrounding nitrogen atoms (NH). In this work, the altered pKa's are leveraged to introduce various alkyl groups and coordinate metal ions to the peptide backbone in a site-selective manner. Using biologically relevant aza-pentapeptides and aza-tripeptides as model compounds, the chemical reactivity of internal aza-amino acids is explored as a means for late-stage functionalization. A combination of X-ray crystallography, MS/MS sequencing, Edman degradation, and NMR experiments are used to demonstrate that the functionalization of these unnatural residues is highly selective even in the presence of numerous natural backbone amides.

John W. Britt[1], Victoria Karakis[2], Mahe Jabeen[2], Adriana San Miguel[2], Balaji M. Rao[1, 2]

Graduate Program: Genetics[1]; Chemical and Biomolecular Engineering[2]

Advisor: Balaji Rao

Poster Number: 24

Derivation of Trophoblast Stem Cells from the placenta at birth

Human trophoblast stem cells (hTSCs) have emerged as an attractive model system for mechanistic studies on human placental development. Like cytotrophoblasts in vivo, hTSCs can give rise to the two major differentiated cell types in the placenta – extravillous trophoblast (EVT) and syncytiotrophoblast (STB). hTSCs have been derived from blastocyst-stage embryos and first trimester placental samples. While these hTSC lines have been helpful in studies on early human placental development, they are subject to a few limitations. The pregnancy outcomes of sources used to derive current hTSC lines is unknown. Further, genetic diversity of available hTSC lines is limited. Finally, it is unclear if these hTSC lines can be used to model pathologies associated with later gestation age, such as late-onset preeclampsia. To overcome these limitations, we have derived hTSCs from placental tissue at birth. The medium used for derivation of hTSCs from first trimester placental samples and blastocyst-stage embryos by Okae et al., (denoted TSCM) does not support derivation of hTSCs from term placentas. However, we show that TSCM supplemented with the mitochondrial pyruvate uptake inhibitor UK-5099 and lipid-rich albumin can be used to successfully derive hTSCs from term placentas.1 These hTSCs show expression of several key trophoblast markers, GATA3, AP-2γ, KRT7, YAP, and TEAD4. However, unlike hTSCs from first trimester cells, we also detected CDX2 expression.1 Furthermore, we were able to differentiate the cells into both HLAG+/Notch1+ EVTs, and multinucleated, hCG+/Syndecan+ STB using established protocols.1,2 Term trophoblast also cultured in TSCM+UK+AlbuMAX could be passage into TSCM after a few passages in TSCM+UK+AlbuMAX. Overall, our results will enable mechanistic studies on trophoblast biology in normal and pathological development.

Emily E. Brown, Iuliia Mandzhieva, Patrick Tom-Hon, Thomas Theis, Felix N. Castellano

Graduate Program: Chemistry

Advisor: Felix N. Castellano

Poster Number: 26

Ru(II) Catalysts for Visible Light Sensitized Parahydrogen Induced Hyperpolarization

Despite its vast utility, nuclear magnetic resonance (NMR) spectroscopy is restrained by low nuclear spin polarization, due to the near equivalent population of spin states. One prominent method to address the low polarization is para-hydrogen induced polarization (PHIP) which uses the singlet spin isomer of H2 to circumvent near equivalent thermal populations. Para-Hydrogen (p-H2) based polarization often relies on thermally catalytic or, infrequently, UV-activated catalytic hydrogenation. Visible light activated hydrogenation is both lower energy and offers more direct and timed control of hyperpolarization and measurement of short-lived intermediates. Here, we use well known triplet photosensitizers to sensitize a d6-transition metal dihydride, known to photo-release H2 and reabsorb p-H2 in solution. With these complexes we hydrogenate and hyperpolarize both the dihydrides and organic substrates using visible light for photochemical pump NMR-probe experiments. By sensitizing triplet ligand-field states with visible light, we can hyperpolarize the dihydrides and a range of unsaturated substrates and produce enhanced signals for room temperature and below. Without the addition of light, in otherwise consistent experimental conditions, hyperpolarization is not generated. This enables a shift from a thermal or high energy UV activation motif to one which can occur with easily available and controllable visible light sources and at low temperature, termed triplet-sensitized PHIP (Trip-PHIP).

J. H. Choi[1,2], C. L. Morris[3], M. Blatnik[4], L. J. Broussard[5], S. M. Clayton[3], C. Cude-woods[1,2,3], S. Currie[3], D. E. Fellers[3], E. M. Fries[4], P. Geltenbort[6], F. Gonzalez[5], L. Hayen[1,2], K. P. Hickerson[4], A. Holley[7], T. M. Ito[3], C. -Y. Liu[8], M. Makela[3], C. M. O'Shaughnessy[3], R. W. Pattie Jr.[3], B. Plaster[9], D. J. Salvat[8,10], A. Saunders[4], Z. Tang[3], Z. Wang[3], A. R. Young[1,2], B. A. Zeck[1,2]

Graduate Program: Physics[1]; Triangle Universities Nuclear Laboratory[2]; Los Alamos National Laboratory[3]; Kellogg Radiation Laboratory, California Institute of Technology[4]; Oak Ridge National Laboratory[5]; Institut Laue-Langevin[6]; Physics, Tennessee Technological University[7]; Physics, Indiana University[8]; University of Kentucky[9]; University of Washington[10]

Advisor: Albert R. Young

Poster Number: 32

Search for the Neutrons Decaying into Dark Matter using Ultracold Neutrons

Precision measurements of the free neutron lifetime have predominantly been measured with two systematically different methods: one is the "bottle" method that takes advantage of the low trapping potential of Ultracold neutrons (UCN), and counts remaining neutrons after filling the bottle and waiting for a set of holding times. The other method is the "beam" method that counts the decay particles, the protons and electrons, while measuring the flux of a neutron beam that passes through the decay volume. There is a 4σ discrepancy between the measured neutron lifetime with these two methods, raising the possibility of a small decay "branch" to particles invisible to conventional detectors, or Dark Matter. In some scenarios, this decay to a dark particle can be accompanied by the emission of a gamma ray, motivating the installation of a High Purity Germanium (HPGe) detector next to a UCN buffer volume on the UCNτ beamline at the Los Alamos UCN source to search for a monoenergetic gamma ray associated with the Dark Matter decay mode. The sensitivity of this measurement is determined from the intensity of any remaining peaks in the spectrum after subtracting known backgrounds. In order to determine the strength of the possible Dark Matter decay branch, the total number of UCN in the buffer volume during the time of measurement must also be determined. Complementary to the previously measured UCN density in the buffer volume, we have developed a detailed UCN transport model to cross check the extrapolated total number of UCN to place additional constraint on the estimate. Incorporation of the new simulations to the analysis of the search will be presented.

