ASSIST - Nanosystems ERC for Advanced Self-Powered Systems of Integrated Sensors and Technologies

Poster Number: 97

Conductive Ink Errors In Wearable Technology
Marissa Breitenstein Mechanical Engineering University of Kentucky
Mentors and/or Co-Authors:
Jesse Jur College of Textiles NC State University

Wearable technology on textiles is a rapidly evolving field that utilizes a number of fiber and ink based strategies for imparting electronics within the garment. A major issue is the failure in the conductive inks due to cracking of the inks and delamination of the encapsulate used to protect the ink from the environment. The goal for this research is to provide a quantified analysis of these failures through mechanical testing and optical analysis. Mechanical strain cycling (up to 1000 cycles) was applied to the ink architectures. Through the process of selecting the correct materials for encapsulation and conductive stretchable inks, a design that can strain beyond the max amount that a human would while putting the shirt with electrodes on and off can be realized. To further improve the ink recovery from crack formation, our team also investigated the crack-healing property of the conductive track under stretched conditions by incorporating solvent loaded microcapsules in the encapsulation layer.

Poster Number: 50

The Effect Of Contact Resistance In Flexible Thermoelectric Generators
Ashley Del Valle Electrical Engineering University of Puerto Rico Mayaguez Campus
Mentors and/or Co-Authors:
Mehmet Ozturk College of Engineering NC State University
Guy Kunzmann Molecular Biology NC State University
Gentry Williamson Human Biology NC State University

Interest in self-powered wearables for health and environment monitoring has made energy harvesting from the human body using thermoelectric energy generators (TEGs) a subject of great interest. TEGs have the potential to eliminate batteries enabling continuous operation for long-term monitoring. A novel flexible TEG has been developed using high quality thermoelectric bulk legs embedded in a stretchable elastomer. This is a new approach that aims to enhance the efficiency and wearability of TEGs. In order for the flexible device to be competitive, increasing the efficiency is crucial. One way to increase the output power of flexible TEGs is decreasing the electrical resistance of the device. Eutectic Gallium Indium has been used to produce stretchable low resistance interconnects for this purpose. As explained in previous reports from the group, the contact resistance contributes to ~10% of the total resistance of the device. One of the sources of this resistance is the contact resistance between the gold contacts on top of the legs and the liquid metal interconnects. If this percentage decreases, the device will have less resistance, leading to more power. To measure the contact resistance accurately, miniaturized contacts are required so that the resistance is high enough to be measured. In this work, an experimental process is presented in order to obtain a mathematical correlation between contact surface area and resistance. By developing the methodology to accurately measure the contact resistance, we hope to optimize the contact metallurgy to minimize the contact resistivity of the liquid metal - contact interface.

Poster Number: 271

Canine Wearable Collar For Treatment Of Laryngeal Paralysis
Chadwick Gillan Electrical Engineering NC State University
Mentors and/or Co-Authors:
Alper Bozkurt Engineering NC State University
Laryngeal paralysis is a common condition that occurs in middle-aged to older dogs caused by a weakened or non-functional *cricoaortenoideus dorsalis* muscle which imposes complications in the dog’s ability to respire and eat properly due to the inability to open or close the glottis. Currently, the best medical procedure to remedy this condition is to use sutures to tie back one flap of arytenoid cartilage. Sutures work well for treating this condition, although they impose some complications; primarily an increased risk of aspiration pneumonia. To rectify the problems accompanying the use of sutures, a functional canine larynx can be simulated by implanting a silicone-coated rare-earth magnet into one flap of arytenoid cartilage so that it may be opened or closed via a battery-powered electromagnet affixed to a dog collar or harness. Research consisted primarily of testing the attraction range of several types of DC electromagnets by varying voltage, material, and mass of the object being pulled to determine the best implant to use. The fields were then modeled using relevant equations and finite element method. Temperature testing was also done to determine an optimal cooling solution and ways to control the electromagnets were also investigated. With further research and testing on temperature reduction, biocompatibility, power delivery, packaging, and electromagnet positioning, this system will revolutionize the treatment of laryngeal paralysis and replace the use of sutures. It will decrease the time of surgeries, as well as provide dogs diagnosed with this condition a better quality of living.

Poster Number: 203

**Smart Belt: Battery-less Approach For Powering Wearable Health Monitoring Sensors**

**Francisco Matos** Electrical Engineering University of Puerto Rico Mayaguez Campus  
**Mentors and/or Co-Authors:**  
**Daryoosh Vashaee** College of Engineering NC State University

As we continue to move to an era where health monitoring becomes part of our everyday life, there will be more needs to keep up the technologies that can support such needs. Wearables can play key roles by monitoring the body and environmental conditions. One of the main problems for the operation of wearables today is their dependency on battery power, which would need frequent recharging and can cause interruptions in their operation. Therefore, there is increasing interests to replace the batteries with uninterrupted energy sources such as body heat. Thermoelectric generators (TEG) convert the body heat directly into electricity and provide power for low power sensors. A TEG is a device in which electrons are driven by thermal energy and create electrical current. A TEG can last years without losing efficiency, and is eco-friendlier than batteries. ASSIST, or Advanced Systems of Integrated Sensors and Technologies, at North Carolina State University is entitled in developing battery-less wearable electronics for health and environmental monitoring. In this project, with the help of ASSIST and dedicated staff, the construction of a *smart-belt*, that harvests the body heat to power electronic wearable sensors is implemented. This belt generates sufficient energy for low power sensors and at the same time is not invasive to the human body. In addition, it is battery free, maintains a pleasant appearance while providing one with the information about oneself health, and lending the opportunity to make lifesaving decisions in the moment that may be most likely needed.

Poster Number: 44

**Performance Of R-wave And Heart Rate Detection From A Multi-channel Ecg At Subsampled Frequencies**

**Erick Morales** Electrical Engineering California State University, Long Beach  
**Mentors and/or Co-Authors:**  
**Edgar Lobaton** College of Engineering NC State University

Heart rate is a valuable physiological measurement which can detect abnormalities with the heart and other health issues. In our research, we developed an algorithm that measures heart rate from a multi-lead electrocardiogram (ECG) by detecting R-waves. We began by removing the baseline wander, then locating R-wave peaks in each individual channel. We then implemented what we called “BPM enforcing” which takes an ongoing measurement of R-wave distances and removes/adds peaks as needed. A voting scheme was used to combine and to locate where channels agreed on the peaks in order to detect them more robustly. If more than three agreed within a 7ms window then it is concluded that an actual peak occurred. The remaining peaks are then used to measure the heart rate. We tested our algorithm on a dataset taken from an ECG sensor, which consisted of four channels sampled at
frequency of 202Hz. We manually analyzed the data to establish a ground truth which tested our results. Our results showed 99.51% precision and 99.38% sensitivity after combining the four channels. We found that by using multiple channels, the detection precision and sensitivity increased. On average without combining, the precision was 95.68% and sensitivity was 98.43%. We then down sampled the data to various sample sizes to analyze its effects. The performance was acceptable up to 100Hz, which had a precision of 88.99% and sensitivity of 89.18%, and had a significant drop off at 75Hz where both were below 80%.

Poster Number: 255

**How Will Huvecs Respond To Different Flow Conditions Over Time?**

**Daniela Rendon** Biomedical Engineering George Washington University

**Mentors and/or Co-Authors:**

**Michael Daniele** College of Engineering NC State University

Microfluidic devices have many applications in biomedical research. They are useful for simplifying biological systems, while having full control over biological properties such as fluid dynamics and cell behavior. These devices are usually created using master molds that have been designed to suit the needs of the experiment. Here, we studied for the effects of increasing flow rate and shear stress on Human Umbilical Vein Endothelial Cell (HUVEC) polarization and proliferation. It is hypothesized that by increasing shear stress, the cells will maintain proliferation and become more polarized with the direction of flow. The device we used to perform this experiment was cast from polydimethylsiloxane (PDMS), which was bonded to a glass slide with oxygen plasma. The channel was designed to be a straight rectangular channel with a width of 500µm and a height of 100µm. HUVEC cells were seeded into the device and allowed to adhere to the glass slide. HUVEC cells are ideal for the experiment given that they capitulate the blood vessel lumen. A peristaltic pump was used to flow media through the channel in order to generate shear stresses between 0-15dyn/cm². At fixed time intervals, the device was stained for F-actin and DAPI to be imaged by a fluorescent microscope to look for cell polarization. The results of this experiment show that shear stress has a direct effect on endothelial cell morphology and future work see how this links to angiogenic potential.

Poster Number: 49

**Automated Data Collection And Graphing Of Cmut Gas Sensors**

**Derek Santos** Computer Science Wake Technical Community College

**Mentors and/or Co-Authors:**

**Omer Oralkan** College of Engineering NC State University

**Neha Menon** Human Biology NC State University

**Nathan Kohn** Genetics NC State University

Capacitive micromachined ultrasonic transducers (CMUTs) have sparked interest within the research community due to the ease of implementation when using them to detect volatile organic compounds (VOCs). A single die of eight CMUT sensors can detect VOCs using multichannel detection. Data from commercial gas sensors and information about environmental variables such as temperature, humidity, and pressure can help characterize and calibrate CMUT sensors. Data management and processing increase in complexity as sensor varieties are introduced to the topology. This is due to the unique processing method required by each sensor model. Before the current control interface implementation, users could only establish a connection to one sensor concurrently. This inefficient method resulted in unnecessary lost experimental time. The two resulting custom applications have enabled easy data collection and graphing, thereby eliminating further lost experimental time. The Sensor Manager collects data and creates JavaScript Object Notation (JSON) files which are then plotted by the Graphing Utility. Furthermore, each sensors’ bias voltage and gate time can now be independently manipulated. Each graph correlates to the respective data sets of resonant frequency, resistance, temperature, pressure, and humidity.
Textile Mounted Conductive Leads Based On Aligned Carbon Nanotube Sheets Embedded In Thermoplastic Polyurethane

Victoria Schatzer Bioengineering Clemson University

Mentors and/or Co-Authors:

Philip Bradford College of Textiles NC State University

With wearable technology quickly advancing, it is imperative to study new technologies that allow for electrical connections across garments. The purpose of this study was to study a new approach to create conductive leads, using electrically conductive carbon nanotubes that can be adhered to textiles. In the Bradford lab, we grow arrays of aligned millimeter long carbon nanotubes (CNTs) that can be spun into flexible sheets, making them ideal for electrical applications. To achieve adhesion, thermoplastic polyurethane (TPU) was used with a dual function, to bond the CNTs in the sheets together and then bond that larger assembly to a fabric. A 5% TPU solution was first laid and dried to serve as an adhesive base layer for the lead. This layer was followed by a mixture of a 1% TPU solution dropped onto a CNT sheet condensed into a small ribbon. A variety of samples were made with a range in number of CNT layers. Samples were cured to textiles and tested for resistivity, strain to failure, and the effectiveness of the TPU as an adhering agent. Although the samples demonstrated low resistivity and good adhesion, the strain to failure was low. The samples made in this study are the first example of CNT based adhesively bonded textile electrodes and with further optimization could provide a viable lead material for wearable technologies.

Direct Write Printing

Ellie Scott Materials Science and Engineering NC State University

Mentors and/or Co-Authors:

Jesse Jur College of Textiles NC State University

Smart textiles are a growing area of research within the sphere of wearable technology. Printed electronics on textiles offer a route to flexible and stretchable wearable devices. However, current processes utilizing thermoplastic polyurethane films are laborious and time-consuming. The process of direct dispense printing elastomeric interface materials allows for integrated printing of dielectric-conductive-dielectric structures which can be used to fabricate interconnects, smart garments, or wearable heating devices. This research explores the various material layers used in the wearable devices to see how each component may be improved in both function and process manufacturing. As a result, relationships between the process parameters, material properties, and surface modification outcomes will be identified. Five specific layers are analyzed, including the textile/pretreatment, interface layer, conductive layer, external protection layer, and conductive via. The goal is to identify attributes of each layer and how they may be applied using a novel direct write printing process. Evaluation of these materials includes key interface properties such as contact angle, surface roughness, and porosity. The limitation of the direct write process is taken into account, noting the process is dependent on viscosity and fluid pressure at which the ink is dispensed.
BeeMORE - Bees and Microbes in Organized Research Experiences

Poster Number: 1
**Effects Of Rosmarinic Acid On Parasite Loads In Bumble Bees**
Victoria Barnette *Plant Biology* NC State University  
Mentors and/or Co-Authors:  
**Rebecca Irwin** *College of Agriculture & Life Sciences* North Carolina State University

Plants use secondary metabolites as a defense against herbivory. However, these toxic compounds are often present in the nectar and pollen of plants, subsequently interacting with beneficial pollinators. These compounds may be harmful to consumers, but may also provide antimicrobial properties that can help to defend pollinators against harmful parasites. In this experiment, rosmarinic acid, an aromatic compound that is commonly found in the mint family, was tested to determine if it had any effect on a common bumble bee parasite, *Crithidia bombi*, which can decrease bee fitness and reduce lifespan. We inoculated individual bumble bee (*Bombus impatiens*) workers with *C. bombi* and provided each with either a rosmarinic acid-laced nectar solution (70ppm or 150ppm) or a control nectar solution. There was a trend of higher *Crithidia* prevalence in the nectar with 70ppm of rosmarinic acid than in the control nectar, but it was not significant. This suggests that rosmarinic acid may have a negative effect on bee health.

Poster Number: 84
**Investigating RnaI As A Means Of Controlling An Invasive Honey Bee Pest, The Small Hive Beetle.**  
Nikhil Brocchini *Undeclared* Brown University  
Mentors and/or Co-Authors:  
**Marce Lorenzen** *College of Agriculture and Life Sciences* NC State University

RNA interference (or RNAi) is a gene silencing technique that is widely used to study gene function. Additionally, due to its high species-specificity and potential lethality, it is appealing as a method of pest control. The small hive beetle, *Aethina tumida* (SHB), is a nonnative pest to honey bees (*Apis Mellifera*) in the United States. High infestations can significantly reduce beehive health. Honey bees are responsible for over $14 billion of agricultural output and are crucial to the security of food infrastructure, both domestically and internationally. Because most insecticides have a negative impact on the health of honey bee colonies, SHB are exceedingly difficult to target with conventional pesticides. We used a SHB transcriptome developed in our lab to identify homologs of genes found to be effective RNAi pest-control targets in other coleopteran pests, such as the Western Corn Rootworm (*Diabrotica vergifera vergifera*) and the Sweet Potato Weevil (*Cyclus formicarius*). In these beetles, RNAi of *V*-ATPase was particularly effective at killing larvae, so we chose it as our first target in SHB, and evaluated its ability to induce mortality and cause knockdown with both microinjections and feeding assays. Results from this study are expected to provide insights into the biology of SHB, and may help establish new control methods for this insect.

Poster Number: 113
**Digestion Of Galacto-oligosaccharides By Lactobacillus Rhamnosus**  
Taylor Niehoff *Biology* Georgia Tech  
Mentors and/or Co-Authors:  
**Jose Bruno-Barcena** *College of Agriculture & Life Sciences* NC State University

Probiotic bacteria, nonpathogenic commensal bacteria, are important in establishing a healthy gastrointestinal tract. In particular, *lactobacillus* bacteria are major players in establishing a healthy microbiota because they have antimicrobial properties that prevent pathogens from inhabiting the GI tract. Isolated from the human infant gut, *Lactobacillus rhamnosus* 010 and 143 are two probiotics of piqued interest because they may be crucial in establishing a healthy microbiota in infants. In this study, I aim to analyze how *L. rhamnosus* 010 and 143 respond to galacto-oligosaccharides (up to 4 galactoses in a chain with a lactose end) in terms of growth and metabolism. Lactose is the most common form of sugar found in infant formula. However, these commensal bacteria may respond better to galacto-oligosaccharides (a prebiotic), and thus it would be a beneficial additive to formula. To determine this, I grew both strains in lactose and GOS (90% pure) media, plotted growth curves, and analyzed samples using high performance liquid chromatography. I conclude that 143 has improved growth in the GOS media, because it utilizes the tetrasaccharide sugar. The 010 has
decreased growth in the GOS media, because it can only utilize the lactose and some of the trisaccharide sugar. These results show that GOS sugar helps L. rhamnosus 143 grow and better populate the human infant gut. This sugar would thus be a beneficial additive to infant formula. In addition, the 143 strain could purify the pentasaccharide and hexasaccharide galacto-oligosaccharides, which are expensive to synthesize and for which there are no standards.

Poster Number: 175
**Queen Honey Bees And Deformed Wing Virus: The Impact Of Early Dwv Exposure On Infection**
Tatianaide Medina Nieto *Psychology* Wake Forest University

*Mentors and/or Co-Authors:*
David Tarpy *College of Agriculture & Life Sciences* NC State University
Tyler Shaw *Bioprocessing Science* NC State University
Pharen Barron *Bioprocessing Science* NC State University
Rachel Pope *Bioprocessing Science* NC State University
Nicholas McNamara *Bioprocessing Science* NC State University

Deformed Wing Virus (DWV) is an RNA virus that causes wing and abdomen deformities and a shortened lifespan of less than 48 hours in honey bees. The virus can be transmitted horizontally through varroa mites, sexually during mating between queen honey bees and infected drones, and vertically by being passed onto worker offspring on the outer shell of newly laid eggs. As such, DWV infection in queens can be detrimental to entire colonies. In this study, we are investigating the mechanism of DWV infection during queen development to elucidate how DWV presence and exposure at the earliest developmental stage can manifest in disease. We used RT-qPCR to identify DWV-infected colonies and to test DWV presence on washed and unwashed eggs from the selected colonies. Additional eggs were collected for queen rearing and treated with low, medium, and high concentrations of DWV. Upon emergence, the queens were screened for DWV and the results are discussed.

Poster Number: 206
**Harnessing Bee Microbes For Lignin Degradation**
Nadezhda Russell *Biology* Bard College

*Mentors and/or Co-Authors:*
Amy Grunden *College of Agriculture and Life Sciences* NC State University
Juanita Asonye *Psychology* NC State University

Lignocellulose is plant material that is present in the cell wall containing cellulose, hemicellulose, and lignin. These complex macromolecules can be broken down to provide readily fermentable compounds to generate fuel and other high value chemicals. Bacterial enzymes capable of efficiently converting cellulose and hemicellulose to sugar monomers have been identified and produced at industrial scale. While numerous fungal enzymes that can degrade lignin have been elucidated, large-scale recombinant production is difficult. Identifying and characterizing bacterial lignin-degrading enzymes that are amenable to large-scale recombinant production and that are stable for use with current lignocellulose pretreatment methods is highly desirable. For this project, we examined a new source of microbes that could have the ability to degrade the components of lignocellulose, particularly lignin. We chose carpenter bees as our source because they burrow in wood. Bees were collected, ground, and resuspended in phosphate buffer saline. The suspension was spread on LB and M9 minimal media plates, both containing 10% black liquor and grown at 30°C. Black liquor is a liquid waste product of the pulp and paper industries with significant amounts of lignocellulose. Isolated colonies were subsequently grown on LB plates with 0.1% Congo Red and M9 plates with 0.2% xylan, cellulose, or lignin to test their ability to break down lignocellulose components. Of the isolates that grew on M9 media, we have identified 8 via 16S rRNA sequencing that also grew on all components. In the future we would like to whole genome sequence the most robust candidates.
Behavioral Neurobiology

Poster Number: 36

The Role Of Kisspeptin In Spawning Of Thalassoma Bifasciatus.

Haley Beuttell Biology Indian River State College

Mentors and/or Co-Authors:
John Godwin College of Sciences NC State University

The neuropeptide kisspeptin is crucial in the regulation of reproduction in vertebrates. The purpose of this study is to identify the role of kisspeptin in sex change, sex change related behavior, and spawning times using the bluehead wrasse, *Thalassoma bifasciatus*, as a model species. Expression levels of kisspeptin mRNA are to be analyzed by performing qRT-PCR on brain samples from different sexual phenotypes (females and large territorial males) and proximity to the daily spawning period. The anticipated outcome of this study is to identify sex differences in the expression of kisspeptin within different brain regions (hypothalamus and habenula), and whether tidal patterns of spawning behavior affect the production of the mRNA for this neuropeptide. The findings in this model for social influences of reproductive behavior may be useful in understanding the neurobiology of sociosexual behavior in other vertebrates.

Poster Number: 38

Investigation Of The Association Between Aromatase Expression And Behavior In Thalassoma bifasciatum

Anthony Thompson Biology Indian River State College

Mentors and/or Co-Authors:
John Godwin College of Sciences NC State University

Aromatase is a highly conserved enzyme which is responsible for the biosynthesis of estrogen in vertebrates. Previous research has provided much evidence linking aromatase expression to changes in aggression. The focus of this research is the role of aromatase in the vertebrate neuroendocrine system using the bluehead wrasse, *Thalassoma bifasciatum* as a model. This fish is capable of changing both its sex from female to male and its phenotype from yellow initial phase to blue-green terminal phase. These changes, and the corresponding behavioral changes, are likely mediated by changes in the levels of expression of certain neuropeptides and steroid hormones in the brain. Biological samples from both sexual phenotypes were collected at two different points in the daily spawning cycle, in order to examine a possible link between neurohormone levels and the behavioral changes associated with reproduction. This research project aims to study the differences in the expression levels of the genes for aromatase based on sex and spawning readiness of bluehead wrasses. Based on previous research, we hypothesize that aromatase will be more highly expressed in female fish than in the terminal phase males, due to the predicted relationship between increases in estrogen and a decrease in aggressive behaviors. Further, we also hypothesize that aromatase will be more highly expressed in fish which were near spawning than further from spawning, since neural estrogen affects reproductive behavior in many vertebrates.
BESST - Basic and Environmental Soil Science Training

Poster Number: 253

Exploration Of Soil Pores Through Microct Scans
Eva Arroyo Mathematics Duke University

Mentors and/or Co-Authors:
Daniel Richter Nicholas School Duke University and NC State University

Soil porosity dictates the motion of fluids through soil, and reflects biological and physical factors of soil formation. Using the recent technology of MicroCT scanners, this study begins exploratory analysis of the three-dimensional structure of soil porosity from the depths of 0-250 centimeters from aggregates of Ultisols in South Carolina. These were taken from three land covers: hardwoods, pine forest on regenerating agricultural land and agricultural fields. This study analyses both the pores in an aggregate as well as each pore individually to describe volume, connectivity, shape, and orientation of the pores in a soil. Volumetric measurements from described as a fraction of the total aggregate and compared to measures of bulk density, as well as taken for a volume-size distribution of pores within soil. Shape is analyzed by examining the circularity of individual pores, using the Crofton perimeter. Connectivity is measured by the distribution of distances to the nearest neighboring pore for each pore and compared to the null Poisson random distribution of pore clustering. Lastly orientation is analyzed not for the mean but skew of orientations across a sphere. These analysis serve as exploratory metrics for hypothesizing on the greater structure and pattern of pores in soil.

Poster Number: 66

Enzyme Activities And Microbial Community Evaluation Of Featured Geomorphologic North Carolina Soils
Alwin Joshua Chico Environmental Science NC State University
Sarah Yim Natural Resources NC State University

Mentors and/or Co-Authors:
Terrence Gardner College of Agriculture and Life Sciences NC State University

The three distinct land regions of North Carolina (Coastal Plain, Piedmont, and the Blue Ridge Mountains) contain uniquely different geographical features often used to classify the diverse soils and landscapes in the state. The goal of this project is to conduct soil and microbial analyses to gain improved understandings of soil-microbial interactions involved in elemental nutrients cycling and soil health over a two year period. Sixteen soil samples (0-10 cm) were collected along the east-west transect of North Carolina for soil, enzyme, and microbial community analyses. Initial physiochemical assays indicated that soil moisture content ranged from 4 to 120 % and pH values ranged from 4 to 6. Total carbon and nitrogen tests were conducted, as these are elements essential for plant growth and proper soil functionality. Selected enzyme activities of \( \beta \)-Glucosidase, \( \beta \)-Glucosaminidase, and Acid Phosphatase were assayed to determine the activity status of enzymes related to soil carbon, nitrogen, and phosphorus cycling. Data suggested that soils from the coastal plains and mountains had higher enzyme activities compared to Piedmont region soils. Biolog (Biolog Inc.) was performed to elucidate biochemical properties and taxonomic identities of detected bacteria. This study builds upon new found knowledge and seeks to increase the importance of understanding how microbes drive many essential processes in North Carolinian soils.

Poster Number: 128

A Comparison Of Methods For Valence Property Characterization Of Synthetic And Fungal Manganese Oxides
Josh Henson Environmental Technology and Management NC State University

Mentors and/or Co-Authors:
Owen Duckworth College of Agricultural and Life Sciences NC State University

Manganese (Mn) oxides are ubiquitous in natural soil and water systems, where they may largely control contaminant dynamics. These Mn(IV) oxides are mostly considered the product of microbially catalyzed Mn(II) oxidation. Although studies suggest that fungi play an equal or greater role in Mn(II) oxidation than bacteria in certain environments, properties of fungal Mn oxides are less understood, motivating their further characterization. In particular, structural Mn(III) may play crucial roles in the redox reactions of Mn oxides. Therefore, understanding valence properties of Mn oxides is crucial to predicting chemical processes at the soil-water interface. Traditional methods to
determine valence properties of Mn oxides are tedious, and subject to numerous interferences. Here, we calculated average manganese oxidation number and valence composition for three synthetic Mn oxides and six Mn oxides produced by fungi isolated in a severely contaminated environment by using X-ray absorption spectroscopy, a potentiometric titration method, and a Mn(III) extraction using pyrophosphate. Determination of the valence properties of several fungal Mn oxides may provide insights into the potential reactivity of these minerals produced by Mn(II) fungi inhabiting a severely contaminated environment. This information helps to elucidate the potential impacts of fungal Mn oxides on the chemical processes of contaminated soil and water systems.

Poster Number: 90

Potential Plant-availability Of Phosphate As Influenced By Different Levels Of Phosphate-enhancing Polymers And Co-added P
Tonny Hoang Environmental Science and Management University of California, Davis
Mentors and/or Co-Authors:
Dean Hesterberg College of Agriculture & Life Sciences NC State University
Conor Perks Nuclear Engineering NC State University

Phosphate (P) fertilizers have limited availability in soil for crop uptake because of the strong retention of this macronutrient by the soil solids. AVAIL® is a polymer-based additive developed to enhance plant availability of P fertilizers applied to soils. However, its effectiveness varies in improving crop performance in the field. This study aims to determine the conditions at which the polycarboxylic molecule, the main chemical in AVAIL®, can increase potential plant availability of P in soils. Soil materials collected from an agricultural field in the Coastal Plain Region of North Carolina were packed in --- L pots in three 5-cm thick layers. The middle layer contained --- g/kg avail and --- g/kg P. The soil in each pot was irrigated allowed to drain by gravity. Soil sample were then obtained from the middle 5-cm layer of each pot. After determining the water content of the samples, equivalent to 1 g of oven dried soil from each pot will be mixed with --- mL of water. The mixture will then be shaken for --- h, before extraction. The amount of P in the extract will then be determined. Trends of water-soluble P will be evaluated as a function of different levels of co-added AVAIL® and P. Findings of this experiment can provide insight towards field applications of phosphate enhancers in improving crop production and soil fertility.

Poster Number: 273

Effects Of Different Soil Organic Matter Contents On Atrazine Bioavailability
Rachel Kanaziz Biology, English, and Environmental Science Adrian College
Mentors and/or Co-Authors:
Travis Gannon College of Agriculture and Life Sciences NC State University

A bioindicator is a living organism used to assess the health of a particular environment by indicating the presence, or lack thereof, of a particular pollutant. The health of the bioindicator serves as a metric of the pollutant’s potency. In this study, canola was the bioindicator species evaluating the presence of the pollutant atrazine. Atrazine, one of the most common herbicides used in the United States, acts upon broadleaf plants by inhibiting photosynthesis. By comparing atrazine treated pots seeded with canola and seeded pots not treated with the herbicide, the bioavailability of atrazine within an organic matter content level was evaluated through time. The rate at which atrazine leached through the soil was also determined by analyzing treated pots not seeded with canola. Treated pots were sprayed on day zero. Pots were soil sampled and seeded on days zero, fourteen and twenty-eight, and plants were harvested three weeks after seeding. It was expected that the more days that passed between spraying and seeding, the less effect atrazine would have on the canola because the herbicide was less concentrated. In addition, a lower organic matter content enabled the herbicide to dissipate lower into the soil at a faster rate, making it less potent. Increased organic matter content was expected to bind atrazine to the organic matter and persist in the soil longer, thus remaining more bioavailable. Overall, the canola bioindicator was an effective tool in evaluating the bioavailability of atrazine.

Poster Number: 61

Elucidating The Role Of Carbon Sources On Abiotic And Biotic Release Of Arsenic Into Cambodian Aquifers
Markus Koeneke Environmental Technology and Management NC State University
Mentors and/or Co-Authors:
Matthew Polizzotto College of Life and Agricultural Sciences NC State University
Arsenic (As) is a naturally occurring contaminant in Cambodia that has been contaminating well-water sources and poisoning millions of people. Typical studies look into the biotic factors that cause the arsenic to be released from aquifer sediments to groundwater. However, abiotic release of As from sediments, though little studied, could also play a key role in As contamination of well water. The goal of this research is to quantitatively compare organic-carbon mediated abiotic and biotic release of arsenic from sediments to groundwater. Batch anaerobic incubation experiments under abiotic and biotic conditions are being conducted using Cambodian aquifer sediments, four different organic carbon sources, and six different carbon concentrations. Dissolved arsenic concentrations in the treatments are being measured over time through 112 days of incubations. Carbon mass balance is being assessed by measuring the sediment carbon and total and inorganic carbon for the solution. Collectively, these results are expected to show how different carbon sources, different carbon concentrations, and how abiotic and biotic factors impact the release of arsenic from Cambodian sediments into aquifers.

Poster Number: 68

Using Remotely Piloted Aerial Cameras To Estimate Runoff Into Sediment Basins

Michaela Long Civil Engineering University of Arizona

Mentors and/or Co-Authors:
Robert Austin College of Agriculture and Life Sciences NC State University

Unmanned aircraft vehicles (drones) GIS technologies have emerged as a reliable, low-cost, easily accessible tool applicable to a wide range of environmental applications. The imagery and aerial surveys collected by these systems adds a highly useful layer of digital information and provides a spatial aspect to issues of sediment erosion control and storm water mitigation. The timeliness, accessibility and cost-effective benefits of UAV technology has exceptional potential to observe and measure dynamic topographic conditions. A three acre sediment control basin in Durham, North Carolina was instrumented to measure soil moisture, water level and precipitation over a three month summertime period. Six precipitation events were captured and used to derive hydrographs using the rational method in conjunction with a water budget analysis and the UAV derived topographic model. The accuracy of the topographic model was determined by comparing a total station survey of known control points to the digital elevation model produced by the UAV aerial images and processed using a Structure through Motion (StM) technique in Agisoft Photoscan software. The vertical error associated with the digital elevation model is within ±1 foot and the horizontal error is within ±5 feet. The hydrograph analysis resulted in a linear water budget model that determined the peak discharge and consequently, supported the efficiency and resourcefulness of the UAV digital elevation model for use in small basins and to evaluate the effectiveness of local hydrologic regulations.

Poster Number: 229

Compost Amendments In Soil To Improve Physical Conditions And Plant Growth

Clare Magalaner Physics Grinnell College

Mentors and/or Co-Authors:
Richard McLaughlin College of Agriculture and Life Sciences NC State University

Soils located in post-construction zones are often highly compacted and thusly unable to provide adequate conditions for plant growth. This causes limited infiltration which can increase runoff rates after storm events. The hydraulic conductivity and plant available water content of a soil both indicate important soil physical characteristics that affect the ability to transmit water through the soil column and sustain plants. The varying textures of the soil as well as the root properties of plants will change these characteristics. In this study, species of wildflowers and grasses were grown in different compost to soil ratios to find the lowest amount of compost necessary to see improvements in soil hydraulic conductivity and plant available water content. The plants selected correspond to methods used by the North Carolina Department of Transportation to mitigate runoff and erosion in soils compacted by construction. Recommendations based on the soil physical properties found in this study can be made to improve plant growth and control erosion.
Mechanical Improvement Of Coal Ash Using Enzyme Induced Calcite Precipitation

Chelsea Obeidy  
Environmental Science  
Humboldt State University

Mentors and/or Co-Authors:

Brina Montoya  
College of Engineering  
NC State University

The long-term storage of coal ash in impoundments is associated with various stability concerns. To address these concerns, microbial induced calcium carbonate precipitation (MICP) using Ureolytic bacteria has been proposed. The resulting coal ash when treated with MICP has improved strength and reduced compressibility, indicative of more stable material. However, inoculating the coal ash material with ureolytic bacteria results in significant filtering of the bacteria, which in turn results in non-uniform calcium carbonate precipitation. To overcome these concerns, urease enzymes are used to treat the coal ash through enzyme induced carbonate precipitation (EICP). The uniformity and degree of mineralization using EICP is compared to MICP through a series of soil column tests. The degree of mineralization is assessed by measuring the shear stiffness of the treated coal ash using shear wave velocity, as well as the mass of precipitated calcium carbonate. The results of the soil columns indicate that the same level of mineralization was achieved for both EICP and MICP treatment methods; however, the EICP method achieved a more uniform distribution of mineralization throughout the column. Furthermore, the shear strength of the treated coal ash is assessed under undrained simple shear loading. The results indicate that both EICP and MICP treatments resulted in comparable shear strengths. Based on these preliminary results, improving the stability of coal ash impoundments using ureolytic enzyme induced mineralization is feasible and provides a more uniform level of treatment throughout the deposit.

Biotic And Abiotic Contributions To The Reduction Of Fe-oxides At Circumneutral Ph

Emma Rieb  
Chemistry and Earth Sciences  
Dartmouth University

Mentors and/or Co-Authors:

Owen Duckworth  
College of Agricultural and Life Sciences  
NC State University

Although the formation of Fe-oxides at circumneutral pH in soils and streams was previously believed to be an abiotic process, increasing attention has been drawn to microbial effects on metal cycling and biomineralization at these conditions. In this study, we investigate the biotic and abiotic factors controlling the reduction of environmental bacteriogenic Fe-oxides (EBIOS) at circumneutral pH and any accompanying phase changes. Composite EBIOS and synthetic 2-line ferrihydrite (2LFh) were incubated for 2 weeks under one aerobic (~20% O2) and two anoxic (100% N2 and 95/5% N2/H2) conditions. Total Fe and Fe(II) concentrations in solution were measured on days 1, 3, 7, 10, and 14, and changes in Fe-oxide mineralogy were measured by using X-ray diffraction (XRD). Dissolved Fe(II), resulting from reduction of EBIOS samples, was detected under all conditions by trapping with the Fe(II) complexing agent 1,10-phenanthroline, but the extent of reduction was greater under the two anoxic conditions. Additionally, XRD revealed the formation of the Fe(III) oxide-hydroxide mineral goethite in the EBIOS samples under both aerobic and 95/5% N2/H2 conditions. In contrast, 2LFh samples experienced minimal reduction and did not exhibit similar phase changes. Understanding the reduction mechanism(s) of EBIOS will enhance our understanding of both Fe biogeochemical cycling and the bioavailability of environmental contaminants.

Spatially Applying A Soils Classification System Highlighting Forestry Management

Emily Stoll  
Earth and Planetary Sciences  
Johns Hopkins University

Mentors and/or Co-Authors:

Rachel Cook  
College of Natural Resources  
NC State University

Soils are classified to communicate characteristics that often denote what management techniques might be required. However, the widely accepted NRCS Soil Survey classification system is not tailored specifically to forest management, where the geology and land use heavily impact tree growth. A new classification system, constructed by the Forest Productivity Cooperative (FPC), provides a more comprehensive assessment of what factors influence forest response to management techniques. This project constructed the FPC soil classification system from NRCS soil data and applies it spatially. To maximize interaction, a web platform allows users to click on an area of interest, identify FPC codes within a stand, and be presented with management techniques recommended for optimum growth, such as fertilizer application or site preparation. Future recommendations to include in the mapping system include potential
nitrogen volatilization. To begin to address this question, we evaluated nitrogen loss from urea fertilizer under three different independent variables: the use of two urease inhibitors mixed with the urea, the presence of pine leaf litter on the soil, and the landscape position of the study which influenced topsoil depth. Results show that there is less volatilization on pine litter than bare soil and less volatilization with an inhibitor present. Landscape position made no statistical difference in nitrogen loss. A wider network of this type of experiment can be applied to the soil classification map to show spatially what management techniques would be best applied for optimizing forest productivity.