Grant D. Colip[1], Elana L. Leithold [1], Karl W. Wegmann [1,2], Daniel L. Brothers[3], Rika R. Burr[4]

Graduate Programs: Marine, Earth, and Atmospheric Sciences[1]; Geospatial Analytics[2]; Pacific Coastal and Marine Science Center, U.S. Geological Survey[3]; Chesapeake Energy Corporation[4]

Advisors: Elana L. Leithold, Karl W. Wegmann

Poster Number: 33

Seismic reflection imagery aids Late Quaternary earthquake history reconstructions at Lake Crescent, Washington, USA

Lake Crescent is a 180-m-deep, glacially carved lake located in Olympic National Park, Washington, within the forearc of the Cascadia subduction zone (CSZ). The lake's sediments are a high-resolution recorder of local paleoseismic activity, including from the CSZ and the North Olympic Fault Zone (NOFZ), which includes the Lake Creek-Boundary Creek and Sadie Creek Faults. Previous work at Lake Crescent has revealed a series of at least three meter-scale mass transport deposits (MTDs) in sub-bottom sediments at the lake during the last ~7,200 years, the two most recent of which are dubbed MTD-I and MTD-II, and additional centimeter-to-decimeter-scale turbidites. This study uses seismic reflection data in combination with existing geochronological and sedimentological data to characterize the upper two MTDs and further analyze the post-MTD-I record (< ~3,100 YBP) of mass wasting (MW) deposits and their correlation to turbidite layers. Newly acquired CHIRP seismic data allow us to better resolve presumed debris flow and overlying turbidite deposits in MTD-I and MTD-II and to identify correlative mass wasting deposits along the basin margins. Isopach modeling indicates maximum layer thicknesses of 3.9 and 7.6 m for the two layers, respectively, in the lake's northern basin and 2.9 and 5.8 m in the southern basin. Cumulative wet volumes for MTD-I and MTD-II are estimated at 8.3 x 106 and 9.9 x 106 m3. The seismic dataset also reveals five groupings of slope-marginal MW deposits above MTA in the southern basin. These MW deposits transition basinward into turbidites deposited in the past 3100 years, indicating that many turbidites were sourced from more than one slope failure location, which may indicate an earthquake-induced trigger. These findings highlight the utility of lake deposits for assessing the seismic hazards to the Olympic Peninsula posed by the North Olympic Fault Zone and the Cascadia Subduction Zone.

Ashley Connors, Jeffrey A. Yoder

Program: Toxicology

Advisor: Jeffrey A. Yoder

Poster Number: 34

Investigating the Impact of Per- And Polyfluoroalkyl Substances (PFAS) on Macrophage Phagocytosis

Immune function can be impaired by environmental contaminants. One class of chemicals recently shown to interfere with the immune system is per- and polyfluoroalkyl substances (PFAS). Earlier work focused on impacts on the adaptive immune system, though disruptions to the innate immune system have also been identified. These studies indicate that PFAS exposure can influence the numbers of innate immune cells, cellular signaling, and functional endpoints. For example, we reported that certain PFAS can reduce the oxidative burst in vivo in larval zebrafish (Danio rerio), in vitro in a human neutrophil-like cell line, and ex vivo in primary human neutrophils. To complement these neutrophil studies, we are evaluating how macrophages are affected by a 2-day (in vitro) and 4-day (in vivo) exposure to ten PFASs: perfluorobutanesulfonic acid (PFBS), perfluorohexanesulfonic acid (PFHxS), perfluorooctanesulfonic acid (PFOS), perfluorohexanoic acid (PFHxA), Perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorodecanoic acid (PFDA), Nafıon Byproduct 2, perfluoro-2-methoxyacetic acid (PFMOAA), and hexafluoropropylene oxide dimer acid (HFPO-DA or GenX). In single-PFAS cytotoxicity studies with macrophage-like THP-1 cells, exposure to 320 μM PFDA, PFNA, PFOS, and Nafıon Byproduct 2 significantly reduced viability. We observed no changes in cell viability at or below exposures to 80 μM PFAS. We are currently investigating how phagocytosis is affected during PFAS exposures using both zebrafish larvae and THP-1 cells: macrophage populations derived from zebrafish and THP-1 cells will be challenged with fluorescent heat-killed E. coli. Phagocytic index and number will be measured with flow cytometry. Thus far, we have observed that PFOS, but not PFOA, increases the average extent of phagocytosis. Based on these functional assays, 2-3 PFASs will be selected for further studies to elucidate currently unknown molecular mechanisms of PFAS immunotoxicity. Understanding how PFAS affect innate immunity will help us better understand how these chemicals can alter an organism's ability to recognize and destroy pathogens in its environment as well as infected or transformed cells.

Deepasika Dayananda, Chueng-Ryong Ji

Graduate Program: Physics

Advisor: Chueng-Ryong Ji

Poster Number: 42

Study of the Local Four-Dimensional Relativistic Space-Time Transformations from the Perspectives of the Global Five-Dimensional de Sitter and Anti-de Sitter Spaces

De Sitter and anti-de Sitter spaces are the maximally symmetric vacuum solutions of Einstein's field equation with positive and negative cosmological constants, respectively. As the geometry of the spacetime is deeply connected with the corresponding groups and algebras, we present the projection of de Sitter and anti-de Sitter groups (SO(4,1) and SO(3,2)) into Poincaré group (ISO(3,1)) in the limit of cosmological constants of their spaces go to zero making the curvature of the spaces vanish. From this global perspective of the space-time configuration, we discuss the local four-dimensional Minkowski space-time characteristics in particular for the application to the relativistic quantum field theories. We illustrate the kinematic and dynamic properties of the Poincaré generators in the computation of relativistic quantum field theoretic scattering amplitudes and explore the interpolation between the instant form dynamics and the light-front dynamics.

Chathuri De Alwis[1], J. Dylan Denison[1], Ruby Shah[1], Gregory S. McCarty[1], Leslie A. Sombers[1,2]

Graduate Programs: Chemistry[1]; Comparative Medicine Institute[2]

Advisor: Leslie A. Sombers

Poster Number: 43

Achieving Comprehensive Electrochemical Detection of Individual Exocytosis Release Events at Single Cells

Real-time monitoring of individual exocytosis events can be achieved by coupling amperometry with carbon-fiber microelectrodes. Typically, a disk microelectrode is positioned above a single cell in an 'artificial synapse' configuration, and neurotransmitter release is triggered by puffing a secretagogue onto the cell. Released neurotransmitter is oxidized at the electrode surface, resulting in a series of current spikes. The amount of charge passed in each individual spike is used to precisely quantify the number molecules detected in each release event. Over the past several decades, this approach coupled with disk microelectrodes of ~10-μm diameter has yielded tremendous insight into dense-core vesicle fusion kinetics. However, the extent of analyte loss associated with these measurements remains unclear. Since the electrochemical signal is defined by mass transport to and from the sensor surface, electrode geometry can be exploited to overcome diffusional loss. In this work, 10- and 30-μm diameter carbon-fiber disk microelectrodes were used to characterize exocytosis events from individual bovine chromaffin cells using constant potential amperometry and fast-scan cyclic voltammetry (FSCV). The larger 30-μm diameter electrode resulted in a substantial gain in sensitivity to catecholamines and enkephalins. It more effectively covered the entire cell (~16-μm diameter), and a higher frequency of events and a larger quantal size were measured. Treatment of chromaffin cells with L-dopa and adjustment of cell-electrode spacing provided further evidence for restricted material loss at the larger electrode. Furthermore, FSCV data collected at the cells allowed for real-time characterization of vesicular contents released. Overall, this work provides an important advance in electrode technology while addressing often overlooked sources of analyte loss in electroanalytical measurements of exocytosis.

Rushabh Gala[1], Matthew Green[1,2]

Graduate Program: Physics[1]; Oak Ridge National Laboratory[2]

Advisor: Matthew Green

Poster Number: 59

Preliminary background model for LEGEND-1000 experiment

The light masses of neutrinos compared to the other elementary particles of the standard model of particle physics may be related to the possibility that neutrinos are their own antiparticles (i.e. Majorana particles). This also motivates a possible explanation for the matter-antimatter asymmetry in the universe. Observation of Neutrinoless double beta decay, a hypothesized radioactive decay process would confirm the majorana nature of the neutrinos. Tonne-scale experiments running nearly background-free have been proposed to extend current half-life sensitivities by an additional factor of 100. LEGEND-1000 is one such upcoming Ge-based experimental program with a discovery potential of a half -life beyond 1028 years. To achieve this, we need to be able to distinguish the background from the signal events. This requires an accurate modeling of the contribution from various background sources as well as development of components that are radio-pure. I will present the different methods we use to reduce and veto the background events in order to reach the desired sensitivity goal of the experiment.