Poster Number: 10

Examining Mortierella Elongata Siderophore Production Via The Cas Layer Plate Assay Adapted For Fungi

Jakob Sulzer Biology Northland College

Mentors and/or Co-Authors:
Marc Cubeta College of Agriculture & Life Sciences NC State University

Fungi, bacteria, and some graminaceous plants produce low molecular weight molecules called siderophores, which chelate iron among other biologically important metals such as copper. Iron is vital for many physiological processes such as electron transport and synthesis of toxins and antibiotics. Siderophores provide a mechanism for microorganisms to compete for, and solubilize insoluble yet abundant Fe(III) at physiological pH (~7.40). This research examines siderophore production by four strains of the soil fungus Mortierella elongata, two containing the endophytic bacterium Mycoavidus cysteinelegens (gen.nov, sp.nov), via the colorimetric Chrome Azurol-S (CAS) Layer Plate assay recently adapted for fungi. This assay has not yet been used to study any members of phylum Zygomycota. M. elongata is reported to only produce rhizoferrin, a carboxylate type siderophore with relatively low Fe(III) affinity. This fungus has been shown to enhance growth of Tomato (Solanum lycopersicum), and preliminary data has suggested that M. elongata can promote leaf growth and flowering of the solinaceous plant Calibrachoa. The CAS-L plate assay allows for the detection and quantification of siderophore equivalents via a color change from teal blue to yellow upon the release of Fe(III) from the Fe-CAS dye molecule complex, and analyzing images of this color change using JMicor Vision software. Results from this study may provide an increased understanding of the mechanisms for beneficial association between M.elongata and Calibrachoa.
BIT SURE - Biotechnology Summer Undergraduate Research Experience

Poster Number: 3

Uncovering The Dna Repair Cascade Through The Study Of Novel Protein-protein Interactions Involving Radd

Brinkley Artman Materials Science and Engineering NC State University

Mentors and/or Co-Authors:
Stefanie Chen College of Agriculture & Life Sciences NC State University

The underlying objectives of this experiment are to reaffirm known interactions between SSB proteins and various helicases, especially RadD, and to uncover new protein interactions involving RadD further downstream of the DNA repair cascade. RadD is known to not only hydrolyze ATP independently of ssDNA or SSB, but is also known to protect dsDNA from UV radiation/ciprofloxacin-induced damage in a complementary, yet inexplicable manner with RadA. The experiment tested the known RadD-SSB interactions from previous literature via yeast two-hybridization assays and far Western blots, qualitative in vivo and quantitative in vitro tests, respectively. Individual characteristics of SSB binding ssDNA and of RadD hydrolyzing ATP were confirmed by the EMSA and the ATPase assay, respectively. Finally, novel protein-protein and protein-DNA complexes with RadD were investigated with the yeast two-hybridization assays, anaerobic RadD prep, and chromatin immunoprecipitation (followed by PCR/qPCR). The results from the EMSA and far Western experiments suggest that previous literature’s conclusions about SSB-DNA and SSB-RadD are supported by reproducible data. The investigation into the DNA repair cascade and characteristics of RadD have so far resulted in mostly negative data, which helps narrow down the range of possible proteins that RadD interacts with during the repair mechanism.

Poster Number: 222

High-throughput Screening Of Oncology Drugs As Potential Antibiotics Against Delftia Acidovorans

Alexandra Burd Microbiology NC State University
Sheridan Littleton Biological Sciences NC State University

Mentors and/or Co-Authors:
Carlos Goller College of Sciences NC State University

Delftia acidovorans is an opportunistic pathogen responsible for nosocomial infections, particularly in immunocompromised individuals and intravenous drug users. We searched for compounds that inhibit Delftia acidovorans SPH-1 growth using automated high-throughput compound screening. We tested 813 compounds from the National Cancer Institute (NCI) Developmental Therapeutic Program’s Mechanistic Set IV at 10 µM final concentration using an Eppendorf epMotion 5075 TC liquid-handling robot. Cetylpyridinium chloride (CPC) at a final concentration of 0.02% and DMSO at a final concentration of 1% were used as positive and negative controls, respectively. Twenty active compounds inhibited growth by at least 80 percent. After bioinformatically excluding toxic compounds and pan assay interference compounds (PAINS), we tested the remaining 11 compounds in twelve-point dose-response curves. We identified three active compounds that inhibited growth by at least 50 percent with minimum inhibitory concentrations (MIC) between 0.156 and 2.5 µM. Our results suggest these compounds could be potential lead molecules for drug development with the goal of preventing and treating Delftia acidovorans infections in clinical environments. Future research may also develop and optimize compound screening campaigns for different NCI libraries on Delftia spp. and work to determine the mechanism of action of oncology drugs as antibiotics.

Poster Number: 224

Paenibacillus Larvae: A “sneaky” Summer Of Lysogeny And Phage Ubiquity

Ismael Hernandezvillasuso Biology NC State University

Mentors and/or Co-Authors:
Eric Miller College of Agriculture & Life Sciences NC State University

American Foulbrood (AFB) is a highly contagious disease of honey bee larvae caused by the bacterium Paenibacillus larvae. This disease is devastating to honey bee populations and causes beekeepers to burn an infected hive to prevent dissemination. Bacteriophages that infect P. larvae may be of value in the prevention and treatment of AFB, and can
provide insights into genome evolution and gene transfer between bacteria. A *P. larvae* strain (NW6) was previously isolated from an AFB-infected hive in North Wilkesboro, NC and its genome has been sequenced. There are ten putative intact prophages predicted by the program Phaster in the NW6 genome. When growing NW6 as a confluent lawn, the appearance of spontaneous tiny plaques suggests prophage induction. A bacteriophage (dubbed “Sneaky”) from a tiny plaque appearing on NW6 was previously purified and its genome sequenced. The 39 Kbp DNA genome was annotated using DNA Master, NCBI and HHPRED. Culture supernatants from NW6 incubated at 42°C for 5 min were plated on a different *P. larvae* strain, ATCC 9545, where many larger plaques were observed. Several plaques have been purified and their genomes will be sequenced. Comparative genome analysis between Sneaky, the new, induced NW6 prophages, and related phages in GenBank will be carried out. The data from this study expand the diversity of available *P. larvae* phage genomes and provide insight to the abundance of prophages poised for induction and lytic growth on AFB-causing *P. larvae* bacteria.

Poster Number: 267

**Characterization Of Leaf Senescence Of Two Genotypes Of Medicago truncatula In Response To Iron Deficiency**

**Morgan Jarrett** Biology NC State University  
**Mentors and/or Co-Authors:**  
**Christina Valerie Garcia** College of Agriculture & Life Sciences NC State University

Micronutrient deficiencies, such as iron deficiency, affect 2 billion people globally creating a demand for crops that can meet nutritional requirements. Understanding characteristics related to micronutrient mobilization are important to producing improved staple crops, like legumes. Leaf senescence, a process in which photosynthetic machinery in leaves are degraded and remobilized to other parts of the plant, has been associated with micronutrient remobilization from leaves to developing tissue. Previous research has shown that *M. truncatula*, a legume, genotype A17 exhibits increased partitioning of dry matter to leaves and decreased partitioning to seeds while the genotype DZA315.16 shows relatively no difference in dry matter partitioning in response to iron deficiency. We hypothesize that DZA315.16 plants will display increased senescence associated traits compared to A17 in response to iron deficiency. To assess senescence related activity, we looked at senescence related gene expression and protease activity of *M. truncatula* in response to iron deficiency. The plants were grown hydroponically and subjected to either iron sufficient or iron deficient conditions. Gene expression was assessed by measuring mRNA present associated with leaf senescence using RT-qPCR. Increased protease activity tends to be associated with senescence and was assessed using gel zymography. Gene expression and protease assays are still in progress. We also hypothesize that DNA methylation is occurring in the A17 genotype causing down regulation of senescence related genes. DNA methylation was assessed using bisulfite sequencing to compare methylation patterns between A17 and DZA315.16. A17 datasets from bisulfite sequencing are consistent with successful bisulfite reactions.

Poster Number: 221

**Metagenomic Analyses Of Gutter And Amphibian Microbiomes From Environmental Swab Samples Using High-throughput 16s Amplification And Sequencing**

**Sheridan Littleton** Biological Sciences NC State University  
**Alexandra Burd** Microbiology NC State University  
**Mentors and/or Co-Authors:**  
**Carlos Goller** College of Sciences NC State University

Metagenomics is the study of genetic material recovered directly from the environment to understand microbiomes within an ecological context. A microbiome is the combination of the DNA of the microbial community in a particular environment. To analyze the microbiomes of environmental samples, we prepared 16S rRNA libraries from two existing sample sets for Illumina MiSeq high-throughput sequencing. The first sample set included genomic DNA extracted from nine gutter swabs submitted by North Carolina citizens. The second sample set included genomic DNA previously extracted from four amphibian swabs submitted by North Carolina field biologists. Several replicates and controls were included to validate the process. We utilized automation with an Eppendorf epMotion 5075 TC liquid-handling robot to minimize potential sources of human error and streamline the workflow. Variable V3 and V4 16S regions were amplified with universal primers, tagged with eight base sequence adaptors, and cleaned with AMPure XP magnetic beads. Amplicons were quantified, normalized, and pooled at 10 nM final concentration. Sequencing results will provide taxonomic classification of microbes present in each sample, suggesting the core microbiomes of North Carolina gutters and whether infection with ranavirus FV3 alters the microbiome of amphibians. Gutter sample results will be published.
online to promote citizen involvement and further scientific research focused on the microbial inhabitants of our homes and their ecological impact. The automation of tedious processes allows for standardization of protocols and high-throughput processing of numerous replicates for dozens of samples.

Poster Number: 277

**Investigation Of Radd Expression In E.coli Under Various Stress Conditions**

**Brooke Loewengruber** Bioprocessing Science and Food Science NC State University  
**Mentors and/or Co-Authors:**  
**Stefanie Chen** College of Agriculture & Life Sciences NC State University  
**Drew Kelliher** Materials Science NC State University

The radD gene, formerly known as yejH, is named for its role in radiation survival and DNA repair. If radD is deleted, the cell’s chance of survival after ionizing radiation significantly decreases. Through comparing microarray data, testing of algorithms MEME and bioprospector, and performing the chIP assay, it was concluded that radD is under the sigma 54 stress response promoter (Zhao, Liu, Burgess, 2009) as opposed to the sigma 70 promoter, which is known to be the “housekeeping” promoter. Therefore, the gene should only be expressed in response to specific stressors, so we exposed single colony founder strain E.coli cells to different stress conditions to see if the radD gene would be expressed. These stress conditions included added ciprofloxacin, nitrogen and glucose starvation, nitrogen starvation, amino acid starvation and UV radiation. Cells were exposed to their respective stress condition and placed into conicals for treated and untreated cells. After purifying the RNA from the treated and untreated cells and using reverse transcriptase to get DNA, we tested if the gene was expressed through analysis of mRNA levels with RT-qPCR while accounting for errors with controls in place. These controls included testing the radD alongside glnA and cysG, while comparing the untreated mRNA to the treated mRNA. The level of radD expression did not significantly change under ciprofloxacin exposure, UV radiation, nitrogen starvation or nitrogen and glucose starvation. Further research should be conducted on the conditions in which radD is expressed.

Poster Number: 24

**High-throughput Microfluidic Device To Characterize Peptide To Protein Affinity**

**Mohammad Omary** Chemical and Biomolecular Engineering NC State University  
**Mentors and/or Co-Authors:**  
**Adriana San Miguel** College of Engineering NC State University

Proteins carry numerous functions that are essential for the sustenance and growth of humans and all forms of life. However, the affinity of proteins to peptides and their interactions are not fully explored. Identifying binding peptides can be useful for protein purification, diagnostics and therapeutics. Microbeads can be used as surfaces to allow different ligands to bind to proteins. The aim of this study is to automate a platform that can sort thousands of these beads and identify which peptides have affinity to proteins such as host cell proteins. A novel, automated, high-throughput microfluidic platform is constructed to sort the beads. Fluorescent tags, such as GFPs, are used to characterize the affinity. Because the beads range in size between 100-300 µm, the result is a robust device that can address and tolerate both larger and smaller beads. The microfluidic device contains an inlet, two outlets and four valves, all of which are controlled with a pneumatic pressure box. Additionally, Matlab is used to process fluorescent images taken of each bead and sort the beads into two groups. The goal is to use the platform to explore an array of different peptides and proteins.

Poster Number: 41

**Presence Of Ranavirus In North Carolina Herptofauna And Phylogenetic Characterization Of Identified Strain Sequences**

**Stephanie Thi** Zoology NC State University  
**Mentors and/or Co-Authors:**  
**Thomas Lentz** BTEC NC State University

Ranavirus is a genus of large, icosahedral, double-stranded DNA viruses. These viruses can cause mortality through cell death and inflammation response in several amphibian, reptile, and fish species. Additionally, stressed or immunocompromised individuals, such as those that have suffered from a physical injury or secondary infection, might
be more susceptible to infection. Ranaviruses have been discovered around the world, and can spread rapidly via indirect aquatic transmission and human factors (e.g., animal trade). Because of these factors, Ranaviruses pose a threat to endangered species, biodiversity, and economically important aquaculture species. Though Ranaviruses are known to be widespread, it is uncertain which strains of virus are circulating in the wild and which species of animals are infected. Mapping connections between strain of virus and host could help curtail the spread of Ranavirus. To this end, swab samples were collected from amphibians and reptiles across North Carolina. DNA was extracted, and the presence of Ranaviruses was determined by qPCR. Samples that tested positive by qPCR were confirmed by a secondary PCR assay targeting distinct regions of the viral genome. Strongly positive samples were sequenced and the phylogenetic relationship of these viruses was analyzed. Ranavirus was found across a broad range of taxonomic groups, including frogs, toads, snakes, salamanders, and lizards. Several species not previously known to carry Ranavirus were demonstrated to be positive. Attempting recovery of circulating strains of virus from liver tissue samples is ongoing. If recovered, these wild-type viruses will also be identified by PCR and DNA sequencing.
In designing nuclear reactors, engineers need to be able to rely on codes to accurately design the core of a nuclear reactor. CASMO is a theory code that is widely used throughout the nuclear industry. However, CASL, The Consortium for Advanced Simulation of LWRs (Light Water Reactors), uses MPACT for the same purposes CASMO is being used in the industry. Both theory codes use similar methods for solving the nuclear transport and fission reactions. This is important because the data retrieved from these codes essentially models the power of the reactor. Comparing CASMO to MPACT will ascertain if the two-dimensional lattice containing IFBA, integral fuel burnable absorber, and gadolinia, Gd, can be modeled accurately in CASMO. When comparing the reactivity and power from both codes, the results indicate that CASMO is accurate and therefore a reliable code for nuclear reactor code design.
Microfabrication Of Bioengineering Muscle Tissues For High Throughput Screening
Sindhoor Ambati Biomedical Engineering/English NC State University

Mentors and/or Co-Authors:
Donald Freytes College of Engineering NC State University
Beverly Setzer Mathematics NC State University

Current tissue engineering approaches in the field of muscle regeneration rely on animal models to test the efficacy of the design. We are limited to studying the interactions in immune-comprised animals to avoid rejections and often fail to recapitulate human physiology. Therefore, in vitro models that use human cells can provide an initial testing platform that can be used to screen potential therapeutic cells and engineered constructs. This project aimed to create an in vitro platform, using bioengineered muscle tissues (BMTs) to study the effects of cell and tissue interactions with polarized macrophages. Given the significant role of inflammation during wound healing and degenerative diseases, the insights obtained using this new culture system will allow us to recapitulate key steps of the inflammatory response in vitro that will help develop new strategies to enhance the clinical therapeutic effects of engineered constructs. hiPSC derived cardiac muscle cells were seeded into a collagen gel, and then the gel was transferred onto PDMS posts. Once the cells had differentiated into myotubes, electrical stimulation was applied to the gel, leading to contraction by the cells and deflection of the posts. By creating this environment, an in vitro response can be characterized to analyze the deformation of the posts and the cell contractions after stimulation. Histological staining was also used to analyze the cellular morphology of the tissues and gene expression analysis with q-PCR was used to determine changes in response to the inflammatory cells.

Allele Specific Gene Expression In Hybrids
Alan Brown Genetics NC State University

Mentors and/or Co-Authors:
David Aylor College of Sciences NC State University

Hybrids are the result of mating between two genetically distinct organisms, for example mules or a cross between two different inbred strains of mice. Hybrids are useful for evaluating allele specific expression (ASE) because sequence variants unique to each parent at each locus of a hybrid can be used to identify and quantify which parental alleles are expressed in the hybrid offspring. The greater difference between the parents, the more variation will exist in the hybrid which allows ASE to be evaluated across a wider range of genes. Studying differences in expression of parental alleles will lead to insights about the heritability of gene expression and aid the discovery of cis-regulatory elements. This summer I helped build a bioinformatics pipeline that will incorporate strain-specific variants into a reference genome to create strain-specific pseudogenomes. RNA-seq reads from a hybrid will be aligned to each pseudogenome. Reads containing parental specific variation will have a higher alignment score when mapped to their respective parental pseudogenome and thus allow quantification of ASE through comparisons of alignment scores. This summer I used the pipeline on cichlid fish data to quantify which and how many loci segregate between parents in order to guide a future hybrid experiment using those fish.

Brain Neural Coding In Response To Pain Induced By Inflammation And Osteoarthritis
Isley Correia Biological Sciences: Human Biology concentration NC State University

Mentors and/or Co-Authors:
Duncan Lascelles College of Veterinary Medicine NC State University
Stacey Davis Psychology NC State University

Pain is a common symptom of inflammation and naturally occurring disease like osteoarthritis yet the cellular basis of its neural coding in the brain is still unclear. By analyzing the neuronal response in the brain to induced pain models, we can attempt to explain whether different pain models share common circuitry in the brain. To do this, we developed an
osteoarthritis-based model (Mono-iodoacetate (MIA) injection) and an inflammatory model (Complete Freund’s Adjuvant (CFA) injection), as well as a control injected with PBS. Brains were sectioned, immunohistochemistry was performed using cFos antibody, which is an immediate early gene (IEG) that functions as a activation marker, and sections were analyzed. Our results demonstrated IEG activation in the Ventromedial Hypothalamic Nuclei (VMH), Lateral Habenula (LH) and the hippocampus of the CFA-induced brain and the VMH, Nucleus Acumbens (ACB), hippocampus and amygdala in the MIA-induced brain, however more trials must be conducted to confirm these results. These analyses are the beginning of much broader research, however identification of activated areas during pain induction will help us get one step closer to understanding the mechanisms underlying osteoarthritis, which can help finally identify a potential treatment for chronic pain.

Poster Number: 43
Identifying Novel Innate Immune Response Targets To Alter Salmonella Typhimurium Pathogenesis.
Eddy Cruz Microbiology NC State University
Mentors and/or Co-Authors:
Johanna Elfenbein College of Veterinary Medicine NC State University
Morgan Danyi Food Science, Nutrition NC State University
Addison Collins Food Science NC State University
Leah Isenhour Food Science NC State University
Andrew Priest Food Science NC State University

Salmonella infections have remained a prevalent public health concern for over a decade. Currently, there is a significant need to reduce the incidence of Salmonella infections in a way that does not contribute to further emergence of antimicrobial resistance. Salmonella Typhimurium infection is unique as Salmonella induces a neutrophilic inflammatory response that allows it to thrive in the gut. During this response, neutrophils contribute by causing collateral damage to the host intestine and resident microflora, and producing reactive oxygen species that nourish Salmonella growth. We hypothesize that dampening the host neutrophilic response within the gut will decrease pathogen survival and host injury during Salmonella gastroenteritis. To accumulate a robust inflammatory response, neutrophils conduct effector functions including migration and respiratory bursts. The Myristoylated Alanine Rich C-Kinase Substrate (MARCKS) protein, which is upregulated in activated neutrophils, plays a key role in regulating these effector functions; making it a potential therapeutic target. We hypothesize that MARCKS is upregulated in the intestine during Salmonella infection. We will use a calf ligated ileal loop model of Salmonella Typhimurium Gastroenteritis to evaluate MARCKS expression and phosphorylation patterns in uninfected, wild type (WT) and ΔSPI-1 infected intestinal loops. Harvested gastrointestinal tissue will then be immunoblotted for MARCKS and Phosphorylated MARCKS (Serine 167/170), with GAPDH as a loading control. To date, our preliminary data suggests that total MARCKS expression decreases with WT Salmonella infection. Future studies will use the calf ligated ileal loop model to evaluate whether MARCKS inhibition is a viable treatment strategy to alter Salmonella pathogenesis.

Poster Number: 63
Nanofiber Scaffolds For Cartilage Repair
Jay Davis Chemical and Biomolecular Engineering NC State University
Mentors and/or Co-Authors:
Stephanie Teeter College of Engineering NC State University

With approximately 200,000 ACL reconstructions and 850,000 meniscectomies in the United States each year, orthopedic soft tissue injuries are a prevalent issue. Traditional treatments are invasive, and often simply treat only the symptoms, as opposed to restoring function. Tissue engineering and regenerative medicine provide the possibility of less invasive, bio-specific treatments that could restore function to the damaged tissue. We aim to develop a bio-scaffold using microbial cellulose that can guide the formation of functional cartilage tissue in vitro using chondrogenic cell types. Microbial cellulose will be harvested from a Gluconacetobacter Xylinus bacterial culture and incorporated into a cellular scaffold by way of 3D bioprinting. As the viscosity of the cellulose “bio-link” is critical for successful extrusion-based 3D printing, different cellulose concentrations ranging from 0.5-2% wt. will be evaluated. Development of a cellulose scaffold is beneficial as this material is an abundant, cost-effective polymer that is naturally composed of nanofibers, thus mimicking the structure of native extracellular matrix components, including collagen fibers. Successful fabrication of a cellulose scaffold that can support cartilage formation in vitro would provide the basis for future in vitro studies.
Antivirals Derived From Plant Extracts To Combat Zika Virus

Hannah Jarmer Microbiology NC State University

Mentors and/or Co-Authors:
Scott Laster College of Sciences NC State University

Zika virus is a positive-sense, single-stranded RNA virus of the family flaviviridae. Zika virus is predominately transmitted by Aedes aegypti, akin to the world renowned Dengue Fever Virus. With more than 2.5 billion at risk of contracting Dengue Fever annually, and Zika virus spreading rapidly in over 60 countries, these viruses pose huge challenges to public health. Zika virus is closely associated with microcephaly and Guillain-Barré syndrome. There is currently no vaccine or antiviral approved to prevent Zika virus. We investigated the effects of various plant extracts in order to ascertain whether or not they had antiviral activity against Zika virus. The extracts tested contain compounds which have been known to inhibit Dengue – anthocyanins, procyanidins, flavonoids, and phenolic acids. The viral inhibition efficacy of each extract was evaluated via a one-step growth curve. We grew Zika virus in Vero cells for 48 hours, adding extracts either during or after infection, to test viral binding/entry inhibition and viral replication/assembly inhibition, respectively. Newly produced virus was harvested and quantified using a plaque assay. Potential cytotoxic effects of the plant extracts were evaluated via lactate dehydrogenase assay. Our results demonstrated replication inhibition by way of four extracts – Glycyrrhiza glabra aerial hexane, Glycyrrhiza glabra root ethyl acetate, Glycyrrhiza glabra root hexane, and Angelica keiskei root ethyl acetate. The long-term goal is to develop a naturally derived antiviral compound that is less expensive than antivirals currently used to combat other diseases, thereby creating a more affordable treatment option to defend against Zika virus.

A Novel Steroid-eluting Esophageal Ring For Treatment Of Eosinophilic Esophagitis

Caroline Kornegay Animal Science NC State University

Mentors and/or Co-Authors:
Anthony Blikslager College of Veterinary Medicine NC State University

Eosinophilic esophagitis (EoE) affects 1 out of 2,000 people, and has recently been recognized as an emerging disease in developed countries. EoE is defined by abnormal infiltration of eosinophils into the esophageal mucosa, leading to dysphagia and progressive esophageal stenosis. With no FDA approved medications, treatment options are sub-optimal with poor response rates. It has been established that drug-eluting rings placed in muscular luminal organs can deliver medication successfully. A novel fluticasone-eluting ring is being designed and 3D printed to test the elution and absorption of fluticasone into the esophageal mucosa. Initially, the esophagus was measured in 6-8-week old pigs, and found to be approximately 2cm in diameter. This has facilitated ring design. After optimizing drug delivery and mechanical properties of the ring, it will be placed endoscopically into the esophagus of test pigs. Serial blood and tissue samples will be taken during repeat endoscopies during an eight-week time period. It is suspected that esophageal explants from the pig will show high local levels of fluticasone with little systemic absorption and the rings will remain in position without causing local esophageal injury. By using porcine models, the goal is to ultimately develop a drug-eluting ring that can be safely used in humans to successfully treat Eosinophilic esophagitis.

Immunosuppression In Malignant Canine Gliomas

Mitchell Martin Microbiology NC State University

Mentors and/or Co-Authors:
Christopher Mariani Veterinary Medicine NC State University

Malignant gliomas are the most common brain tumors in humans. They pose a serious detriment to human health and are difficult to effectively treat. Opportunities to study immunological processes in canine models may all the development of immunotherapeutic treatment options that can be adapted for humans. This project focused on characterizing populations of immune cells within glioma tissue samples with a particular emphasis on immunosuppression using immunohistochemical techniques. CD18+ microglial cells were found to be particularly prevalent within and around the tumors, which could indicate a mounted immune response against the tumors. CD45RA+ lymphocytes and CD3+ T-cells
were found sporadically within the tumors and primarily in the vicinity of vessels. These cells often appeared to be in various states of degradation, suggesting that gliomas may be mounting an immunosuppressive response. CD11d+ dendritic cells were found sporadically throughout the tumors, suggesting recognition of the tumor via adaptive immunity. Studies to further characterize immune cell populations and to evaluate cytokine and chemokine concentrations in the serum and cerebrospinal fluid of tumor bearing dogs are planned.

Poster Number: 137  
**Modeling The Collective Dynamics Of Host Cell Defense Against Virus Infection**  
**Hayley Russell**  
*Mathematics and Computer Science* NC State University  
*Mentors and/or Co-Authors:*
- **Ruian Ke** College of Sciences North Carolina State University  
- **Xiangyu Bi**  
- **Piyavdee Pariyavuth**  
- **Rachel Wooten**  
- **Krystal Mirshahi** *Food Science* NC State University  

The success of a virus infection depends on its ability to evade the immune system at both the intracellular and intercellular level. The first line of defense of the immune system is the innate immune response, primarily driven by the interferon (IFN) response. In infected cells, cell pathogen recognition receptors can detect viral genomes, which lead to the transcription of interferon genes and subsequent production of interferon. Interferon works as signaling molecules, diffusing rapidly into the surrounding area, to induce antiviral gene expression in neighboring cells and thus rendering them refractory to viral infection. Although the molecular mechanisms of the interferon response have been under intensive study, the underlying principles of cell-to-cell communication through IFN and how the cell population collectively responds to viral invasion as a whole are not well understood. Here, we implemented an agent-based cellular automata model to describe the production, packaging, and spread of virus particles in addition to the activation of IFN production and cell-to-cell communication through IFN signaling on a lattice. Our model represents a monolayer of host cells that can be used to observe the spatial-temporal patterns of infection and complex behaviors of interferon regulation. The wave speed of infection, viral load, and percentage of infections suppressed by IFN was measured to determine the threshold of successful infection events. With this, we gain a quantitative understanding of virus-innate immune interaction and the emerging principles underlying the collective behavior of host cells that is required to develop novel therapeutic approaches and mitigate disease symptoms.

Poster Number: 148  
**Cardiac Expression Patterns Associated With Feline Cardiomyopathy Mutations**  
**Josh Slaydon**  
*Genetics* NC State University  
*Mentors and/or Co-Authors:*
- **Mary Anna Carbone** College of Sciences NC State University  

Hypertrophic Cardiomyopathy (HCM) is an inherited disease characterized by thickening of the left ventricular myocardium. Mutations in the gene MyBPC3 have been associated with HCM in people. The disease commonly affects young athletes and often goes unnoticed due to its first symptom usually being congestive heart failure. In addition to affecting humans, HCM is the most common form of heart disease in cats. Two separate mutations in feline MyBPC3, A31P and R820W, have been identified in the Main Coon and Ragdoll breeds respectively. While HCM is a fairly common genetic disease it is difficult to obtain a large sample size of either cats or humans with this condition. A possible solution to this problem is to use *Drosophila melanogaster* as a model to study HCM. In this study, we have generated wildtype, A31P, and R820W variants of the MyBPC3 gene. Using a PhiC31 transformation we have inserted our MyBC3 variants into *Drosophila melanogaster*. The heart rate of the mutant larvae was found to be significantly higher than that of either the control or wild type larvae. We will use the treadwheel, an exercise apparatus, to induce exercise related stress and determine if there is difference in this phenotype. RNA-sequencing will be conducted to reveal expression patterns of transcripts affected by the overexpression of MyBPC3. Regulatory pathways that are uncovered by this study can serve as a translational model for studies of therapeutics in human and feline clinical trials.
Ataxias are hereditary diseases that give rise to cerebellar and spinocerebellar degeneration and locomotor deficits. Over 50 different types of hereditary ataxia have been identified in humans, varying in mode of inheritance from autosomal dominant and recessive, to X-linked. These diseases have also been observed and studied in purebred dogs. A polymorphism in the canine Rab24 gene is associated with hereditary ataxia in Old English Sheepdogs and Gordon Setters. Rab24 is a member of a family of small GTPases that regulate intracellular trafficking and vesicle fusion. We are developing a genetic model for canine ataxia using Drosophila melanogaster as a model organism. We have amplified the Rab24 gene from dog cDNA mutated it by site-directed mutagenesis to generate the pathogenic glutamine to proline mutation (Q38P), and then introduced both the wild-type and the Q38P vectors into fly embryos through PhiC31 transformation. The canine Rab24 gene (wild-type and Q38P) will be expressed in Drosophila melanogaster using the GAL4-UAS binary expression system with a pan-neuronal elav-GAL4 driver. We will measure open field locomotion, negative geotaxis and phototaxis of transgenic flies versus controls to assess whether flies expressing the wild type or mutated Rab24 gene will show impaired coordination and balance, replicating the ataxia phenotype in dogs. A positive outcome will enable subsequent experiments aimed at identifying epistatic modifiers of the transgene that reduce or enhance the phenotype.
Conjugated Dienes: A Potential Link Between Lipid Oxidation And Flavor-related Fade In Green Coffee Beans

Proity Akbar Chemistry New Mexico Highlands Univeristy

Mentors and/or Co-Authors:

Gabriel Harris College of Agriculture and Life Sciences NC State University

This study investigated the links between lipid oxidation and the flavor defect known as "fade" in green coffee beans. Coffee beans are prone to lipid oxidation, which degrades their sensory and nutritional qualities. Faded green coffee beans, viewed under UV light, fluoresce, while non-faded/standard green coffee beans do not. We hypothesized that conjugated dienes, an intermediate of lipid oxidation with fluorescent properties are present in the faded samples and that lipoxygenase (LOX), a naturally occurring enzyme that oxidizes lipids in plants, was involved in the formation of conjugated dienes. Green coffee beans were analyzed for moisture and protein content using an oven-drying technique, and BCA analysis, respectively, since moisture content affects LOX activity and measurable protein is a potential indicator of the presence of LOX. Green bean samples were extracted with hexane and analyzed for conjugated dienes using UV/VIS spectrophotometry. The LOX activity in the fractions was indirectly monitored as conjugated diene formation. The moisture content of the green coffee beans ranged from 9-12%, which meets the accepted standards for coffee. Protein content of green coffee beans varied from 20-50 mg per 100 g. Hexane extracts exhibited absorbance at 233 nm, the lambda max for conjugated dienes, providing tentative evidence for the presence of conjugated diene compounds in the beans. Further research is needed to examine the association between lipid oxidation and off-flavor formation in green coffee beans. Future studies will seek to confirm the presence of conjugated dienes and the role of LOX in their formation.

Manipulation And Quantification Of Interfacial Slip

Diana Bickmore College of Wooster

Mentors and/or Co-Authors:

Chris Pernell College of Agriculture and Life Science NC State University

Food rheology examines the rheological properties of food and is an essential approach to analyzing texture. At hypothetical solid-liquid interfaces, the no-slip boundary condition, one of the main assumptions considered in shear rheology, assumes that the velocity of the liquid is the same as the velocity of the moving surface. Although it may occur, violation of the no-slip boundary condition is difficult to detect because it is easy to incorrectly attribute slip to other rheological properties. The primary intent of this study was to quantify the presence of interfacial slip by means of contact angle and squeeze flow properties, thus using inherent properties of known materials to evaluate the unknown slip properties. A range of silane surfaces were prepared on glass microscope slides with the intention of achieving uniformity of contact angle across the entire surface. A goniometer was then used to measure the contact angle of water droplets on the various surfaces, and the average contact angles were compared to the squeeze flow properties measured by a universal testing machine when starch gels were placed in between two of the silane treated surfaces. The range of surfaces with distinct contact angles did demonstrate unique squeeze flow properties, suggesting preliminary quantification of interfacial slip, which may be significant in actually manipulating the occurrence of interfacial slip in future experiments.
FREEDM Center

Poster Number: 147
High Frequency Transformer Design For Modular Ac-ac Solid State Transformer
Seth Courtney Engineering Physics Murrany State University

Mentors and/or Co-Authors:
Kristen Booth College of Engineering NC State University
Karen Son Psychology NC State University

The focus of this poster is to analyze the planar and traditional transformer cores for use in the FREEDM AC/AC Solid State Transformer. In selecting which core type to use it is imperative to consider the needs of the SST model. Core type selection is primarily governed by economy, low profile, and high-power density. There exists optimal volume to power loss ratio in core size dependent on the switching frequency of the SST model and type of wire used.

Poster Number: 8
Advances In Electronic Packaging
William Dement Civil Engineering NC State University

Mentors and/or Co-Authors:
Yang Xu Engineering NC State University

Power semi-conductor devices are becoming more prevalent in modern society. As these devices become more powerful, the technology will continue to progress and improve through faster switching and the ability to operate at higher voltages and currents. Electronic packaging has to develop and progress just as quickly as the devices are to work towards having reliable devices. The electronic packaging field will continue to focus on removing heat, providing reliable interconnections from thermal stress, and working to avoid unwanted parasitic elements within a device. One of the ways electronic packaging is advancing is through multi-physics simulation software such as COMSOL to provide insight and estimations to how the device will perform under power. This allows researchers to predict maximum temperatures and stresses as well as the parasitic elements within a specific device and optimize the geometries to reduce these maximums. In addition to simulation, electronic packaging is progressing by having housing models 3D printed specifically for the devices they are containing. The main benefits to 3D printing is the ability to produce exact non-standard geometries for a device as well as reducing the amount of time to produce a prototype. This has resulted in electronic packaging labs requiring 3D printing of high temperature materials to produce durable housings for unique devices. Ultimately, the goal is to further develop and push the boundaries of the packaging to support the progressing electronic device industry.

Poster Number: 208
Andrew Galamb Electrical Engineering NC State University

Mentors and/or Co-Authors:
Mesut Baran College of Engineering NC State University

Researchers continue to work to improve solar energy technology for a sustainable solution to the world’s growing energy needs. This project outlines the simulation of an equivalent-circuit model for a single-phase grid-tied photovoltaic(PV) system. Simulated electrical components are connected following established modeling techniques to represent a PV system under varying temperature, insolation and series and parallel module combinations. The model incorporates a DC-DC buck-boost converter, a maximum power point tracking algorithm, and a DC-AC inverter to tie into the grid. The result is a full-circuit model of a single-phase grid-connected PV system that measures the power output of a module or array and displays system dynamics. This simulation provides a model of a PV system that could be installed on a neighborhood rooftop as part of a distributed renewable energy generation system.
Design And Modeling Of Boost Converter Interface Solar Pv Renewable Energy Generation Unit

Norma Granados Electrical Engineering University of Texas at El Paso

Mentors and/or Co-Authors:
Dhrubo Rahman College of Engineering NC State University

The objective of this project is to improve the performance of the boost converter interfaced Solar Photovoltaic Panels, in order to extract the maximum power out of the system. The system being used is expecting a DC input-output, therefore a converter is used rather than a transformer because a transformer would require an inverter to convert to AC. The DC-DC boost converter prevents power losses throughout the circuit and is used to provide a higher voltage potential across the terminals of the energy storage unit.

Transactive Energy And Its Effects On Electrification And Decentralization Of Electric Energy

Mariel Jeffris Electrical Engineering NC State University

Mentors and/or Co-Authors:
Ewan Pritchard College of Engineering NC State University

Transactive Energy (TE) is an emerging energy market system that provides a novel approach to energy generation, distribution and consumption. A model that accounts for the integration of distributed energy resources (DERs) into the current grid, supply and demand laws, prosumers, amongst others, TE produces several effects on the electrification and decentralization of the power grid. This project seeks to analyze these effects and how current efforts contribute to the transition towards a more transactive energy market.

Wireless Communication System For Ecoprt

Kristi Kazmierczak Computer Science Wake Technical Community College

Mentors and/or Co-Authors:
Alireza Dayerizadeh College of Engineering NC State University

The purpose of this research project is to identify how to establish a wireless communication link between two microcontrollers that will be used for a self-driven, electric transit system called EcoPRT. To recharge, the vehicle requires a charging management system that utilizes wireless power transfer. Wireless communication between the vehicle and charging station is essential to its operation. The EcoPRT vehicle will drive over the station and send a signal or message to the charging pad instructing it when to start and stop charging. The research involves using C programming for the code used by the microcontrollers to be able to transmit and receive real time data. Establishing communication between the devices will allow the vehicle to operate autonomously.