Jimmy Hickey

Graduate Program: Statistics

Advisors: Jonathan P. Williams, Emily C. Hector

Poster Number: 71

Transfer Learning with Uncertainty Quantification: Random Effect Calibration of Source to Target (RECaST)

Transfer learning uses a data model, trained to make predictions or inferences on data from one population, to make reliable predictions or inferences on data from another population. Most existing transfer learning approaches are based on fine-tuning pre-trained neural network models, and fail to provide crucial uncertainty quantification. We develop a statistical framework for model predictions based on transfer learning, called RECaST. The primary mechanism is a Cauchy random effect that recalibrates a source model to a target population; we mathematically and empirically demonstrate the validity of our RECaST approach for transfer learning between linear models, in the sense that prediction sets will achieve their nominal stated coverage, and we numerically illustrate the method's robustness to asymptotic approximations for nonlinear models. Whereas many existing techniques are built on particular source models, RECaST is agnostic to the choice of source model. For example, our RECaST transfer learning approach can be applied to a continuous or discrete data model with linear or logistic regression, deep neural network architectures, etc. Furthermore, RECaST provides uncertainty quantification for predictions, which is mostly absent in the literature. We examine our method's performance in a simulation study and in an application to real hospital data.

Cassidy Hubbard

Graduate Program: Biology; North Carolina Zoo

Advisors: Jenny Campbell, Emily Lynch, Daniel Schmitt

Poster Number: 75

A 24-hour Approach to Animal Welfare: Evaluating Around the Clock Behaviors of a Zoo-housed Herd of African Elephants (Loxodonta africana)

To improve the well-being of animals under human care, we must consider welfare over a 24 hour cycle. Stress-induced behaviors may be expressed by zoo-housed elephants (Loxodonta sp.) and can vary in the frequency of expression. Here, we assessed the effects of season and housing on the activity budgets of seven (3.4) African elephants (L. africana) over a 24 hour period housed at the North Carolina Zoo. Using video playback and live observations, we collected data two days and nights per week for the winter (January - March) and summer (May - August) seasons of 2022. We collected data from 9am to 7am the following morning. We performed Wilcoxon Signed Rank Tests to compare the activity budgets of each individual and as a herd. We observed that the mean frequency of active, foraging, resting, and stress-induced behaviors differed between individuals during both daytime and overnight. We also found that the frequency of active behaviors was significantly higher overnight in the summer than in the winter. Finally, the frequency of stress-induced behaviors was higher overnight in the winter than in the summer. These observations highlight the importance of considering overnight behaviors in zoo-managed animals to improve welfare across all hours.

Somayeh Kashani[1], Zhen Wang[1], Chad Risko[2], Harald Ade[1]

Graduate Program: Physics[1]; Chemistry, University of Kentucky[2]

Advisor: Harald Ade

Poster Number: 85

Relating reorganization energies, exciton diffusion length and non-radiative recombination to the room temperature UV-vis absorption spectra of NF-SMA

State-of-the-art organic solar cells (OSCs) rely on bulk-hetero- junction (BHJ) active layers of nonfullerene small molecule acceptors (NF-SMAs) and polymer donors. The device-relevant thin film opto-electronic properties are generally correlated to both intra-molecular properties and inter-molecular interactions of the molecules in different packing within the film. Understanding excited-state reorganization energies, exciton diffusion lengths and non-radiative (NR) recombination, and the overall optoelectronic responses of NF-SMA is important in order to rationally design new materials with controlled properties. While the effects of structural modifications on the optical gaps and electron affinities of NF-SMAs have been studied extensively, analyses of their absorption spectra that carefully characterize electronic and vibrational contributions that allow comparisons of intra-molecular reorganization energies and their implications for exciton diffusion lengths and NR recombination have yet to be reported. Here, utilizing multi-parameter FC (MFC) analyses along with density functional theory (DFT)/ time-dependent DFT (TD-DFT) calculations we endeavor to delineate the spectral features of three structural classes of NF-SMAs in dilute solutions at room temperatures. The results of MFC/DFT analyses reveal that the absorption spectra of curved, Y6-like structures can be described using an MFC model with two electronic transitions and two effective vibrational modes. Moreover, it reveals that Y6-like structures exhibit the smallest intra-molecular reorganization energy and highest conformational uniformity among the materials studied. Since the intra-molecular reorganization energy is correlated with exciton diffusion length and nonradiative voltage losses (DVnr), our results highlight the power of RT absorption spectroscopy and DFT calculations as simple tools to designing improved OSCs materials with small reorganization energies, small DVnr, large exciton diffusion length and low energetic disorder (due to a strongly dominant conformation). Finally, the result of this study can be used to infer the absorption features of SM-NFA in the film and aggregates and indeed the inter-molecular properties of the materials.

Nicholas Larsen, Srijan Sengupta, Jonathon Stallrich

Graduate Program: Statistics

Advisors: Jonathon Stallrich, Srijan Sengupta

Poster Number: 93

HODOR: A two-stage hold-out design for online randomized experiments on networks

A/B tests are standard tools for estimating the average treatment effect in online controlled experiments (OCEs). The majority of OCE theory relies on the Stable Unit Treatment Value Assumption, which presumes the response of individual users depends only on the assigned treatment, not the treatments of others. Violations of this assumption occur when users are subjected to network interference, a common phenomenon in social media platforms. Standard methods for estimating the average treatment effect typically ignore network effects and produce heavily biased results. Additionally, unobserved user covariates, such as offline information or variables hidden due to privacy restrictions, that influence user response and network structure also bias current estimators of the average treatment effect. In this paper, we demonstrate that network-influential lurking variables can heavily bias popular network clustering-based methods, thereby making them unreliable. To address this problem, we propose a two- stage design and estimation technique called HODOR (Hold-Out Design for Online Randomized experiments). We show that HODOR is unbiased for the average treatment effect, has minimizable variance, and provides reliable estimation even when the underlying network is partially-unknown or uncertain.

Isabella Livingston [1,7], Taylor M. Gregory[2,3], Eleanor C. Hawkins[2], Andrea Loyola[4], Ashley Cave[2], Shelly L. Vaden[2], Diane Deresienski[2,5], Matthew Breen[7], Marjorie Riofrio-Lazo[5,6], Greg A. Lewbart[2,5], Diego Paez-Rosas[5,6]

Graduate Program: Genetics[1]; Department of Clinical Sciences[2]; Fort Worth Zoo[3]; Dirección Parque Nacional Galápagos, Departamento de Ecosistemas, Isla Santa Cruz EC200350, Islas Galápagos, Ecuador[4]; Galapagos Science Center, USFQ & UNC-Chapel Hill, Av. Alsacio Northia, Isla San Cristóbal EC200150, Islas Galápagos, Ecuador[5]; Universidad San Francisco de Quito (USFQ), Colegio de Ciencias Biológicas y Ambientales, Isla San Cristóbal EC200150, Islas Galápagos, Ecuador[6]; Department of Molecular Biomedical Sciences[7]

Advisor: Matthew Breen

Poster Number: 99

Genetics and Genomics Aid in Identification of Parasites from Non-Native Species in an Endangered Galapagos Pinniped

Darwin's discovery of the Galapagos archipelago revolutionized science and our understanding of the natural world. Since then, the Galapagos islands have remained one of the most preserved natural habitats. Despite this, the archipelago faces growing threats as a result of anthropogenic impacts, including introduced species. These non-native species, including companion animals like dogs and cats, are a primary cause of biodiversity loss through competition, predation, and infectious disease. Companion animals roam freely on occupied islands and have unrestricted interaction with wildlife. Historically, the introduction of new species to the archipelago has been limited due to its geographic isolation, so native life cannot adapt to new pressures and possess an increased vulnerability to disturbances. Further, they likely evolved without many pathogen exposures; thus, interaction with introduced species can cause disease spillover, a potentially catastrophic threat to the archipelago. To investigate this potential threat, in May of 2022, I, along with members of NCSU's CVM, traveled to the "enchanted islands" to conduct health assessments for a characteristic species within the archipelago, the Galapagos sea lion. We performed health assessments and collected samples from 28 sea lions. We tested blood from each with a commercial heartworm test kit on site and documented the presence of canine heartworm in this species for the first time. We validated this finding with genomic assays for identifying filarial nematode DNA in sea lion whole blood. With our assays, we are exploring the prevalence of parasites in these pinnipeds. This study will provide context for the conservation of a Galapagos pinniped and innovative measures needed to mitigate the detrimental impacts of introduced species on native wildlife.

Paul Miller

Graduate Program: Chemistry

Advisor: David Shultz

Poster Number: 108

Metal-Semiquinone Magnetic Exchange to Modulate the Electronic Ground State of Conjugated Bis(Semiquinones)

The electronic structures of Kekulé-type biradicals ¾ two antiferromagnetically coupled radicals that can form a π-bond ¾ have been a point of research and debate ever since Chichibabin's hydrocarbon was synthesized in 1907 and was finally determined to be closed shell in 1987. Reactivity of biradicals has complicated data collection and analysis, however the utilization of bulky metal complexes of semiquinone radical donors _ previously used in the Shultz Group in Donor-Bridge-Acceptor systems _ precludes concerns of dimerization and other deleterious reactions in solution. Additionally, semiquinones require the coordination of metal ions to be stabilized, which introduces an additional site of modification that other biradical systems lack. This enables the installation of paramagnetic metal centers, which we have discovered can modulate the the electronic ground state of the bridge between the conjugated semiquinones. We hypothesize that this modulation of the electronic ground state is achieved via the competing metal-semiquinone and the semiquinone-semiquinone magnetic exchange interactions.

Camen Royse, Jingjing Huang, Ilya Arakelyan, John Thomas

Graduate Program: Physics

Advisor: John Thomas

Poster Number: 2

Information Scrambling in an Ultracold Atomic Gas

The interaction strength between trapped, ultracold atoms is magnetically tunable. Near the regime where the atoms do not interact, the energies of the individual atoms are conserved on the order of minutes, while the spin states of interacting atoms are mutually affected. We describe this system as a chain of spins in energy space, with tunable site-to-site couplings. This spin chain model predicts spin waves following coherent excitation, in quantitative agreement with the atom density profiles that we observe for evolution times less than a second. At longer evolution times, however, the amplitude of the spin wave decays, in disagreement with the model, indicating a scrambling of the information that was initially stored in the spin coherence. We report on our latest measurements, employing time reversal of the system and measurement of spin correlations in energy space to quantify the information loss.

Angela Shipman

Graduate Program: Chemistry

Advisor: James D. Martin

Poster Number: 150

How Hydration Directs the Structure and Dynamics of Deep-Eutectic and Ionic Liquid Aqueous Salts

Discrete structural features of liquids compared to a temperature-concentration dependent phase diagram yields a new model and deeper understanding of solute-solvent effects. Solutions are classically approximated as a gas-like continuum with stronger intermolecular forces or an averaged field of a dielectric constant. However, such approaches do not predict “non-ideal” deviations in their properties, which limits control over structure-property relationships in application. Through exploitation of the strong interactions between water and the highly charged Al3+ cation, the AlCl3•RH2O system exhibits unique structural and dynamic features in 1H-NMR spectroscopy, T1 and T2 relaxation, and X-ray diffraction measurements. Chemical shift data exhibit a unique trend inversion, indicating a concentration-dependent competition between the electron-donating influence of the anion and electron-withdrawing influence of the cation. Relaxation data of the salt-rich side of the eutectic demonstrate macromolecular-type cooperative structure of the bulk and an increasing cooperativity between the first and second hydration shells around Al3+, suggesting a substantial ionic liquid structure and an evolving liquid phase. Diffraction data reveals that the Al – O bond between Al3+ and water shortens by 3.7% from R=22 to R=18, which is associated with chloride insertion into the immediate hydration shells around Al3+. These trends are indicative of unique liquid domains that are analogous to a melt of the proximate crystallizing phase, bolstering a working hypothesis for the existence of four unique liquid phase regimes: the Solute-Influenced Liquid (SIL), the Ice-Forming Liquid (IFL), the Pentadecahydrate-Forming Liquid (PHFL) and the Ionic Liquid regime (IL). The interplay of these liquid phases provides new insight into how structure-induced solute-solvent interactions dictate crystal nucleation and the deep-eutectic liquidus. This work, integrated with other work in the Martin group, is developing the Solvation Shell Ionic Liquid (SSIL) model of aqueous electrolyte solutions that may accurately predict their properties compared to traditional models.

Emma E. Tobin[1,2], Ayushma Sharma[2], Jonathan R. Hall[1,2,3]

Graduate Programs: Toxicology[1]; Department of Biological Sciences[2]; Center for Human Health and the Environment[3]

Advisor: Jonathan R. Hall

Poster Number: 162

The Role of C/EBPβ in Keratinocyte Regulated Cell Death after DNA Damage

In response to DNA damage a cell must make the decision to repair the damage and continue proliferating or to induce regulated cell death. The decision to undergo regulated cell death (also known as apoptosis) after DNA damage is vital in preventing damaged cells from progressing into cancer cells. The basic leucine zipper transcription factor CCAAT-enhancer/binding protein b (C/EBPβ) is highly expressed in epidermal keratinocytes. C/EBPβ is a suppressor of epidermal keratinocyte apoptosis in response to UVB-induced DNA damage and skin tumor stress, and C/EBPβ is required for skin tumor formation and skin tumor survival. The mechanism by which C/EBPβ protects epidermal keratinocytes from apoptosis, and alternatively the mechanism by which loss of C/EBPβ sensitizes DNA damaged keratinocytes to apoptosis, is not yet defined. There are two major mechanisms of apoptosis: intrinsic and extrinsic apoptosis. Intrinsic apoptosis is mediated by the mitochondria and is characterized by formation of the apoptosome and cleavage of caspase-3. Extrinsic apoptosis is mediated by a family of transmembrane receptors called death receptors and results in activation of caspase-8 and caspase-3. Utilizing pharmacological inhibitors and RNAi-mediated gene silencing we have observed the enhanced cell death in C/EBPβ deficient keratinocytes is dependent on a novel DNA damage response (DDR) involving the type I interferon pathway, classic mediators of the DDR including ATM and p53, and activation of pro-apoptotic caspases-8 and -3. We have observed that C/EBPβ suppression of cell death occurs in response to multiple sources of DNA damage, including UVB radiation and chemotherapeutic DNA damaging agents etoposide and cisplatin – suggesting that C/EBPβ suppression of cell death could be a general DDR applicable to cells and cancers outside of the skin. Defining the role of C/EBPβ in regulating cell survival could identify novel therapeutic targets to restore regulated cell death pathways and to prevent and treat cancer.

Kang Wang

Graduate Program: Statistics

Advisor: Subhashis Ghosal

Poster Number: 171

Nonparametric bayesian inference under shape restrictions

Shape restrictions on the functional relationships between variables, such as monotonicity, convexity, and log-concavity, are prevalent across many fields, including econometrics, bioinformatics, sociology, and more. Nonparametric inference under shape restrictions has proven to be an effective method for estimating the concerned function, as it is against model misspecification and eliminates the need for subjective tuning. While previous research has focused on nonparametric maximum likelihood estimation and Bayesian inference for univariate functions, this work fills the gap in estimating multivariate monotone functions using nonparametric Bayesian inference in both multivariate regression analysis and multivariate density estimation. We extend the conventional Bayesian approach by incorporating shape restrictions during the posterior sampling stage through the so-called “immersion maps”. Our focus is on the asymptotic properties of the resulting induced “immersion posterior”. We show that the posterior distribution contracts at an optimal rate to the true function, and the pointwise credible interval covers the true function value with probability exceeding the predetermined credibility. Additionally, we have studied k-monotone density estimation and proposed a Bayesian approach using the Dirichlet process prior and finite mixture prior. Our approach is capable of adapting to the model parameter k, and it outperforms existing non-Bayesian methods only available for known k. We have also shown that the posterior distribution contracts to the true density at an optimal rate in the Hellinger metric. Finally, we have applied the k-monotone modeling to the estimation of the proportion of null hypotheses in large-scale simultaneous testing based on p-values. The simulation studies show our approaches enjoy good estimation accuracy and less variation.