Simulation Of Dc-dc Converters In Photovoltaic Systems

Katie Mallinson Electrical and Computer Engineering NC State University

Mentors and/or Co-Authors:
Dhrubo Rahman College of Engineering NC State University

This project is to conduct research on the integration of boost and buck converters with photovoltaic systems. It involves the simulation of inverters, rectifiers, and buck and boost converters, with a focus on the DC-DC boost converter, using both software and hardware tools. Converters greatly increase the efficiency and controllability of PV systems. DC-DC converters are necessary to step-up and step-down voltages distributed between the source and the energy storage unit. In this case, the source would be the energy generated by the photovoltaic cells. Current research is conducted on the application of different control methods to increase the efficiency and reliability of these converters. The focus of this project is on simulating peak current control methods, covering PI control, in DC-DC boost converters.
Power Module: Packaging And Testing
Daniel Rios Electrical Engineering University of Texas at El Paso
Mentors and/or Co-Authors: Bo Gao College of Engineering NC State University

Power electronics packaging is a multidisciplinary field concerned with the design and assembly of power modules and the heat transfer of selected materials used. A power module is made up of semi-conductor devices that are housed in a package. Furthermore, the power module must go through extensive testing to observe its performance and ensure it meets specified requirements. In the team’s application, a full bridge converter was implemented in order to assess the power module at 5kV and 100kHz. One inductor bank and three capacitor banks are used in the converter set up. A ventilation system was developed in order to monitor and control the temperature of these banks. This system consists of a series of 4-Wire PWM fans, an array of DS18B20 digital temperature sensors, and an Arduino Due. It is designed to run the PWM fans at full power when the temperature of the banks surpasses 70˚C and reduce fan speed at lower temperature. A vast majority of industrial goods and services rely heavily on these high voltage and high frequency switches. The optimization of these modules makes applications in industry cheaper and more energy efficient.

Wireless Power Transfer For Electric Vehicle Charging
Tim Sonnenberg Electrical Engineering NC State University
Mentors and/or Co-Authors: Srdjan Lukic College of Engineering NC State University

In response to a need for more efficient transportation between campuses, NC State is in the midst of building two person autonomous electric vehicles known as the EcoPRT. In order for the EcoPRT to remain completely autonomous, it must be able to charge itself completely on its own. We propose wireless charging as a complete solution. Our wireless charging system will be achieved through multiple power electronic stages and two planar coils operating at a resonant frequency. The system will be able to continually deliver maximum power as the load dynamically changes during charging. This way, the vehicle will be able to position itself over the charging pad and efficiently charge without external aid. As a result the EcoPRT will have a reliable, and autonomous charging process that will allow it to perform at maximum productivity.

Solar-powered Vehicles: An Analysis Of Practicality
Bryon Spells Mechanical Engineering NC State University
Mentors and/or Co-Authors: Ewan Pritchard College of Engineering NC State University

Transportation is critical to the prosperity of humanity. Today, people increasingly use ground vehicles to transport anything and everything, including themselves. From an economic standpoint, this is exciting and desirable. From an environmental standpoint, not so much. The EPA states that over fifty percent of nitrogen oxide and thirty percent of carbon emissions in United States atmosphere is due to transportation and contributes to health issues. It is imperative that society move away from internal combustion engines in order to ensure the longevity of the human race. Electric vehicles have been proposed as a solution and offer a promising solution to the previously expressed issues. However, their full potential cannot be realized until clean, efficient energy generation is achieved as well. One hybrid electric vehicle topology which is plagued with doubt and curiosity, is the solar-powered vehicle. A solar-powered vehicle is one that can primarily charge itself using a solar array mounted on the vehicle. Though there is much curiosity about this technology, there has not been enough or stringent evidence to evaluate its usefulness. This project focuses on developing an analysis of the effect of solar arrays on electric vehicles under real weather and road conditions by using the Advanced Vehicle Simulator to engage model-based design. Model-based design is a powerful tool for systems analysis which allows quick iteration of design inexpensively and accurately rather than traditional, expensive physical prototyping.
Effects Of Winding Composition On Leakage Flux In A Transformer

David Storelli  
Electrical and Computer Engineering NC State University

Mentors and/or Co-Authors:
Subhashish Bhattacharya College of Engineering NC State University

The implementation of renewable energy technologies in the electric grid infrastructure will require the development of numerous supporting devices, and continued pursuit of greater efficiency in these devices will continue to drive the adoption of clean energy. One such device is the Dual Active Bridge inverter, which is commonly used in renewable energy systems and is a topic of great interest for research. To study the performance of the magnetic components of the Dual Active Bridge inverter, the authors have constructed a magnetic materials testbed to characterize a variety of core materials and transformer designs. The preliminary results from the testbed displayed an unexpected artifact in the electrical current through the transformer, which was found to be likely caused by eddy current losses, caused by high occurrence of leakage flux near the transformer windings. The authors propose to show that physical properties of the windings, such as number of turns and coil proximity to the core, have a large impact on the leakage flux and thereby the eddy current losses in the transformer. This conclusion is supported by numerical analysis of current models of leakage inductance as well as a comparative analysis of Finite Element Models. The results of this study will be used to improve the winding design of the isolation transformer in the Dual Active Bridge inverter.
**GEAR - Global Engagement in Academic Research**

**Poster Number: 232**

**Statistical Model Comparison In Genomic Selection With E-maize Challenge Data**

Bowei Ding
Statistics
Zhejiang University

*Mentors and/or Co-Authors:*
Zhao-Bang Zeng
College of Science NC State University

Genomic selection has become an important tool in plant and animal breeding. It has been shown widely that this approach gives accuracies sufficient to generate rapid genetic gains in simulation and empirical studies with both plant and animal dataset. In the meantime, much larger number of single nucleotide polymorphisms (SNP) had been discovered by genome sequencing and new methods to efficiently genotype the large number of SNP. With the rapidly increasing amount of genotype information, however, the accuracy and computing efficiency of those traditional models had not been tested in high-dimensional data. The goal of this research is to compare overall performance and the underlying methodologies of different types of statistical models, and thereby choose more appropriate models in genomic selection. The models analyzed in this research include basic shrinkage regression models (Ridge and LASSO), Bayesian shrinkage regression methods (B-LASSO, Bayes B, wBSR) and some machine learning approaches (RF). The dataset used in the research consists of approximately 1.9 million SNPs and 6210 hybrid lines with three traits. And the models are constructed in the training set of the whole dataset and evaluated using cross-validation by the value of Pearson-correlation-coefficient between estimated values and true values. The results are expected to show a strong correlation between the estimated and true value of traits and to select models in consideration with both predicting accuracy and computing complexity. Implementation of appropriate models in genomic selection is likely to have major implications for genetic evaluation system and for genetic improvement programs generally.

**Poster Number: 246**

**Exact Solutions For Riemann Problems Of The 1-d Euler Equations**

Kaiduo Fang
Vehicle Engineering
Jilin University

*Mentors and/or Co-Authors:*
Hong Luo
College of Engineering NC State University

Riemann problems are a class of initial value problems of a system of conservation equations consisting of two piecewise-constant initial states, with a single discontinuity separating them. Depending on the eigensystem of the conservation equations, the Riemann problem generates a series of shocks, rarefaction and contact waves. These waves help understand the fundamental mathematical and physical nature of the conservation equations being studied. In this work, the Euler equations of compressible fluid dynamics are considered. These comprise of a system of nonlinear hyperbolic PDE’s describing conservation of mass, momentum and total energy of the fluid. Riemann problems of the compressible Euler equations are very well known and serve as important benchmarking tests for advanced computational fluid dynamics solvers. The aim of the project is to write an exact Riemann solver for the 1-D Euler equations in FORTRAN. In this research, with initial and boundary conditions, we will solve the Euler equations by singular value decompositions in order to get their eigensystem. Then, by using the method of characteristics, imposing the entropy condition and the Rankine-Hugoniot relation, the exact solution is obtained. To summarize, this research aims to offer the exact solutions of Riemann problems of the Euler equations of compressible fluid dynamics at different initial conditions. This would help obtain exact solutions of Riemann problems generating any combination of waves, propagating in any direction. These solutions are then useful as references to assess the performance of numerical methods in the early stage of development.

**Poster Number: 168**

**Lubrication Properties Of Polyzwitterion Brushes On Silicon Wafer**

Yu Fang
Macromolecular Materials and Engineering
Zhejiang University

*Mentors and/or Co-Authors:*
Lilian Hsiao
College of Engineering NC State University
Shannon Fiore
Psychology
NC State University
Polyzwitterion is a neutral polymer with both positive and negative charges. Unlike typical polyampholytes or polyelectrolytes, charges on polyzwitterion side groups are balanced inside the chain. Polyzwitterions possess excellent lubrication in aqueous environment due to the absorption of water molecules onto their side groups. In this work, we graft poly(2-(dimethylamino)ethyl methacrylate) (PDMAEMA) onto silicon wafer surfaces using atom-transfer radical polymerization (ATRP). We first use [11-(2-bromo-2-methyl)propionyloxy] undecyltrichlorosilane (BMPUS) as an initiator, followed by a postpolymerization modification (PPM) strategy to obtain the polyzwitterion brushes. Thickness of the PDAEMA brushes is altered by changing the time scale of ATRP reaction and is characterized using the molar mass of brushes. We hypothesize that brushes with different molar mass exhibit different lubrication properties. We use a rheometer to measure the friction coefficient between the coated silicon wafers and a polydimethylsiloxane (PDMS) ball. Future research will involve developing a method to grow PDAEMA brushes on PDMS substrate, which is a biocompatible material.

Poster Number: 220

Analyzing Solar Energy Consumption And Generation Using Weather Data

Xiyuan Gao Mathematics and applied mathematics Jilin University

Mentors and/or Co-Authors:
Al Chen College of Management NC State University

Chinese National Energy Administration has reported that its solar power production more than doubled in 2016, hitting 77.42 gigawatts by the end of the year. China is now the world's biggest generator of solar-based electricity in terms of capacity. Currently solar energy represents just 1 percent of Chinese total power output but it is important to design effective approaches to integrate solar power into the current power grid. This research proposes to analyze the interaction of energy consumption and generation of individual households and buildings in order to minimize their dependence on the external power grid. First, the individual household’s daily electricity consumption is assumed to be solely dependent on the outside air temperature while holding the power efficiencies of all household appliances constant. Historical energy consumption and generation data will be used to formulate an equation for estimating future patterns. Given the daily electricity consumption and generation are weather dependent and changes during the day, the estimation equation will be used to build a real-time statistical model with stochastic factors to predict net energy generation for each household. This solar energy will be shared between neighboring households and building to reduce the stress on the power grid.

Poster Number: 15

Applying Alternative Materials To Reduce Sanitary Sewer Overflows

Xinyue Huang Environmental Engineering Tsinghua University

Mentors and/or Co-Authors:
Joel Ducoste College of Engineering NC State University
Caleb Lewis Biochemistry NC State University
Mahad Munawar Biochemistry NC State University

Fat, oil and grease (FOG) deposition in sewer lines has been the cause of up to 25% of the sanitary sewer overflows (SSOs), which exposes the public and the environment to health risks. Further, municipalities across the USA must spend billions of dollars annually for relevant maintenance. Researchers have shown that the mechanism of FOG deposit formation in sewer lines results from saponification reaction between long chain free fatty acids (LCFFAs) and calcium ion (Ca\(^{2+}\)) present in the wastewater. The corrosion of sewer collection system constructed by concrete materials is also a source of calcium besides background wastewater. The use of alternative binder material that could be incorporated into future concrete materials used to construct parts of sewer collection system can be an effective way to eliminate or reduce the calcium leaching from the corrosion process and to reduce the amount of FOG deposits in sewer lines. In this study, concrete made with traditional cement and alternative binder materials will be submerged in synthetic wastewater in the presence of LCFFAs and oil to determine its calcium leaching potential and to verify the hypothesis that alternative binder material that contains less calcium will lead to reduction of FOG deposits. At the end of the test, the amount of FOG deposits formed on two different materials will be measured using total solids standard methods. Fourier Transform Infrared (FTIR) spectrometer analysis will also be used to determine the fatty acid profile of the FOG deposit.
Combing Data Visualization And Social Network Analysis For The Study Of Interactions In An Engineering Course

Zhuojun Huang Information Engineering Zhejiang University
Mai Ke Civil Engineering Zhejiang University
Yi Ren Automation Beijing Institute of Technology

Mentors and/or Co-Authors:
Kevin Han College of Engineering NC State University

This research focuses on studying interactions and communications between students within a new course structure. Parsing JSON files from SLACK—a communication software used in the course and applying Neo4j—a graphic database to visualize data, several graphic models are established to provide an explicit and straightforward way to show information and represent data. Two analytical methods are used during the process of study: social network analysis (SNA) and natural language processing (NLP). The SNA focuses on the time and manner in which the communication occurs, while the NLP tracks the communication in chronological order by analyzing the message content and finding the keywords. From the methods above, the following aspects are investigated: (a) the interaction patterns between members of a team. (b) interaction patterns within a channel between different teams (c) changes of interactions along with different time stages. (d) the type and frequency of messages sent by individuals in one channel (either their own or another). The case study presented in this paper provides an example of how visualization database, SNA and NLP are used to capture and analyze characteristics of educational social networking between students from a certain course in North Carolina State University. In addition, it provides an innovative method of analyzing social network between individuals.

Intelligent Traffic And Communication With Ev3

Qingyuan Jin Vehicle Engineering Beijing Institute of Technology
Ki Jia Electrical Engineering Zhejiang University

Mentors and/or Co-Authors:
Mo-Yuen Chow College of Engineering NC State University

The objective we are focusing on is a Lego robot with three color sensors, two motors and an EV3 brick. The robot for research is a vehicle model built by ourselves. An EV3 brick is a robotic controller just like a brain of robots used for receiving command from base station (PC) and we fetch some data from OptiTrack. In this case, we will utilize those above as a basic platform and program in MATLAB/Simulink to achieve our goals. Our main goal is to design a PID tracking algorithm and use color sensors to realize path tracking, and deal with some complex situations in the intersection. The method we use to evaluate the tracking performance is Tracking Error Area per Second (TEAS). The second goal is fetching data from OptiTrack and design a MATLAB GUI displaying the location and orientation in real-time. Once two goals above are realized, we can expand the model to real engineering problems such as intelligent traffic, which will definitely decrease the number of traffic accidents and make our traffic safer. What’s more, with Optitrack or GPS and the programmed controller of the driverless car, we can assume that everyone can just send their destinations to the base station and close their eyes without any consideration of traffic accidents.

Real-time Energy Audit Of Built Environments: Simultaneous Localization And Thermal Mapping

Mai Ke Civil Engineering/Public Management Zhejiang University
Zhuojun Huang Information Engineering Zhejiang University
Yi Ren Automation Beijing Institute of Technology

Mentors and/or Co-Authors:
Kevin Han College of Engineering NC State University

Recently, Fusing SLAM and thermal sensing have become more practical for construction environment. It can be applied in detecting potential dangerous areas which can lead to a much safer construction environment and a lower life-cycle cost. SLAM (simultaneous localization and mapping), the core technique of the project, is a real-time vision-based
technique which can extract visual data from camera. By combining SLAM with thermal mapping, the SLATM (simultaneous localization and thermal mapping) could be used to locate the position of the camera, estimate pose of the camera and map the environment in real-time in 3D. Then our next step is to collect image sequences of a building and test the purposed methods by using RGB+thermal cameras through FLIR Duo and FLIR VUE with regular camera then compare the data in different sets. The current status is that the selected building is symmetric-like which causes some captured faces of the shape are incorrect estimated. In order to solve that, we need to reselect a building to collect data and analyze it in VisualSFM program to find whether the purposed methods work or not. The potential result shows the possibility of using SLATM in civil infrastructures in detecting and analyzing conditions of building through thermal mapping.

Poster Number: 155

**Design Of Image Annotation Interface For Pose Estimation, Image Segmentation And Attribute Labeling**

Ao Li *Electronic Engineering* Beijing Institute of Technology  
Daotong Zhang *Mechatronic Engineering* Beijing Institute of Technology  
Xiaoyu An *Electronic Engineering* Beijing Institute of Technology  

**Mentors and/or Co-Authors:**  
Tianfu Wu College of Engineering NC State University  
Memoree Blackmon *Food Science* NC State University  
Lisa LaFountain *Food Science* NC State University  
Yiliang Cheng *Food Science* NC State University  
Mike Draper *Food Science* NC State University  

The project is to investigate a model for joint human body parsing, attribute recognition and action recognition. It consists of two sub-tasks: one is to augment an existing human pose dataset (the MPII human pose benchmark) with attributes annotated, and the other is to build on top of a baseline human parsing model to incorporate attribution and action recognition. The MPII dataset is a state of the art benchmark for evaluation. To achieve the former, we will develop an easy-to-use annotation interface to collect training data. This interface allows users to manually annotate the image and create the dataset on PC. It is written in python language and uses PyQt4 as its graphical interface. For the latter, we will simply incorporate attribute and action classification losses branch in the existing human parsing model which applies a bottom-up method to estimate the pose of people in an image frame via PAF and the confidence maps of different body parts.

Poster Number: 199

**Rapid Detection Of Cyanotoxins With Paper Devices And Mobile Phone-based Readout**

Wanru Li *Chemistry* Jilin University  

**Mentors and/or Co-Authors:**  
Qingshan Wei College of Engineering NC State University  

Cyanotoxins are an increasing problem in aquatic environments, since they can reach human and other animals through drinking water. Hence, there is a growing need for rapid and field-applicable detection methods for these toxins. Toxins can routinely be tested in the lab with samples taken from the field using mass spectroscopy; however, for immediate tests, portable devices are needed to enable detection on site. My research project will focus on developing a portable paper device to detect cyanotoxins such as cylindrospermopsin (CYN) from environmental water samples. The paper device runs a fluorescent aptamer assay specific to CYN. We first aim to test the feasibility of the aptamer assay in solution by tuning binding buffer and DNA aptamer to SYBR Green (a fluorescent intercalating dye) ratios. Then, the aptamer-based capturing ligand will be immobilized on the paper devices and the performance of the paper-based aptamer assay will be optimized. A hypothesis of the working principle of the aptamer assay is that the intensity of fluorescence will decline as the concentration of toxin increases due to competitive binding between CNY and SYBR Green to the aptamer sequence. If successful, a mobile phone-based fluorescent reader will also be developed to enable detection and quantification of cyanotoxins directly in the field.
Interaction Of Email Use And Persuasion Tactics In Email Phishing Attacks

Ziyue Liang  
*Applied Psychology*  
Zhejiang University

**Mentors and/or Co-Authors:**

Chris Mayhorn  
College of Humanities & Social Sci NC State University

Phishing involves an attempt to gain sensitive information such as usernames, passwords and so on, often for malicious reasons, by camouflaging as an authentic entity in an electronic communication. Previous social science research has demonstrated an interaction between personality and persuasion tactics in the realm of email phishing (Lawson & Mayhorn, 2017; Uebelacker & Quiel, 2014). The current study was conducted to investigate whether there is an interaction between the usage of email and performance during an email identification task where participants had to identify phishing and legitimate emails. Email messages used in the identification task utilized some combination of Cialdini’s persuasion principles (see Zielinska, Welk, Mayhorn, & Murphy-Hill, 2016 for more information on stimuli used). Data was collected to quantify participants’ usage of email as well as thirteen aspects of the users’ computing habits. Results indicate that some habits of using email are predictive of increased susceptibility to phishing attacks (i.e., poor ability to identify phishing emails in the identification task). For instance, frequency of email usage and the use of email rules are correlated with participants’ ability to discriminate between phishing and legitimate email messages. Moreover, efforts to analyze the relationship between users’ habits and their susceptibility to different persuasion principles revealed that frequency of email usage was related to falling for messages that used authority and scarcity as persuasion tactics.

Hunting For Evidence On The Value Of Game Lands

He Liu  
*Applied Economics*  
The Chinese University of HongKong (Shenzhen)

**Mentors and/or Co-Authors:**

Erin Sills  
College of Natural Resources NC State University

James Homiller  
*Biological Engineering*  
NC State University

Anneliese Vendel  
*Biological Engineering*  
NC State University

The North Carolina Wildlife Resources Commission (WRC) manages “game lands” throughout the state primarily to provide opportunities for hunting, trapping, and fishing. These game lands also offer other use and non-use values for visitors and nearby residents. However, the value of ecosystem services such as aesthetics, recreation opportunities, and clean water and air are difficult to quantify because they are not transacted in markets. The hedonic method is one way to infer these values from observable market transactions. Specifically, these non-market values should be reflected in the sales prices of houses located at different distance from game lands. I explore the feasibility of using the hedonic method to estimate the value of game lands by conducting (i) a systematic review of prior literature that has applied the hedonic method to the value of green space, (ii) exploratory analysis of data sets on housing prices and attributes obtained from different sources, and (iii) proof of concept of a hedonic pricing model for one game land in North Carolina.

Autonomous Vehicle Control Strategy On Lego Ev3

Zhihan Lu  
*Electrical Engineering*  
Tsinghua University

Chentao Wang  
*Vehicle Engineering*  
Jilin University

**Mentors and/or Co-Authors:**

Mo-Yuen Chow  
College of Engineering NC State University

Self-piloting is one of the most fundamental requirements for an intelligent automobile. The vehicles must precisely track the user's intentions and avoid road hazards automatically. A reliable self-piloting control strategy ensures the safety of both passengers and pedestrians. Generally, an intelligent automobile will navigate with the help of data acquired from several sensors (a range finder camera, sonar, etc.) attached to the automobile. At certain points, such as crossroads and crosswalks, the automobile needs to stop to check the surroundings and pass through after traffic has cleared in order to avoid accidents. In our research, we used LEGO EV3 as our experimental platform and developed a control strategy design based on PID control and finite-state machine. We downloaded the control strategy to our intelligent vehicle to provide path tracking, platooning and intelligent driving controls. Experiments were then conducted under different situations to demonstrate the accuracy, reliability and rapidity of the proposed control strategy.
Nowadays, people cast an increasing interest on the liquid metal properties for a wide range of applications in different fields. Liquid metals that intriguing people most are gallium or its alloys because of metallic and fluidic properties with low toxicity at room temperature unlike mercury, the most common liquid metal in our cognition, which evaporates easily at temperature and causes damage to human. However, liquid metals are still mysterious to public in some specific fields. One thing that we want to point out here is the wetting phenomenon of liquid metals between different substrates. The wetting phenomenon is extremely complex influenced by many parameters. There have already been experiments concerning contact angle while without control of different variables. Therefore, in our research, we dedicated to controlling variables to figure out what kind of role do these parameters play and find the optimal condition for the improvement of measurement. We test a more available liquid metal gallium-indium alloy called EGaIn (75 wt% Ga, 25 wt% In) to explore the wetting phenomenon using goniometer to test contacting angle on different substrates. Meanwhile, we test water’s contacting angle for a comparison between these two materials to figure out how the liquid metal contacts with different surfaces exactly. It can be put into use of equipments containing EGaIn to find a proper substrate to make a longer lifespan or a better adaption to the goal function as well as apply for 3D print on different materials using EGaIn.

Determining a person’s emotion based on physiological signals is a pattern recognition problem and has a variety of possible applications. For example, a wearable device with emotion recognition function may help to monitor an elder’s health state. The main challenge for this task is the physiological signal processing, and feature extraction and selection. Since physiological responses can be affected by the emotional state of an individual, it is reasonable to consider physiological signals as a way to predict the emotional state. A database, called HCI Tagging Database, of approximately 1,500 labeled 1-minute sessions collected from 30 participants is used for our analysis. This comprehensive database contains audio, video, gaze data and physiological data. We make use of the physiological data for this project. Electrocardiogram (ECG), Electrodermal activity (EDA), Respiration and Skin Temperature signals are analyzed and several features are extracted from those signals. A classifier is trained to classify emotional state based on these features. In this project, we hope to determine the most suitable features for classifying emotional state and develop an effective method of extracting features.

Clustering is a fundamental problem in data analysis. Convex clustering is very useful when we identify structure in high-dimensional data. However, there exists a problem that when we deal with high-dimensional data, the cost of storage and calculation is relatively high. In order to make convex clustering more efficient, it’s necessary to compress down the dimension of data. Using dimensionality reduction to reduce the problem of manipulating large data sets is very helpful. If n data points with p features are compressed down to ap features (where α ∈ (0,1)), which is equivalent to cluster n points just using ap features. In this context, random projection enables us to compress down the dimension
of data. Random projection can maintain the distance between data points so we can keep the most geometry of data. More specifically, two closer data points would be still closer, after random projection. There is a limit that if we compress down the dimension too much, clustering would break. In this context, we find out how much can we compress down, that is to find the suitable range of \( \alpha \). This would be helpful to an effective and efficient operation of convex clustering.

Poster Number: 219

**Analysis Of How Fashion Marketing Strategies Of Sustainability Affect Consumer Behavior**

*Lan Sang*  
*French and Business Administration*  
*Nanjing Normal University*

*Mentors and/or Co-Authors:*  
*Al Chen*  
*College of Management NC State University*

Business sustainability, also known as corporate sustainability, is the management and coordination of environmental, social and financial demands and concerns to ensure responsible, ethical and ongoing success. As more people embrace sustainability, the fashion industry must consider how to minimize the environmental footprint of their business operations. It is imperative for companies to understand their sustainability conscious target customers before setting up effective marketing strategies to showcase company’s sustainability initiatives and performance. In this project, we investigated a range of five sustainability strategies based on a consumer survey conducted in China with the responses related to the issues that affect shopping decisions and the demographic data of 300 participants. This study proposes to identify how consumers respond to the brands that effectively communicate their sustainability program and accomplishment through their marketing strategies. Results of this study will be useful for companies to prioritize their sustainability initiatives and to promote their sustainability performance effectively to their customers.

Poster Number: 11

**Water Absorption And Thermomechanical Characterization Of Epoxidized Sis Block Copolymers**

*Jinzi Si*  
*Materials Forming and Control Engineering*  
*Jilin University*

*Mentors and/or Co-Authors:*  
*Richard Spontak*  
*College of Engineering NC State University*

In this work, the water absorption characteristics and thermomechanical properties of epoxidized poly(styrene-b-isoprene-b-styrene) triblock copolymers (ESIS) are studied. As a non-polar polymer, SIS shows resistance to water. In order to develop its function as sealing and water swelling, epoxidation is a convenient way to incorporate oxygen in the diene blocks to increase molecular polarity. By varying the degree of epoxidation (DOE), the water absorption characteristics and mechanical properties of ESIS can be controlled. A series of ESIS block copolymers differing in degree of epoxidation were prepared. Water absorption studies can be carried out in distilled water maintained at room temperature. The weight was measured after periodical intervals to find the influence of epoxidation degree on water absorption rate and swelling ratio of the materials. Mechanical properties measured via Instron can be carried out to measure the stiffness(elastic modulus), tensile strength, and ductility as a function of both DOE and water absorption. In general, as the degree of epoxidation increases, the water absorption characteristics of ESIS are enhanced, as well as the repeated water absorption. Understanding the effect of water is an important parameter for utilizing these materials as swellable coatings, etc.

Poster Number: 260

**Classifying The Green Bonds Issuers Using Fcm Clustering Algorithms And Discriminant Analysis**

*Yuqi Su*,  
*Statistics*,  
*Jilin University*

*Mentors and/or Co-Authors:*  
*Al Chen*  
*College of Management NC State University*

Green bond is a win-win for investors and the organizations to fund projects that have positive environmental benefits. Through Green Bonds, borrowers have more access to capital for sustainability-related projects, which are environmental-friendly to the environment, and branding opportunities as well as positive publicity. And for investors, less risk is exposed. Currently, most reports mainly describe the transaction outcomes of Green Bonds, and few of them focus on analyzing the issuers of Green Bonds. This research project proposes to perform principal analysis of selected
variables such as amount issued and credit ratings of issuers using the Q-type cluster analysis with FCM clustering algorithms and the data from database “Climate Bonds” and “Standard&Poor’s”. Next, the Green Bonds’ transaction data of institutions in North Carolina such as Asheville City and Apple’s iCloud data centers in North Carolina will be used to validate the rationality of the result of cluster analysis via discriminant analysis. Recommendations will be provided to Green Bonds issuers for promoting sales. The results of the study will help investors make informed decision in Green Bond investment.

Poster Number: 244

**A Preliminary Analysis Of Tip Wear Process**

**Yujie Sun** Control Science and Engineering Zhejiang University

*Mentors and/or Co-Authors:*

**Jingyan Dong** Engineering NC State University

In order to study the features of the tip wear process, several mathematical models will be proposed to detect tip wear both qualitatively and quantitatively based on the data obtained in the experiments. In the first model, the maximum patterns available under different machining conditions which consist of different set point forces and varied feed rates. In the second model, the relationship between set point force, feed rate and pull-off forces will be purposed which represents the ability of tips to wear patterns, and the whole process will be divided into initial tip wear region and tip failure region. In the third model, the features of the initial tip wear region and the whole region will be compared and the efficiency of tips under different conditions will be studied.

Poster Number: 198

**Transparent Paper Devices For Point-of-care Molecular Diagnostics**

**Ying Tan** Polymer materials and engineering Zhejiang University

*Mentors and/or Co-Authors:*

**Qingshan Wei** College of Engineering NC State University

Paper-based devices offer unparalleled simplicity and cost-effectiveness for sensing and molecular diagnostic applications ranging from human physiological analyte detection, agricultural sensing, environmental testing, and product quality evaluation. However, the detection sensitivity remains the main challenge for all paper-based assays. Here, a transparent paper device is developed based on a simple chemical treatment with surfactant solutions. The transparency will greatly enhance the signal-to-noise ratios of assay signals developed on the paper by reducing background noise level including autofluorescence and nonspecific scattering. Streptavidin (SA) and biotinylated gold nanoparticles (GNPs) will be used as a model system to demonstrate the feasibility of transparent paper devices for diagnostic applications. The streptavidin with gold nanoparticles will be immobilized onto the nitrocellulose membrane (NC membrane) following three different methods: (1) direct absorption onto untreated NC membrane, (2) SA binding to glutaraldehyde modified NC membrane, (3) covalent attachment of thiolated SA on an epoxide-functionalized NC membrane. Afterward, transparency of NC membranes will be enhanced by treatment with Triton X-100. For quantitative assessment of enhancement of detection sensitivity, gray values of the color change of treated and nontreated paper substrates will be measured by using a benchtop microscope. Taken together, this work provides a rapid, portable, and quantitative transparent paper devices with much-improved detection sensitivity which is suited for a variety of point-of-care diagnostic applications.

Poster Number: 145

**Abnormality Detection Using Graph Wavelet Analysis In Heterogeneous Networks**

**Yuanzhe Tian** Electronic and Information Engineering Beijing Institute of Technology

*Mentors and/or Co-Authors:*

**Huaiyu Dai** College of Engineering NC State University

Differentiating epidemics from random failures is one of the trending topics in network analysis. Given a set of infected nodes in a network, the goal is to decide whether the source of the infection is an epidemic or random failure. The differentiation between epidemics and random failures becomes harder when the situation of the nodes can be affected by false positives and false negatives. On the other hand, determining the causality of network abnormalities is necessary
for developing appropriate countermeasure in order to control and handle the infected nodes. In this work, we use the tools from graph wavelet analysis for the problem in hand. We study heterogeneous random graphs in which the edges are arbitrarily weighted. The goal of the research is to determine characteristics of graph wavelet in the presence and absence of epidemics. We use graph wavelet vertex and graph wavelet spectral designs to differentiate epidemics from random failures. Using these two approaches, we propose a statistical algorithm in order to differentiate epidemics from random failures. The performance is evaluated in terms of the probability of detection which reflects the precision of the algorithm. This study is a follow up of the work in which epidemic detection is studied in heterogeneous networks using graph Fourier transform and spectral graph analysis.

Poster Number: 223

**Analysis Of Stability Of Convex Clustering**

**Han Wang** Statistics Zhejiang University  
*Mentors and/or Co-Authors:*

**Eric Chi** College of Sciences NC State University

Hierarchical clustering is a common method to find clusters, however, it is sometimes local minimal rather than global. Properties of convex function lead to the idea that convex clustering is an effective way to obtain the global minimum. To implement convex clustering is to minimize a penalized loss function, which consists of a quadratic term reflecting distances between each data point and its assigned cluster center and a regularization term reflecting distances between these centers. Convex clustering possesses several advantages yet we don’t know how stable it is. The goal of this project is to analyze the stability of convex clustering method using R code. R package ‘cvxcluster’ by Eric C. Chi et al. is used for calculating cluster centers. First, we hypothesize that datasets are generated from the same underlying model, then try to generate perturbed versions of datasets from two perspectives: (1) adding random noise to the original data points; (2) using sub-sampling of high-dimensional data to obtain different random projection in low-dimensional spaces and then cluster the low-dimensional datasets. Secondly, we compare the clustering result of perturbed datasets with the original one by calculating distance scores between these clusters. We then use histogram and other plots to implement data visualization and analysis. If the clustering algorithm is stable, it would obtain similar results despite of perturbation. Stability is an essential property of clustering method when put into application. Furthermore, we will apply this clustering algorithm to several datasets from UCI Machine Learning Repository to test the effect.

Poster Number: 17

**A Chip Device For Rapid Plant DNA Extraction**

**Jiaqi Wu** Chemistry Jilin University  
*Mentors and/or Co-Authors:*

**Qingshan Wei** College of Engineering NC State University

The demand for rapid and on-site diagnosis of plant diseases in the recent years drives us to develop portable devices for pathogen detection. The success of the point-of-care diagnostics of plant diseases depends on rapid identification of the pathogen DNA from infected plants. Current pathogen DNA extraction technology from infected plant leaves is a complex multistep process due to the presence of polysaccharide cell walls and therefore is only applicable in laboratory settings. In this study, our primary goal is to miniaturize the conventional Cetyl trimethylammonium bromide (CTAB)-based plant DNA extraction technology onto a portable chip device for quick identification of the pathogens on site. The first step for conventional plant DNA extraction protocols is to mechanically grind the samples using mortar and pestle to break the rigid cell walls. Therefore, our current focus is to develop an alternative plant cell lysing mechanism which can be performed on a chip. We will explore sonication and vortex based mechanical disruption of plant leaves for this purpose. By comparing effects of different beads diameter which beat the samples during sonication or vertexing, ultrasonic energy and other conditions, we will eventually find the optimum conditions required for miniaturization. We will eventually design and fabricate a microfluidic chip that is capable of on-site diagnosis of single or multiple plant diseases in five minutes.

Poster Number: 270

**Reconstructed Discontinuous Galerkin Methods For 1d Time-dependent Hyperbolic Diffusion Equations**

**Zhenfei Wu** Physics Jilin University  
*Mentors and/or Co-Authors:*

Poster Number: 60

2017 NC STATE UNIVERSITY SUMMER UNDERGRADUATE RESEARCH SYMPOSIUM
Hong Luo College of Engineering NC State University

This project aims to develop reconstructed discontinuous Galerkin (rDG) methods to solve 1D time-dependent diffusion equations based on a first-order hyperbolic system (FOHS) formulation. With FOHS, the diffusion problem would be transformed into a first-order hyperbolic system that yields the same steady solution as the original equation in pseudo time. The developed hyperbolic rDG methods would have the same degrees of freedom as the conventional DG methods. Both hybrid least-squares reconstruction and variational reconstruction have been implemented to deliver high order numerical solutions while keeping total degrees of freedom relatively small. A dual time stepping strategy is adopted for unsteady problems. A number of test cases are presented to assess the accuracy and performance of the newly developed hyperbolic rDG methods. Also, the k-exactness property of the reconstruction schemes has been verified. Numerical experiments demonstrate that the presented schemes are able to obtain the designed optimal order of accuracy for both solutions and their derivatives, indicating that the developed hyperbolic rDG methods provide an attractive and probably an even superior alternative for solving the diffusion equations. Future work would be focused on extending the hyperbolic rDG methods to multi-dimensional problems, such as advection diffusion equations and eventually Navier-Stokes equations on fully unstructured grids.

Poster Number: 274
A Discontinuous Galerkin Scheme For Solving One-dimensional Total Lagrangian Gas Dynamics Equations
Jiacheng Xu Information and Computing Science Zhejiang University
Mentors and/or Co-Authors:
Hong Luo College of Engineering NC State University

There are different viewpoints on the fluid flow phenomenon. Eulerian and Lagrangian formulations are two common approaches to describe the motion of the gas dynamics. Eulerian method has been investigated extensively in the literature. The Lagrangian method is especially suitable for tracking the material interface. In this work, a total Lagrangian formulation is investigated for solving the conservation of mass, momentum and total energy of the flow material, in the sense that the spatial derivatives of the resulting equations are discretized on the reference frame (initial configuration), in contrast to the update Lagrangian formulation whose spatial derivatives are expressed in terms of the physical time-dependent coordinates. The high-order discontinuous Galerkin (DG) method is used for the spatial discretization. In this work, the Taylor basis is chosen for the DG method in consideration, and the solution of the semi-discrete equations is advanced by the Runge-Kutta temporal scheme. The resulting method is employed to solve the one-dimensional test cases, e.g., the Sod shock tube problem, to validate its performance.