Xiaoqin Yan

Graduate Program: Sociology

Advisor: Andrew Davis

Poster Number: 183

The meaning making in knowledge production: American sociology as a cultural system

What are the central research themes of American sociology? How do different subfields in sociology interact and co-evolve over time? Are certain topics more prominent than others? Based on 2,964 doctoral dissertations from 108 U.S. sociology departments completed between 2015 and 2019, this study applies natural language processing and semantic network analysis to the dissertation abstracts to map the evolving backbone of American sociology through a relational lens. We also examine the methodological divide and integration in sociology by analyzing the methodological choice (quantitative, qualitative, or mixed-method) of dissertations. This study facilitates the investigation of how one's intellectual choice could be influenced through interaction with scholars who belong to the same school of thought in conjunction with the institutional structures in academia. While existing theories in knowledge production emphasize the role of interpersonal connections between members of intellectual communities, we propose that the academic institutional structures, such as job market positions and top journal publications, may also influence new scientific idea formation. Finally, we discuss how the consolidation of the methodological divide and research-topic choice shape the future development of sociology.

College of Veterinary Medicine

Liton Chandra Deb, Manuel Jara, Cristina Lanzas

Graduate Program: Comparative Biomedical Sciences

Advisor: Cristina Lanzas

Poster Number: 29

Early evaluation of the Food and Drug Administration (FDA) guidance on antibiotic use in food animals on antimicrobial resistance trends reported by the National Antimicrobial Resistance Monitoring System (2012-2019)

Antimicrobial resistance (AMR) is one of the biggest challenges to the global public's health. To address this issue in the US, governmental agencies have implemented system-wide guidance frameworks and recommendations aimed at reducing antimicrobial use. In particular, the Food and Drug Administration (FDA) prohibited the extra-label use of cephalosporins in food animals in 2012 and issued the guidance for industry (GFI) #213 about establishing a framework to phase out the use of all medically relevant drugs for growth promotion in 2012. Also, in 2015, the FDA implemented veterinary feed directive (VFD) drug regulations (GFI# 120) to control the use of certain antimicrobials. To assess the potential early effects of these FDA actions and other concurrent antimicrobial stewardship actions on AMR in the food chain, we compared the patterns of the phenotypic (minimum inhibitory concentration (MIC) and percentage of resistance) and genotypic resistances for selected antimicrobials (i.e., ampicillin, ceftriaxone, chloramphenicol, ciprofloxacin, gentamicin, and tetracycline) before and after 2016 across different enteric pathogen species Campylobacter coli and C. jejuni (chicken), Escherichia coli (cattle, swine, turkey and chicken), Salmonella enterica serotype Dublin (cattle), Enteriditis (chicken), Heidelberg (chicken), Kentucky (chicken), Montevideo (cattle), and Typhimurium (cattle and Chicken), as reported by the National Antimicrobial Resistance Monitoring System (NARMS). Most of the antimicrobials analyzed at the phenotypic level followed a downward trend in (MIC) after implementing the guidance. Although, most of those changes were less than one 1-fold dilution. On the other hand, compared to MIC results, the results based on phenotypic resistance prevalence evidenced higher differences in both directions between the pre- and post-guidance implementation period. Also, we did not find relevant differences in the presence of AMR genes between pre- and post-VFD drug regulations. We concluded that the FDA guidance on antimicrobial use has not led to substantial reductions in antimicrobial drug resistance yet.

Emily Hellstrom, Amanda Ziegler, Anthony Blikslager

Graduate Program: Comparative Biomedical Sciences

Advisors: Anthony Blikslager, Amanda Ziegler

Poster Number: 69

Serum rescues surgical manipulation induced intestinal barrier permeability greater than interleukin 1 receptor antagonist conditioned serum in large animal model

Surgical manipulation induced intestinal barrier permeability has been previously demonstrated in rodent models and may prove crucial in the development of postoperative complications. The observation of this phenomena in a large animal model, and further understanding of mechanisms as well as potential therapeutic approaches has yet to be fully explored. The enteric glial cell population may prove to be a critical participant as they sense the intestinal environment and communicate with surrounding cell populations. Blockade of glial IL-1 receptor has proven successful in preventing murine postoperative ileus, a possible sequela of barrier permeability. Therefore, we hypothesized that a large animal model would demonstrate surgical manipulation-induced intestinal barrier permeability, which could be prevented by luminal injection of interleukin 1 receptor antagonist conditioned serum (IRAP). Ischemia was first induced in the distal jejunum of juvenile pigs to mimic the disease process that would require intestinal surgery. Jejunum proximal and distal to the ischemic loops was then manipulated without the injection of 1ml of nonconditioned porcine serum or IRAP into the loop. Forty-five minutes after manipulation, tissues were collected for immunofluorescence histology and mounted on Ussing chambers to measure transepithelial electrical resistance (TEER). Manipulated proximal intestine was significantly more permeable than control tissue ($p<0.0001$). In addition, preliminary fluorescent quantification has indicated an increase in glial marker, glial fibrillary acidic protein, in the manipulated tissue ($p=0.0499$). Addition of IRAP significantly increased the resistance of the proximal loop compared to manipulation alone ($p=0.0003$). Interestingly, addition of control porcine serum significantly increased the resistance of both the proximal and distal loops compared to manipulation alone, and to a greater extent than IRAP ($p=<0.0001$ and 0.0008 respectively).While the effects of IRAP on interleukin 1 signaling may play a role in prevention of surgical manipulation induced intestinal barrier permeability, it appears than non-conditioned serum may offer therapeutic benefits.

Samantha Kisthardt[1*], Rajani Thanissery[1], Colleen Pike[1], Matthew H Foley[1,2], Casey M Theriot[1]

Graduate Program: Microbiology[1]; Department of Food, Bioprocessing and Nutrition Sciences[2],

Advisor: Casey Theriot

Poster Number: 89

Microbial derived bile acids inhibit C. difficile growth and pathogenicity while sparing other members of the gut microbiota

Disruption of the indigenous gut microbiota and the loss of microbial derived secondary bile acids are associated with increased susceptibility to C. difficile infection (CDI). Previous work has shown that the secondary bile acid isolithocholate (iLCA), a lithocholate (LCA) derived isomer, has potent inhibitory activity against C. difficile strain R20291. Our objective was to further characterize LCA and its derivatives to determine how they can inhibit toxin production in C. difficile while sparing the indigenous gut microbiota. We tested the inhibitory activity of three LCA derivatives iLCA, 3-oxo-LCA, and iso-allo-LCA (iaLCA) with C. difficile strain R20291 and a commensal gut microbiota panel. To determine the mechanism of action by which LCA and its derivatives inhibit aspects of the C. difficile lifecycle, we performed a series of experiments to identify the minimum inhibitory concentration (MIC), bacterial killing, membrane integrity disruption, and effects on toxin expression and activity. Further, Caco-2 cell apoptosis, viability, and permeability assays were used to determine the cytotoxicity of these compounds against the host. C. difficile growth was found to be strongly inhibited by iLCA, 3-oxo-LCA, and iaLCA; as reflected by low MICs ranging from 0.03 mM to 0.1 mM. In comparison, most commensal gut microbes tested from the panel did not experience inhibition of growth in the presence of high concentrations of the bile acids (1.25 mM). iLCA and iaLCA had bactericidal activity against C. difficile and significantly damaged the bacterial membrane integrity of C. difficile at 0.5X MIC. Finally, iLCA and iaLCA decreased expression of the toxin tcdA at subinhibitory concentrations. These results suggest that both iLCA and iaLCA have potent inhibitory activity against C. difficile while sparing commensal members of the gut microbiota. Although iLCA and iaLCA are both epimers of LCA, they have distinct mechanisms for inhibiting C. difficile. The properties of iLCA and iaLCA suggest their potential use as novel compounds that can target C. difficile while sparing gut commensals that are important for colonization resistance. Future efficacy studies in a mouse model of CDI are warranted.

Ranee A. Miller, Tyana S. McCluney, Ronald E. Baynes
Graduate Program: Comparative Biomedical Sciences
Advisor: Ronald Baynes
Poster Number: 109

Elimination Kinetics of Subcutaneously Administered Eprinomectin in Plasma and Milk in Dry-Off Dairy Cattle

Parasitic infections in dairy cattle negatively impact herd immunity, decrease milk production, and lower conception rates which raise production costs and lessen the quality of food animal lives. The extra-label use of anthelmintics generates food safety risks for consumers as suitable withdrawal times to ensure the safety of milk are not yet established. LongRange® eprinomectin, an extended-release injectable parasiticide, is used to treat and control internal and external parasites in cattle and can have up to 150 days of efficacy in a single dose compared to the topical administration with up to 28 days of efficacy. While there is zero milk withdrawal time for topical eprinomectin, more research is necessary to establish the residues present in milk following subcutaneous administration. The objective of this study was to determine if dairy cattle given a label dose of 1mg/kg of injectable eprinomectin at the start of dry-off 60 days prior to calving would have residues below the U.S. milk tolerance level of 12ppb by the time of post-calving lactation. Thirteen mature dairy cattle subjects had plasma collected daily for seven days post-administration, then at regular intervals for 90 days. Once each cow calved, milk samples were collected daily. Utilizing a HPLC-fluorescence detection method, results indicate that the plasma biphasic concentration time profile has a Cmax of approximately 35ppb. Based on a low milk:plasma partition coefficient, milk residues are expected to be a quarter of what is seen in plasma. This analysis is in progress and results will be published when acquired.

Jessica L. Parzygnat[1,2], Lyndy Harden[2], Muhammed Muyyarikkandy[2], Sid Thakur[2]
Graduate Programs: Comparative Biomedical Sciences[1]; Population Health and Pathobiology[2]
Advisor: Sid Thakur
Poster Number: 119

Prevalence and antimicrobial resistance of high concern Gram-negative pathogens isolated from distinct broiler production systems in the Southeastern United States

Broiler chicken is the number one consumed meat in the United States. Chickens are a known reservoir for foodborne pathogens, such as Salmonella and Campylobacter, that can potentially make humans sick. Popularity of owning backyard poultry in the United States is increasing, which heightens infection risk for farm owners. This is concerning given the severe lack of studies regarding surveillance of high concern pathogens on backyard farms. It also inhibits comparison to commercial operations in order to assess safe practices. Infection becomes especially frightening considering antimicrobial resistance to commonly used antimicrobials in medicine, as is exhibited by extended-spectrum beta-lactamase (ESBL) pathogens. This is the first study to our knowledge to investigate the prevalence and antimicrobial resistance of Salmonella, Campylobacter, and ESBL E. coli in United States backyard and commercial broiler farms. Preliminary results from 10 commercial and 8 backyard farms show prevalence of pathogens in both bird fecal samples and farm environment. Backyard sample prevalence was 17.47%, 22.76%, and 13.94% for Salmonella, Campylobacter, and ESBL E. coli, respectively. Commercial prevalence was higher with Salmonella, given 52.18% of samples tested positive, and lower with Campylobacter and ESBL E. coli (13.08%, and 2.31%). Salmonella antimicrobial susceptibility testing revealed resistance to antimicrobials used to treat Salmonella infection in humans with 33.4% and 33.7% of commercial isolates resistant to nalidixic acid and ciprofloxacin, respectively. ESBL E. coli results revealed resistance to last resort antibiotics, carbapenems. Of backyard isolates, 4.5% were resistant to imipenem and 3.0% were resistant to meropenem. Better understanding the persistence of antimicrobial resistant bacteria could help determine best practices to ensure safe production and food safety. This study reveals the need for focused research on antimicrobial resistance in broiler production systems, as it is a concern for human, animal, and environmental health alike.

Teresa M. Tiedge, Kelly A. Meiklejohn
Graduate Program: Comparative Biomedical Sciences
Advisor: Kelly A. Meiklejohn
Poster Number: 160

DNA Metabarcoding of Biological Taxa in Soil and Dust for Forensic Investigations

Soil and dust are often submitted to crime laboratories as evidence and can be used to link an individual to a crime or to determine sample origin. Traditional geologic examinations focus on the physical characteristics (e.g., pH, color, etc.) and the inorganic components (e.g., mineral composition). As with other forensic evidence, sample size is often a limiting factor in geologic analyses; thus, there is a need for supplemental approaches to glean additional evidentiary information. DNA metabarcoding is a commonly used approach to identify biological taxa that are present in environmental samples by amplifying and sequencing short, informative regions of the genome and is not restricted by sample amount. The goal of this research was to determine the stability and utility of environmental DNA from four biological taxa associated with mock soil and dust evidence for sample-to-sample comparisons and study site separation. In this study, five mock evidence items were collected monthly over a one-year period from an agricultural and urban location in North Carolina. DNA metabarcoding was applied to characterize bacteria (16S), fungi (ITS1), arthropods (COI), and plants (ITS2, trnL) associated with each sample (n, 1026). Libraries were generated using custom indexed primers and sequenced on an Illumina MiSeq. Raw sequencing reads were processed through a bioinformatic workflow and taxonomic assignment permitted by searching against GenBank. All mock evidence was successfully collected and soil DNA yields were highest and more variable in the agricultural samples compared to urban samples. A preliminary assessment of the sequencing data indicate a) that variation between urban and agricultural locations was most pronounced with plant taxa, b) within a single location (urban or agricultural), similar plant, bacterial, and fungal communities were recovered across all mock evidence types, and c) replicates recovered relatively consistent communities, but there are abundance differences (determined via read count).

Poole College of Management

Hongqiang Yan

Graduate Program: Economics

Advisor: Mehmet Caner

Poster Number: 182

Uniform Inference in High Dimensional Threshold Regression Models

High-dimensional sparse estimators such as the LASSO are widely used in econometrics and statistics to achieve variable selection from a set of many potential variables. However, a major difficulty of the problem is the fact that sparse estimators such as the LASSO do not have a tractable limiting distribution. In this paper, we develop a method for estimating a high dimensional threshold regression model and show how its estimators may be desparsified in the sense of van de Geer et al. (2014) to construct asymptotically honest (uniform) confidence intervals. We establish oracle inequalities only assuming non-sub-Gaussian error terms and covariates. Furthermore, we desparsify the Lasso estimator and show how one can conduct uniformly valid inference on the parameters of the model and construct a uniformly valid estimator of the asymptotic covariance matrix. We illustrate the usefulness of our proposed estimation procedure via Monte Carlo simulations.

Wilson College of Textiles

Feyi Adekunle, Ang Li, Rahul Vallabh, Abdel-Fattah M Seyam

Graduate Program: Fiber and Polymer Science

Advisor: Abdel-Fattah M Seyam

Poster Number: 3

Evaluation and Enhancement of Adhesion in Fiber-Reinforced Laminated Structures: Correlation between T-Peel test and Pullout test

Due to their high strength-to-weight ratio, fiber-reinforced laminates (FRLs) are used in many lighter than air (LTA) applications.FRLs consist of a high-performance load-bearing or fabric layer that is bonded on one or both sides of its surface with a polymeric material. FRLs come in handy when no one material can fulfill all the needs of the LTA demands designed for certain applications.