Poster Number: 248
Improving Emotion Detection By Combining Multiple Camera Views
Shuo Yang Electronic Engineering Zhejiang University
Mentors and/or Co-Authors:
Edgar Lobaton College of Engineering NC State University

Emotion detection from facial expression can be applied to a number of fields such as education, gaming and monitoring. For example, it can detect a driver’s emotional state. If the driver is angry or scared, then the car can stop or remind the driver to relax. It could even alert other cars around it if needed. Most emotion recognition algorithm are trained and tested using frontal face views. However, in real-life applications, facial expression and emotions may need to be detected from various angle. So we will improve the performance for non-frontal face by using a model trained from 4 different angle. As part of this project, we develop a pipeline for processing camera video feeds, which can be used in a variety of smart devices. We make use of the Affectiva SDK in order to obtain emotions from video feed, including values for joy, sadness, disgust and so on. The application is tested using the HCI-tagging database. We analyse the percentage of time that the face is properly detected, and the consistency of the emotion detection. According to the emotion metrics from 4 different angles, we train a model to improve the performance mentioned above.

Poster Number: 228
Explore The Impact Of Reward Functions On Reinforcement Learning Induced Policies
Jiaying Yao  
Electrical Engineering and its Automation  
Zhejiang University

Mentors and/or Co-Authors:
Min Chi  
College of Engineering NC State University

Reinforcement Learning (RL) is one of the most effective machine learning methods for decision making in interactive environments such as Intelligent Tutoring Systems (ITSs). Previous researches have concluded that the pedagogical policy induced by RL can significantly improve students’ learning. While most of the previous research used the student learning gains as reward function and in this proposed project, we will explore both learning gains and learning efficiency. The purpose of this project is to evaluate the induced policy from two different aspects by investigating two types of reward functions: Learning Gains (LG) and Learning Efficiency (LE). We will apply RL to the datasets collected in an ITS called Deep Thought (DT) using the Markov Decision Process (MDP) framework to generate the optimal pedagogical policy using policy iteration. We will explore whether the RL-induced policies using LG as rewards will agree with those using LE as rewards. In other words, whether the instructional interventions that would improve student learning gains would be the same as those that would also improve students learning efficiency. And further applications in educational fields may be discovered in MOOCs.

Poster Number: 30

Robustness Analysis And Improvement For Interdependent Networks
Guoqiang Zeng  
Electrical Engineering and Automation  
Zhejiang University

Mentors and/or Co-Authors:
Huaiyu Dai  
College of Engineering NC State University

Recently, analysis of interdependent networks which considers the interaction between complex networks has become an emerging field of study. There exist many open challenges which need solutions in this area including robustness analysis, modeling the cascade of failures, designing metrics for network connectivity, etc. In the literature, most of these challenges are well-investigated in single layer networks; however, there are still many open problems in multilayer networks. Hence, in the light of these works, the challenges above can be addressed for interdependent networks with major modifications. One of the critical characteristics of the networks is the network connectivity. In graph theory, the second smallest eigenvalue of the graph Laplacian matrix is called algebraic connectivity, which can be considered as a metric for connectivity evaluation of networks. The better the graph is connected, the larger the algebraic connectivity is. In this regard, one interesting problem is to find the best place to add an edge in the network in order to maximize the increase in the algebraic connectivity. In this summer research project, in the light of the proposed methods in the single layer networks, we aim to employ and modify the existing mathematical algorithms and tools in the literature and apply them on interdependent networks for robustness improvement. The goal is to get some insights about the configuration of interlinks that maximizes the algebraic connectivity. In our simulations, we will use Python which is a suitable tool for network modeling.

Poster Number: 9

Privacy-aware Collaborative Idss-a Random Walk Based Approach
Yanping Zhang  
Electrical & Computer Engineering  
Jilin University

Mentors and/or Co-Authors:
Huaiyu Dai  
College of Engineering NC State University
Tanya Ansari  
Bioprocessing Science  
NC State University

With the rapid development of hacking tactics, Internet intrusions have become much more sophisticated and harder to detect, which renders the performance of the traditional Intrusion Detection Systems (IDSs) rarely satisfactory. Aiming to improve the overall detection performance, Collaborative IDSs (CIDSs), in which a group of IDSs collect and share their detection knowledge, have been proposed in literature. However, in the information sharing process, privacy concerns arise. For example, the adversary can easily infer the configuration of an IDS based on its detection result and explore the potential vulnerability. With such consideration, a random walk based approach is proposed to preserve the identity information of the collaborative IDSs, which makes it difficult to identify the source of the shared detection results for the adversary. However, along with the benefit of privacy preservation, the overall detection performance may degrade since the detection results are indistinguishable to the IDSs either. In this summer research project, we explore the trade-off between the detection performance and the privacy preservation in the proposed scheme. Simulations are
conducted to validate the analysis, and evaluate the effectiveness of the proposed approach.

Poster Number: 28

**Network Analysis Of Virus-innate Immune Interaction Within A Host**

*Zhihao Zhang*  Information Engineering Zhejiang University

*Mentors and/or Co-Authors:*

*Ruian Ke*  College of Sciences NC State University

Epidemic spreading in a human population has been extensively studied over the past few decades. However, a formal theoretical model for the virus spreading process within a human body is still lacking. Viruses replicate and spread from cell to cell and from tissue to tissue. In response, infected host cells produce interferons, part of the innate immune response, that act as messenger molecules to induce antiviral defense mechanisms in neighboring cells. This summer research project seeks to formulate a model by taking both the virus spreading and the immune reaction process into consideration. We represent the interaction between virus and the innate immune response at the inter-cellular and the inter-tissue level through graph models, including the Caveman graph and geometric random graph. The well accepted SIS/SIR epidemic model is adopted and modified to describe and analyze the two competing processes – virus spreading and immune reaction. MATLAB programming is used to simulate our modeling. Through simulation, we will investigate the impact of key parameters for the network characteristics, including those representing the interconnection structure and spreading rates, on the virus spreading behavior and final steady state, and attempt to propose treatment guidelines to keep the final infection outcome under control.
ICE - Interface of Computations and Experiments Chemistry

Poster Number: 94
Analyzing The Parent Compounds Of Drugs And Their Metabolites To Predict Human Leukocyte Antigen Interactions
Nyree Baldwin Cheminformatics NC State University
Mentors and/or Co-Authors:
Denis Fourches College of Sciences NC State University

When a certain patient consumes a prescription drug, they can develop severe adverse drug reactions (ADRs). According to the FDA Adverse Event Reporting System (FAERS), over one million cases of ADRs were observed in 2014. Human leukocyte antigen (HLA) surface proteins are directly involved in adverse drug reactions. By taking the metabolites of 14 prescription drugs, and the HLA structure we perform a chemoinformatic study to better characterize the drug-interaction with the HLA system. First, we performed a literature search of all of the parent drug scaffolds to find their altered structures, or metabolites. Then using different X-Ray structures from the most common HLA protein variant structure, HLA-B*57:01 we performed, using Schrodinger Suite, docking simulations combining metabolite and HLA structure. From the literature search sets of 11 to 40 metabolites were extracted by drug and then docked on HLA protein structure. For each case, interacting profiles were computed and analyzed. Including metabolites in HLA docking analysis provides an important understanding of the binding mechanisms. In a long term goal, better understanding HLA interaction and the metabolite dependences, could open new trails to develop drugs with less ADRs.

Poster Number: 181
Acidity And Hydricity Of Rhenium (v) Hydride Complexes By Computational And Experimental Methods
Gregory Curtin Chemistry NC State University
Mentors and/or Co-Authors:
Elon Ison College of Sciences NC State University

In this study the acidity (pKₐ), and hydricity for several rhenium (V) hydride species was investigated both computationally and experimentally. Computational calculations were implemented via the Gaussian09 software package where all calculations were done using density functional approximation techniques (M06) with a 6-31G(d,p) basis set for optimizations and with a larger 6-311++G(d,p) basis set for energy calculations. Values obtained in these calculations were then used to calculate the pKₐ and hydricity of each species. A few of the complexes were then produced experimentally in order to test and verify the level of accuracy of the computational approach. The two rhenium hydride complexes chosen for the experimental study were (R)BuHozRe (Hoz = oxazolinylphenolato) and (PPh₃)₂(0)(I)ReOsiPh₂CH₃. Each complex was confirmed by 'H NMR spectroscopy and possibly other methods such as X-ray crystallography. pKₐs were determined by titration experiments in order to compare with the theoretical results ΔG values for acidity and hydricity were used to find a correlation between natural bond order (NBO) partial charge and the ΔG values in order to reduce the total number of calculations needed and therefore the overall cost to accurately estimate the pKₐ and hydricity of any rhenium (V) hydride complexes.

Poster Number: 108
Uyen Dao Chemistry NC State University
Mentors and/or Co-Authors:
Melissa Pasquinelli College of Textiles NC State University
Doha Medani Applied Nutrition NC State University

Water repellency is a property that is commonly desired in the textile industry. The current prevailing approach to making a textile repel water is to treat it with hydrophobic chemicals, such as fluorocarbons that contain a carbon backbone with fluorine atoms attached. One of the most commonly used fluorocarbon chemicals are those with 8 carbons in the backbone, called C8; an example of which is perfluorooctanoic acid (PFOA). Although fluorocarbons
provide excellent repellency against a variety of liquids including water and oils, there are some health concerns about their use due to their persistency inside the human body and in the environment. Thus, some of the chemicals are being banned by some countries, including C8. An alternative to C8 is a fluorocarbon with only 6 carbons in the backbone, called C6, such as perfluorohexanoic acid (PFHxA). We will discuss the results of some molecular dynamics (MD) simulations that compare the differences in repellency of a C8 versus C6 surface for a series of liquids: water, methanol, dodecane, and vinegar.

Poster Number: 268

Synthesis And Conformational Analysis Of Peptoids Containing Hydrazone And Hydrazine Side Chains

Carolynn Davern Chemistry NC Wesleyan College
Mentors and/or Co-Authors:
Caroline Proulx College of Sciences NC State University

Peptoids are a class of peptidomimetics in which the side chain is bonded to the backbone nitrogen instead of the α-carbon, giving N-substituted glycine oligomers. Compared to peptides, peptoids exhibit increased resistance to peptidases, making them promising leads as drug candidates. However, these peptide mimics possess greater flexibility than their peptide counterparts because of the lack of chiral center and backbone hydrogen bond donor. To restrict conformational freedom in N-substituted glycines, incorporation of cis- and trans-inducing side chains have been reported. For examples, N-(aryl)-, N-(hydroxyl)-, N-(alkoxy)-, and N-(acylhydrazide)-glycine monomers have all been shown favor ω ~ 180°. However, synthetic difficulty has hampered the incorporation of N-(amino)glycines in the past. Here, we demonstrate the use of benzaldehyde hydrazone as a submonomer in peptoid synthesis for the first time, yielding eight different “sandwich sequences” alternating between various alken and benzaldehyde hydrazide side chains in 46-93% crude purities. Additionally, peptoid monomers and dimers which possess amino functional groups were modeled computationally with Gaussian 09 software. Bond angle preference was predicted for monomers and dimers and Ramachandran plots were built for dimers. An optimized dimer with two NH2 side chains was found to prefer an ω angle of 174.7°, which is similar to the previously reported trans preference in an N-(phenyl)glycine dimer. Ramachandran plots indicate which combinations of ψ and φ dihedral angles in the dimer are preferred, providing insight into what type of secondary structures may be reinforced with these monomers.

Poster Number: 55

The Synthesis And Photophysical Properties Of Perinone Coordinated Rhenium(i) Complexes

Tanner Kimberly Biochemistry and Physics Sonoma State University
Mentors and/or Co-Authors:
James Yarnell College of Sciences NC State University
Ian Sprague Nuclear Engineering NC State University
Josh Morsell Nuclear Engineering NC State University
Quincy Bryant Nuclear Engineering NC State University
Margaret Buschmann Nuclear Engineering NC State University
Micah Tillman Nuclear Engineering NC State University

A series of novel chromophores have been synthesized by attaching various perinone chromophores with the requisite diimine moiety (L-L) to a Re(I) tricarbonyl dimethylaminopyridine complex, forming the general [Re(L-L)(CO)3(dmap)](PF6) structure. The photophysical properties of the chromophores were studied using electronic, time-resolved emission, and transient absorption spectroscopies. The use of perinone ligands resulted in low energy ligand-centered transitions being observed in addition to the metal-to-ligand charge transfer transitions normally seen in these types of complexes. Additionally, density functional theory calculations were performed to elucidate the overlapping contributions from the metal-to-ligand charge transfer and ligand-centered excited state transitions observed in the electronic spectra. Relative to the model complex, [Re(phen)(CO)3(dmap)](PF6), these molecules exhibit lower energy absorbances, with similar emission and excited state lifetimes.
Integrating Computational Chemistry With Photoinduced Synthesis Of Thiazolines

Marina Michaud Chemistry Georgia Southern University

Mentors and/or Co-Authors:
Joshua Pierce College of Sciences NC State University

Nitrogen heterocycles represent an integral scaffold of biologically active natural products. More specifically, thiazolines are nitrogen heterocycles characterized by an additional sulfur heteroatom and one degree of unsaturation within their five-membered ring structure. Thiazoline-containing natural products have been shown to possess an array of pharmaceutically applicable properties such as anticancer (curacin A and largazole), antimicrobial (martiapiptide A), and antiviral (thiagazole) activity. Furthermore, thiazoline moieties can be utilized to access a variety of other common functional groups such as aldehydes, ketones, thiazoles, thiazolidines, amino alcohols, and amino thiols, and they have been employed as chiral ligands in stereoselective catalysis. Due to the expansive versatility of thiazolines, we seek to develop novel reactions to access these scaffolds with an approach that utilizes photochemical processes. We have employed a range of photocatalysts and photosensitizers to cyclize S-allyl-O-alkyl thiocarboxylic acid derivatives via iminyl radical intermediates produced by the homolytic cleavage of the weak N–O bond. Theoretical studies using density functional theory (DFT) were integrated into the synthetic strategy by predicting relative N–O bond dissociation energies among the substrate scope of oxime ethers and esters.

Poster Number: 234

Use Of Aryl Methyl Sulfones For Divergent One-carbon Functionalization Reactions

Hector Munoz-Miro Chemistry University of Puerto Rico at Rio Piedras

Mentors and/or Co-Authors:
Vincent Lindsay College of Sciences NC State University

This research project seeks to utilize aryl methyl sulfones as synthetic precursors of one-carbon functionalized arenes via spiroepisulfone intermediates. The advantage of such an approach resides in its synthetic divergence, relying on the initial formation of a benzylic electrophile via a dearomative Ramberg-Bäcklund Rearrangement (RBR). This electrophile is then capable of reacting with a wide array of nucleophilic reagents, including hydrides, fluorides, alkoxides, amides, thiolates and electron-rich aromatics. Using this strategy, libraries of one-carbon functionalized products will thus be obtained from a single substrate. Different α-leaving groups on the sulfone substrate have been installed and experimentally evaluated in the targeted transformation. Computational chemistry allowed us to evaluate the viability of such a dearomative RBR and identify the ideal leaving group for the transformation to occur. In a medicinal chemistry context, this type of strategy would enable the rapid elaboration of compound libraries by simple variation of the nucleophile, eliminating the need to optimize the reaction conditions for each analogue.

Poster Number: 238

N-heterocyclic Carbenes As Ligands For Cu(i) Catalyzed Cycloaddition Reactions: Synthesis, Reactivity And Computational Studies

Christa Parrish Chemical Engineering NC State University

Mentors and/or Co-Authors:
Ana Ison College of Sciences NC State University

N-heterocyclic carbenes (NHCs) have found widespread use as organocatalysts as well as stable sigma donor ligands in organometallic catalysis. One of the most common methods of obtaining NHCs is to form them in-situ from their imidazolium salt precursors. Therefore the synthesis and reactivity of NHC precursors is of high interest. This project focused on the synthesis of a series of NHC imidazolium salt precursors; 1,3-bis (2,4,6-trimethylphenyl) imidazolium chloride (IMes×HCl, 1), 1,3-bis (2,6-disopropylphenyl) imidazolium chloride (IPr×HCl, 2), 1,3-bis (2,6-dimethylphenyl) imidazolium chloride (IXy×HCl, 3) and their subsequent coordination to Cu(I) to form the following (NHC)CuCl complexes (IMes)CuCl (4), (IPr)CuCl (5), and (IXy)CuCl (6). The catalytic activity of the complexes was evaluated in the regioselective cycloaddition of benzyl azide and phenyl acetylene to form 1-benzyl- 4-phenyl- 1H-1,2,3-triazole (7). Computational methods using Gaussian 09 were used to calculate the pKa values of NHC imidazolium salt precursors and compared to available literature pKa values. Calculations were done at the DFT/B3LYP level of theory using 6-311++G** basis set with two different solvation methods, IEFPCM and SMD. The pKa values of NHC
imidazolium salts are relevant to their reactivity as both organocatalysts and in the synthesis of organometallic catalysts.

Poster Number: 51
Mechanistic Studies Of Para-guaiacols As New Substrates For Dehaloperoxidase (dhp) From Amphitrite Ornata
Nicolette Sanders Chemistry Chicago State University
Mentors and/or Co-Authors:
Reza Ghiladi College of Sciences NC State University

Dehaloperoxidase (DHP) from *Amphitrite ornata* is an active oxygen-binding multi-functional hemoglobin. This catalytic marine globin can exhibit peroxygenase, oxygenase, and oxidase activities with various substrates such as haloindoles, nitrophenols, and pyrroles. Most recently, it was inquired on as to how DHP acts with p-guaiacols as its substrate. Using a combination of spectroscopic and spectrometric techniques (UV/vis, HPLC, LC-MS) paired with biochemical assays, we report here on the reactivity of DHP with this new class of p-guaiacol (4-methoxyphenol) substrate. When DHP was reacted in the presence of H$_2$O$_2$ with 2-nitro, 2-bromo, 3-bromo, and p-guaiacol, the substrate turnover was determined using HPLC, and major products were identified using LC-MS. Overall, the substrates reacted similarly with the ferric and oxyferrous forms of DHP with >90% turnover. Of the panel of controls and mechanistic probes used, 4-bromophenol was the only to cause a significant effect on turnover, causing a one-fourth decrease. Substrate binding studies and the pH-dependence of the reaction will also be presented. Using Density Functional Theory (DFT), reaction thermodynamics were studied and theoretical pK$_a$ values were calculated using B3LYP/6311G++ (d, p).