As each of the layers being bonded together using possess own unique properties and chemistry, there is a challenge in effectively adhering the layers together using adhesive(s). If the adhesion is poor, delamination and premature rupture may occur while in use. For comparison and quality assurance, testing to industry standards offers repeatable results. The standard testing method used in evaluating adhesion in FRLs is the t-peel test, which provides a semi-quantitative measure of coating adherence to the substrate. This test has the advantage of being able to carefully regulate the pace of delamination at the site of failure due to a very high-stress concentration at the point when the coating pulls off the substrate. However, there are major problems with the t-peel test. One problem is that the peel test subjects the adhesive to very high strain levels where the fiber and film separate, which most laminates never experience in real-world situations. Another limitation is that the adherends must be strong enough to resist rupture while being flexible enough to bend across the test's angle. Due to these flaws, a new test method coined pullout test was developed by our group to find out whether our test is more consistent and can in fact replace the traditional method. To the authors' knowledge, no work has been found in the public domain relevant to evaluation of adhesion quality using pullout test. We will present the current use of RFLs and their significance in the LTA applications. We will also share the inconsistency test results, supported by images, of the t-peel test along with the proposed pullout test results of range of RFLs.

Suh Hee Cook[1], Jack Twiddy[2], Michael A. Daniele[2,3], Jessica M. Gluck[1]

Graduate Programs: Fiber and Polymer Science[1]; Biomedical Engineering[2]; Electrical and Computer Engineering[3]

Advisor: Jessica M. Gluck

Poster Number: 35

In Vitro Stimulation-Conduction Platforms to Mature Induced Pluripotent Stem Cell-Derived Cardiomyocytes

Heart disease is the leading cause of death worldwide [1]. Cardiac tissue engineering offers various therapeutic and diagnostic solutions, frequently employing induced pluripotent stem cell-derived cardiomyocytes (iPSC-CMs). These iPSC-CMs can be expanded limitlessly and used autologously; however, they are immature compared to healthy, adult cardiomyocytes [2]. Thus, they are insufficiently functional for use in cardiac tissue engineering. We are interested in conductive scaffolds to mature iPSC-CMs by facilitating gap-junctional coupling, particularly in the presence of electrical stimulation. We have endowed electrospun polycaprolactone (PCL) and gelatin scaffolds with electrical conductivity by incorporating carbon nanotube (CNT) arrays. We confirmed the addition of CNTs significantly and anisotropically increases their end-to-end conductance. We also characterized the resulting morphological, mechanical, surface, and degradation properties [3]. We differentiated iPSCs into iPSC-CMs using a Wnt inhibitor-directed protocol [4] and confirmed differentiation with the presence of beating and with staining for α-actinin and connexin 43. We confirmed the biocompatibility of our CNT scaffolds by seeding these cells onto scaffolds with and without CNTs; 24 hours later, a live/dead assay indicated scaffolds presented no cytotoxicity. We also confirmed that the application of voltage-controlled electrical stimulation (square wave, 5 ms frequency, 20% duty cycle) for 5 minutes at magnitudes of 0, 0.1, 1, and 10 V did not introduce cytotoxicity, as indicated by live/dead and metabolic assays. Furthermore, application of 0.1 V electrical pacing resulted in earlier development of ultrastructure and beating. We have developed an upgraded bioreactor which we will use for future work, including probing the role of electrical signals in embryonic cardiac development by varying stimulation timepoints. Additionally, immunostaining, qPCR, and calcium- and voltage-sensitive dyes will be used to characterize iPSC-CMs undergoing electrical stimulation in the presence vs. absence of conductive CNT scaffolds to determine their effect on gap-junctional coupling, and thereby their ability to contribute to the electrophysiological maturation of these cells. If successful, this research could pave the way for advances in cellular pacemaking, physiologically relevant models for heart disease, and cardiac tissue repair and regeneration

Wenna Han, Jitong Li, and Yingjiao Xu

Graduate Program: Textile Technology Management

Advisor: Yingjiao Xu

Poster Number: 65

Consumer Coping during the COVID-19 Pandemic: A Perspective of Fashion Shopping

The COVID-19 pandemic has caused dramatic life changes to consumers. Problems induced by the pandemic included health threats, homebound activities, financial concerns, limited access to physical stores, and product shortages, among others. Accordingly, a profound level of negative psychological effects was also observed during the pandemic,such as fear, sadness, anxiety, boredom, frustration, and a sense of isolation. In response to this stressful situation, consumers have adopted various coping strategies to maintain their physical and mental well-being. Through the lens of fashion shopping, this study aims to provide a systematic understanding of how consumers have coped with the COVID-19 pandemic and corresponding emotional stress. An observational research method of analyzing social media (i.e., Twitter) data was adopted to reveal consumers' coping strategies. Specifically, a total of 24,934 fashion consumption-related tweets posted by consumers in May 2020 were scraped using Brandwatch, 10% of which were content analyzed with a theory-driven deductive process and data-driven inductive process. Following the Coping Orientation to Problems Experienced (COPE) Inventory, six coping strategies were identified from consumers' fashion-shopping-related postings. Two problem-focused coping strategies included active coping (e.g., changing shopping channels) and restraint coping (e.g., holding off fashion shopping), with the goal of resolving stressful situations associated with the pandemic. Four emotion-focused coping strategies included positive reinterpretation (e.g., treating the pandemic as an opportunity to save money), acceptance (e.g., optimism toward the post-pandemic future), mental disengagement (e.g., fashion shopping for escapism), and seeking social support (e.g., gifting), with the goal of managing negative emotions associated with stressful situations during the pandemic. The results of this study lend meaningful implications to the fashion industry as well as human service providers in government agencies and NGOs to better prepare for future public health crises.

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Poster Number: 84

Generalized Maximum Weavability Model for Woven Fabrics Made from Flat Filament Yarns

The maximum construction of woven fabric has been studied thoroughly for the yarns with circular cross section. Based on these studies, the maximum construction can be estimated based on fabric parameters such as warp yarn count, weft yarn count, diameters of warp and weft yarns. With the use of flat filament yarns increasing for specialty applications, where the thickness of the fabric, the aerial cover, etc. are detrimental factors for the material selection. The use of circular yarns is not feasible in these applications and flat yarns are a suited alternative. The existing models would not be able to estimate the maximum construction of the fabric accurately. There was a need to develop a geometric model that can estimate the maximum construction for the 2D woven fabrics made from flat yarns. In our study, we came up with a generalized geometrical model for flat yarns that will be able to estimate the maximum construction of flat yarn woven fabric. The assumptions made allow the model to estimate the maximum construction for the flat yarn woven fabrics. We have assumed for this study that the yarn under the float in the fabric conforms closely to the racetrack structure. We came up with solutions for both jammed and unjammed fabric structures. We expect this theory to help people estimate the maximum construction for the fabric woven from flat filament yarn more accurately.

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Poster Number: 96

Key Opinion Leaders on RED and Chinese Fashion Consumers: What is the Connection?

Being a platform for opinion sharing related to shopping, lifestyles, and traveling, RED has become a significant information source for consumers' purchase decision making in China. Following the huge crowd of potential customers, many fashion brands and retailers have joined RED. Often, fashion brands partner with key opinion leaders (KOLs) on RED to raise awareness, attract new customers, and enhance brand credibility. The purpose of this study is to investigate the influence of RED KOLs on Chinese consumers from the perspectives of eWOM characteristics, KOL characteristics, RED posting characteristics, and consumer characteristics. Particularly, the first objective was to investigate the influence of argument quality, KOL's credibility, and blog design on consumers' information adoption of KOL's posted information on RED. The second objective was to explore the moderating effects of two posting characteristics, including information details and KOL popularity, on consumers' information adoption process. The third objective was to explore the moderating effect of individual differences, including age and fashion involvement, on consumers' information adoption process. Data were collected from 349 Chinese consumers who have at least used RED in the past via an online survey and analyzed using linear regression as well as multi-group regression comparison. Empirical results revealed that argument quality and blog design had a significant influence Chinese consumers' information adoption intention of the information posted by KOL on RED, while the influence of source credibility was not significant. Additionally, KOL popularity, information details, fashion involvement and age were all found having moderating effects on consumers' information adoption process. This study not only provides insights into Chinese consumer's information adoption behavior on RED, but also lends managerial implications to fashion retailers and brands on how to promote their fashion products with KOLs on RED.

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Poster Number: 101

Surface Modified Fibrous Scaffold for Stem Cell Derived Ocular Surface Regeneration

Limbal stem cell deficiency (LSCD) is a debilitating ocular surface disorder occurring due to loss or dysfunction of limbal stem cells (LSCs). Existing treatments for LSCD include transplantation of autologous limbus from the healthy eye in unilateral cases, or allogeneic limbal tissue from living or cadaveric donors when both eyes are affected using human amniotic membrane (hAM), the innermost layer of the placenta as the carrier. However, treatment of LSCD is exacerbated by limited supply of healthy LSCs especially in the case of bilateral LCSD. Scarcity, lack of reproducibility, risk of disease or infection transmission of hAM have made research necessary into alternative biomaterials compatible with LSCs. LSCs derived from induced pluripotent stem cells (iPSCs) have the advantage of being an unlimited and non-immunogenic source. We developed a xeno-free and chemically defined protocol of differentiating iPSCs to LSCs. Electrospun synthetic membranes were laser perforated, plasma-treated, and biofunctionalized with Collagen-IV to mimic the corneal microenvironment with sufficient mechanical strength to withstand surgical manipulation and minimize the obstruction of vision. Laser perforations with different diameters and spacing allowed for regulation of the mechanical properties and light transmittance of the construct. The light transmittance of the construct after perforation was increased to 60%. Plasma treatment allowed more homogenous and profuse covering with Collagen-IV compared to non-plasma treated which improved cell adhesion to the scaffold by providing binding sites that receptors of cells can interact with. Higher proliferation and metabolic activity of corneal epithelial cells were observed plasma treated Collagen-IV samples compared to all other conditions in a weeklong study. Our future work will focus on combining iPSC-LSC on surface-modified scaffold as graft for treatment of LSCD.

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Poster Number: 116

Rapid In Situ Complexation of Monoazo Dyes in Human Hair Using Environmentally Benign Metal Ions

Hair coloring has historically been a popular way to change appearances, primarily with permanent hair dyes. The formation of these dyes involves the oxidative coupling of aromatic amines and phenols inside the hair fiber, resulting in higher molecular weight dye molecules that are not easily desorbed during washing. However, several permanent hair dye precursors are skin sensitizers and pose environmental concerns due to their presence in wastewater. As a more sustainable alternative, the potential of arylazonaphthol and monoarylide dyes to form 1:2 metal:dye complexes rapidly within the hair under mild temperature conditions using benign metal ions was studied. The dye molecules were reasoned to diffuse into the hair fiber in a similar manner as permanent hair dye precursors, and when chelated with Al3+ or Fe3+ ions, formed higher molecular weight molecules that do not easily desorb from the hair shaft. The dyes were applied to hair fibers at 40°C for 40 min and then Al3+ and Fe3+ ions were applied to the dyed fibers at 40oC between 0-40 min. Within the first 5 min of metal ion application, color changes were observed, suggesting the complexed dye rapidly forms. Color changes were most noticeable for hair fibers dyed with arylazonaphthol dye, of which the color of the fibers shifted from magenta to red (with the addition of Al3+ ions) or brown (with the addition of Fe3+ ions). High Resolution Mass Spectrometry (HRMS) data of dye extracted from the hair revealed the metal complex of the arylazonaphthol dye indeed forms within the first 5 min of application in the hair. In addition to these findings, results from an evaluation of the distribution and relative concentration of dye on the surface and within hair fibers using Time of Flight Secondary Ion Mass Spectrometry (ToF-SIMS) will be highlighted.

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Advisor: Emiel DenHartog

Poster Number: 129

Strength Loss Indicator for UV Degraded High Tensile Nylon Webbings

Textile webbings have a unique construction and properties that make it desirable to be used in a range of applications. Common use of webbings can be observed in safety equipment, seat belts and parachutes. It is very important for these webbings to maintain their mechanical properties while undergoing daily wear and tear, since failure of webbings can lead to serious injuries and fatalities. Current research and papers look to utilize image analysis to predict strength loss of the webbings. These methods are reliable to predict strength loss due to mechanical damage. However, image analysis fails when trying to predict strength loss due to UV degradation, since there is no visible damage to the surface of the webbings. The only available method to test for the strength of the webbings due to UV degradation is by performing uniaxial tensile test. Although very reliable it also results in waste of resources, energy and time. This research strives to develop nondestructive methods to indicate strength loss through non-traditional methods. In this research we exposed nylon webbings under 1.5 sun equivalent irradiance at 43°C and 30%RH. We know that the nylon fibers undergo hydrolysis when exposed to UV radiation, so infrared spectroscopy was performed on the webbings to show the change in molecular composition of the fibers. The results from the spectral analysis show increasing -OH and -COO peaks on the FTIR graphs with increasing UV exposure. The FTIR peaks corresponds well with the hydrolysis of nylon and the increasing peaks which is supported by the significant loss of strength. With increasing access to IR spectroscopy, FTIR shows potential to be used in-situ and ex-situ to provide qualitative indicators of strength loss of webbings due to UV degradation of the nylon fibers.

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Poster Number: 156

Development of an Optical Nanomaterial Based pH Sensor for Biomedical Applications

In biological systems, pH fluctuations in tissues and biofluids signal pathophysiological situations such as tumor metastasis, microbial infection, acidosis, cystic fibrosis, and wound healing. The growing needs for pH measurements in healthcare necessitate pH-measuring molecular probes and sensors. Optical detection technologies in biomedical field are emerging. However, suitable molecular probes that enable optical pH measurements are still limited. In this regard, single-walled carbon nanotubes (SWCNTs) are promising materials for optical molecular probes because of their exceptional photophysical features such as non-photo bleaching fluorescence in the tissue transparent near-infrared (nIR) spectral region. However, SWCNTs are hydrophobic and insoluble in common solvents. SWCNTs need to be functionalized to render them water soluble and optically active. Here, we developed SWCNT-based optical probes that enabled the optical detection of pH changes in model biofluids such as artificial sweat within biologically and pathologically relevant pH range. The optical response of the nanotubes to changes in solution pH was significant and took place within minutes. As sweat pH can reflect pathophysiological alterations in certain disease conditions, optical detection of sweat pH measurements provide a non-invasive method for monitoring personal health.

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Advisor: Sonja Salmon

Poster Number: 172

Study in the properties of mechanically milled and enzyme degraded cotton fine fibers and their applications

Millions of tons of textile waste are landfilled or incinerated in the world every year while the values in the wastes are not fully recovered. In this article, cotton is taken as an example for investigating the potential value of cotton fine fibers (CFFs) extracted from the waste. CFFs were obtained from undyed and dyed textile waste fabrics by mechanical milling or enzyme degradation. The aim of the work was to analyze the properties of partially degraded cotton fibers and study the effect of dyes remaining on the fibers for promoting their recycling possibility in applications such as composites and regenerated fibers. Fiber quality analyzer (FQA) test was applied to characterize the size of the CFFs and morphology information was collected via scanning electron microscopy (SEM). Other characterization methods include X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), and thermogravimetric analysis (TGA). The results showed that enzyme treated undyed cotton exhibited unique properties such as rough fiber surface, uniform fiber length distribution, high crystallinity (90%) and better thermal stability than intact reference cotton. Also, the existence of dyes and the type of reactive dyes on the final products have a significant impact on the properties. Both dyed and undyed CFFs show good potential for being utilized in diverse applications.

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