Poster Number: 16
Using X-ray Crystallography And Computational Techniques To Study The Structure Of 2,6-dimethyl- 1,4-dihydropyridine-3,5-dione
Dana Tate Chemistry Converse College
Mentors and/or Co-Authors:
Roger Sommer College of Sciences NC State University

2,6-dimethyl-1,4-dihydropyridine-3,5-dione is the product of the centuries old Hantzsch dihydropyridine synthesis. Two new crystal structures of this compound have been determined using x-ray crystallography. This compound forms both a hydrated and anhydrous structure depending on the water content of the solvent. Both display hydrogen bonding through the N-H group that knits the structure together. Computationally optimized structures were compared to the crystal structures, and the results show that the computational technique accurately reproduces the bonding arrangement in the core ring. Aside from 2,6-dimethyl-1,4-dihydropyridine-3,5-dione, the main compound of interest, derivatives of the compound coming from different side chains off of the core ring were studied as well. Further work also included studying the acid-base properties of the compound in water.

Poster Number: 85
Overexpression And Purification Of P.isnb And Elucidation Of P.isnb-catalyzed Reaction Mechanisms
Nicole Wagner Biochemistry Edinboro University
Mentors and/or Co-Authors:
Wei-chen Chang College of Sciences NC State University
Mary Yavelak Food Science NC State University
Allison Pitts Food Science NC State University
Allison Tepperberg Food Science NC State University
Weon-Deok Seo Food Science NC State University

The enzyme IsnB participates in vinyl isocyanide (isonitrile) biogenesis by catalyzing the conversion of the intermediate, an isocyanide derivative of L-Trp or L-Tyr, to the E isomer of the vinyl isocyanide product. P.IsnB, originating from *pseudomonas*, can be successfully overexpressed and purified in the laboratory for later use in vinyl isocyanide synthesis. The capacity of P.IsnB to be overexpressed is verified via small-scale overexpression of the protein from E.
coli cells transformed with the PET28a plasmid. Multiple 6-L expressions of P.IsnB are also carried out successfully, yielding cell pellets of up to 51.18g mass when induced with 1 mM IPTG. After purification, P.IsnB obtained from 6-L expression is successfully concentrated to above 1 mM, as determined by UV-Vis spectroscopy. Simultaneously, computational experiments are carried out with Gaussian 09 in order to study a model system representing the reaction catalyzed by IsnB. In the model reaction mechanism, one of two possible hydrogens is transferred as a hydride from the isocyanide intermediate to N-methylnicotinamide. Information elucidated via computational methods includes transition state structures and thermodynamic data (in terms of internal energy, enthalpy, and Gibbs free energy) for the transfer of each hydride.

Poster Number: 129

The Role Of Redox Non-innocence In A Co-based Nitrate Reduction Electrocatalyst

Gabrielle Ware Biochemistry St. Edwards University

Mentors and/or Co-Authors:
Elena Jakubikova College of Sciences North Carolina State University

Significant levels of nitrate in ground water can be harmful to human health. Existing nitrate removal processes are expensive, therefore it is important to find affordable methods to control nitrate levels. To this end, density functional theory (DFT) calculations were performed using the B3LYP+D2 functional on a promising homogeneous nitrate reduction electrocatalyst, Co(DIM) [DIM = 2,3-dimethyl-1,4,8,11-tetraazacyclotetradeca-1,3-diene]. Unlike other similar Co-based electrocatalysts, Co(DIM) is capable of completely reducing nitrate to ammonia, as opposed to stopping the reduction at harmful intermediates such as nitrite and hydroxylamine. DFT was used to analyze structural and electronic features of potential mechanisms for the initial reduction of nitrate to nitrite, and these results yielded many insights as to the success of the catalyst in reducing nitrate. One important feature of Co(DIM) is the role of redox non-innocence, as the DIM ligand itself is capable of acting as a reservoir for electrons at critical points in the mechanism, potentially mitigating the formation of a highly reduced metal center. In addition to DIM, lowest energy pathways for nitrite formation show formation of an unusual low-valent Co-oxyl radical species. It appears that the flexibility of the DIM ligand plays an integral part in the mechanism as well. By folding DIM concomitantly with N-O bond cleavage, nitrite is able to rebind the metal center and form a six-coordinate octahedral structure, which significantly lowers the calculated activation energy. Resulting nitrite-bound structures can then potentially re-enter the catalytic cycle leading to the further reduction of nitrite.
**IMPS - Integrative Molecular Plant Systems**

**Poster Number: 158**

**Biochemical Investigation Of Protein-protein Interactions Between Multiprotein Bridging Factor 1 And Lux**

Valeria Laboy Collazo  
*Biology* University of Puerto Rico at Cayey

*Mentors and/or Co-Authors:*

Colleen Doherty  
College of Agriculture & Life Sciences NC State University

Multiprotein Bridging Factor (MBF1) is a transcriptional co-activator involved in regulating when specific genes are turned on. It serves as a transcriptional coactivator by bridging between the TATA-box binding protein, a component of the basal transcriptional machinery and gene specific transcription factors such as leucine zipper proteins. There are three different genes encoding for MBF1 in *A. thaliana*. These different paralogs of MBF1 have shown diverse properties in plants such as conferring thermotolerance and pathogen response. We are investigating the interaction between MBF1 proteins and LUX, a circadian clock protein part of the Evening Complex. The EC is responsible for coordinating growth and development of plants. Yeast two hybrid assays have shown a potential interaction between these two proteins. The objective is to study and understand the interaction between MBF1a, MBF1b and LUX. In order to validate protein-protein interactions of MBF1a, MBF1b, and LUX, the proteins were tagged and expressed in *E. coli*. These proteins are interacted in a co-immunoprecipitation assay where the specific beads would bind to the protein tag. To determine if there is an interaction between LUX and MBF1a/b a western blot is performed and then probed with an MBF1 antibody. We have successfully purified the proteins of interest for the protein-protein interaction experiment. Currently plants are facing greater environmental challenges and the demand to increase yield. Thus understanding how MBF1 proteins, known regulators of biotic and abiotic stress responses, interact with LUX, an important component of the circadian clock, can help develop crops with enhanced resilience.

**Poster Number: 26**

**A Study Of The Interaction Of Vip1 And Sqd2 In Plant Phosphate Homeostasis**

Cullen Dixon  
*Plant Science - Plant Genetics and Biotechnology* Penn State University

*Mentors and/or Co-Authors:*

Imara Perera  
College of Agriculture and Life Sciences NC State University

Phosphorus is one of the most important macronutrients needed for plant growth and development. It is most readily taken up from the soil in the form of phosphate (P$_7$). *VIP1* is an inositol kinase enzyme which converts inositol hexakisphosphate (InsP$_6$) into inositol pyrophosphates (InsP$_7$, InsP$_8$). These molecules are highly important in phosphate homeostatic signaling and cellular energetics. *SQD2* is likewise involved in phosphate homeostasis through the ‘Membrane Remodeling’ activity of its gene product - SQDG Synthase. This process allows for plant cells to remobilize phosphate under phosphate deprived conditions. A Yeast-2-Hybrid assay showed *SQD2* and *VIP1* have potential to interact. Further testing is needed to confirm this interaction. The lab has devised the genetic machinery necessary to transiently express the genes-of-interest in planta. The Arabidopsis *SQD2* gene was cloned into a pK7WGF2 binary vector via Gateway Cloning. This vector was transformed into Agrobacterium to allow for transient expression in tobacco. The ultimate goal is to co-express both *VIP* and *SQD2* proteins *in planta* via co-infiltration and perform a protein pull down assay to test for interaction. A phenotypic study was also conducted to determine if *sqd2* mutants display physical abnormalities or altered growth compared with wild type plants. The proposal that *SQD2* interacts with *VIP1* in the phosphate homeostasis pathway is reasonable and if true could help further the understanding of phosphate use efficiency thereby increasing crop yields.

**Poster Number: 103**

**The Correlation Between Segs I & The Loss Of Resistance To The Cassava Mosaic Disease**

Alexandra Hauke  
*Biological Engineering* North Carolina A&T State University

*Mentors and/or Co-Authors:*

Mary Dallas  
College of Agriculture & Life Science NC State University

Cassava is a starchy thick rooted plant native to South America. It’s the third largest source of food in the tropics, is rich in carbohydrates & is a major staple food in the developing world. Cassava is an extremely crucial crop in Africa, as it
can grow within drought like conditions. While it is mainly used for food, cassava plays a role in biofuel development and animal feed. Unfortunately, a disease called Cassava Mosaic Disease (CMD) prevents the cassava from thriving within the African economy. CMD consists of Begomoviruses that use insect vectors to spread and infect various cultivars of the crop. These viruses cause leaf distortion as well as leaf and root shrinkage. Therefore, CMD contributes to major food shortages & huge income losses to local farmers. In the 1990’s, the most CMD resistant cassava cultivar had a specific locus called CMD2. It is now the most common cassava cultivar in Africa. However recently researchers have found that a DNA molecule known as SEGS I reversed resistance in certain cultivars of cassava, especially CMD2. This is a major concern, because it is possible for the virus to reprogram the plant’s genetic system and inactivate resistance to the CMD. This could destroy the already unstable cassava crop production within African society. This study’s goal is to understand the connection between SEGS I, CMD2 resistance, the difference it has on multiple cassava cultivars as well as the plant’s genetic profile as a whole.

Poster Number: 123

Co-culture Of The Microalga Dunaliella With Marine Bacteria Influences Algal Growth And Lipid Production

Erik Herslebs Biology Emory University

Mentors and/or Co-Authors:

Amy Grunden College of Agriculture and Life Sciences NC State University

Dunaliella, a genus of microalgae, has great potential in the field of biotechnology due to its ability to produce large quantities of many commercially relevant products, the most prominent of which include lipid for biofuel and the nutritional supplement β-carotene. It has been shown that a diverse array of interactions can occur between microalgae and bacteria, resulting in either an improvement or reduction in the algal growth and lipid production. The purpose of this study is to investigate the conditions optimal for Dunaliella growth and byproduct synthesis. Specifically, the coexisting bacterial strains present in Dunaliella's ecosystems that are beneficial and deleterious to its growth are identified. In order to accomplish this, four strains of Dunaliella were tested: D. dunsii, CCAP 19_21, CCAP 19_32, and UTEX LB 999. Each was grown with and without antibiotics in sterile lab media, sterile seawater, and non-sterile seawater. Specific colonies of bacteria from seawater were also used to inoculate the algae. Finally, lipid tests were conducted for each experimental group and 16S rDNA sequencing was used to identify each bacterial strain present. The results indicate that there are indeed a variety of effects that the bacteria have on the microalga when grown in co-culture, with some bacterial strains improving algal growth and lipid production, some decreasing this, and others having no effect.

Poster Number: 54

Alternative Phosphorous Storage In Plants: Expression Of Bacterial Ppk And Ppx Genes In Tobacco Plants (nicotiana Benthamiana)

Kiara Rodriguez Nunez Industrial Biotechnology University of Puerto Rico Mayaguez Campus

Mentors and/or Co-Authors:

Imara Perera College of Agriculture and Life Sciences NC State University

Alexandra Hudson Zoology NC State University

Lukas Morris Zoology NC State University

Phosphorus is vital for living organisms and plays an important role in cellular processes such as glycolysis, and respiration. Phosphate (P\textsubscript{i}) is a major macronutrient for plant growth. However, it is one of the least available resources in soil. To overcome P\textsubscript{i} limitation in crops, phosphate fertilizer is used, but its use is not cost-effective and excess fertilizer causes a negative environmental impact like eutrophication. In microbes, P\textsubscript{i} is stored in the form of polyphosphates (polyP). In E.coli, two enzymes that regulate polyP levels are polyphosphate kinase (PPK) and exopolyphosphatase (PPX), which add and remove, respectively, phosphate groups to the polyP chain. Our goal is to engineer transgenic plants that express PPK and PPX, to study the co-expression of these enzymes in plants and to provide an alternative P\textsubscript{i} storage in plants. PPK and PPX genes were each cloned from E. coli and sub-cloned into plant expression vectors as GFP fusions using Gateway cloning technology. Tobacco plants were transiently transformed by infiltration with Agrobacterium containing the expression vector. Protein production in tobacco leaves will be monitored by fluorescence microscopy and immunoblotting assays. Future work will include generating stable transgenic plants expressing PPK and PPX and determining if these plants accumulate polyP. We anticipate that providing plants with an alternative P\textsubscript{i} store will be a cost effective strategy to improve yield under low phosphate conditions while minimizing environmental and economic impact.
Surface Reconstruction Using 3d Image Processing
Chanae Ottley Mathematics University of the Virgin Islands
Mentors and/or Co-Authors:
Cranos Williams College of Engineering NC State University

Studying how genes are expressed, can provide further understanding of an organism’s behavior. By tagging genes with green fluorescent protein (GFP), special microscopes are used to take images in space and time, which can provide insight into gene expression in a tissue or organ in response to internal or external cues. These images are typically sampled in the X, Y, and Z planes and collected over time. Automated analysis of these time-course images requires software that can reference the spatial location of GFP with respect to the spatial dimensions of the sample. In the model plant, *Arabidopsis thaliana*, we want to reference GFP location inside the root and give a graphical illustration of it. Therefore, we propose a 3D surface reconstruction and referencing software solution that creates a model of the plant’s root. We used two orthogonal contours that illustrate the outline of the plant from the Brightfield channel of the ZEISS Lightsheet Z.1 microscope and connected them at a common point in 3D space. Then, we estimated the surface of the root by interpolating on a known circular path and used triangulation to connect the points of the resulting data set. After the root reconstruction, we created a coordinate system with respect to the root that will allow us to reference the gene expression location and movement inside the plant root. Our methods produce a 3D model that displays similar attributes of the root and enables the possibility of quantifying and tracking of gene expression in space and time.

Phenotypic Characterization Of Two Strigolactone Inducible Reporters In *Arabidopsis thaliana*
Jose Silva Martinez Biology University of Puerto Rico at Cayey
Mentors and/or Co-Authors:
Josefina Fernandez Moreno College of Agriculture and Life Sciences NC State University

Strigolactones are a new class of plant hormones involved in regulating root development and suppressing lateral bud outgrowth in shoots. To facilitate the study of strigolactones in *Arabidopsis thaliana*, we set out to generate translational reporters that would enable visualization of strigolactone responses. Two strigolactone-inducible genes were fused in frame with GUS and yPET using recombineering and the resulting reporters were transformed into plants. The focus of this project was to characterize the transgenic lines for the four reporter constructs under different hormone regimens. *Arabidopsis* seedlings were treated with a synthetic strigolactone GR-24, ethylene precursor ACC, auxin IAA, and cytokinin Zeanin. Our results show that the reporters are inducible by all treatments, thus suggesting that these genes are not specific for strigolactones. These findings support the idea of the existence of crosstalk between different hormones and indicate the need for analyzing the expression of these reporters in strigolactone mutants to pinpoint the contribution of this hormone to the expression patterns of the two genes.

Determining The Impact Of High Nighttime Temperatures On Plant-pathogen Interactions Using *Botrytis cinerea* Infection In Lettuce As A Model
Edmaritz Hernandez Pagan Biology University of Puerto Rico at Cayey
Mentors and/or Co-Authors:
Colleen Doherty College of Agriculture & Life Sciences NC State University

Environmental conditions influence pathogen attack strategies and plant defenses. While higher temperatures allow pathogen to spread through plants, it also affects plants defense responses. The purpose of this investigation is to analyze how increased night-time temperature affects the relationship between lettuce (*Lactuca sativa cv Salinas*) and *Botrytis cinerea*, a necrotrophic fungus that causes grey mold disease. To achieve the aims, the lettuces were grown in controlled chambers in 12h days at 22°C, 12h nights at 16°C for normal night-time temperature (NNT) and at 19°C for high night-time temperature (HNT). For each temperature condition, growth rate was measured in control and experimental plants to determine the effects of HNT on lettuce growth. To evaluate how HNT impacts the interactions between the pathogen and plants, detached leaves from plants grown in both conditions will be inoculated with *B. cinerea*. After inoculation, lettuce leaves will be tested to obtain following factors of *B. cinerea* growth progression: infection efficiency, lesion...
growth rate, sporulation, incubation, and latency progression. The results obtained for now show that high night-time temperature favors germination of seeds, but normal night-time temperature promotes faster plant growth rates. This experiment is still in the phase of detached leaves infection. Our long-term goals are to identify the genetic components of these interactions to obtain targets for improving plant resistance against a changing climate.

Poster Number: 281
The Influence Of Urea On Mycelial Growth And Perithecial Development Of The Plant Pathogenic Fungus Colletotrichum gloeosporioides
Tara Rickman Biology Millsaps College
Mentors and/or Co-Authors:
Marc Cubeta College of Agriculture & Life Sciences NC State University

The fungal pathogen Colletotrichum gloeosporioides (Cg) infects apples (Malus domestica) causing Glomerella leaf and fruit spot (GLFS) disease, which can result in crop losses of 70-100%. Post-harvest foliar application of a 5% urea solution can suppress the development of apple scab disease and apple growers in North Carolina commonly use this practice for managing GLFS. However, the effectiveness of urea application and mechanism(s) on GLFS disease suppression is not known. Our primary research objective is to examine the effect(s) of urea on vegetative growth and sexual reproduction of Cg. To address this objective, 12 isolates of Cg were grown on lima bean agar (LBA) amended with 0, 2.5, 5, or 10% urea (w/v) and assessed for radial hyphal growth and sexual fruiting body (perithecia) development after incubation at 24 °C. Radial growth was measured every 24 hours for 14 days. The addition of urea to LBA significantly increased radial growth. A mycelial biomass study was conducted by growing each isolate in lima bean broth (LBB) amended with 0, 2.5, 5, or 10% urea (w/v) for 5 days, dried, and weighed. The addition of urea to LBB had no effect on mycelial biomass. Perithecia development and counts will also be discussed. To further examine the direct effect of urea on Cg, further testing in the field on apple fruit and leaves needs is needed.

Poster Number: 179
The Role Of Rem Proteins And Protease Inhibitors In Arabidopsis Stem Cell Regulation
Parnell Sheldon Biology & Classics Denison University
Mentors and/or Co-Authors:
Ross Sozzani College of Agricultural and Life Science NC State University

Stem cells are the precursors for all other cells in multicellular organisms. In order to understand how these cells work in plants, we utilize the model plant Arabidopsis thaliana due to its radial symmetry and well organized stem cell populations. Arabidopsis root stem cells are controlled by a vast network of regulatory genes. While some of the mechanisms underlying these networks have been explored, several still remain unknown. Here we used a transcriptomic profile of the Arabidopsis root stem cell niche to identify two genes important for stem cell regulation. We first identified a protease inhibitor whose knockout mutant displays extra quiescent center (QC) and endodermis divisions. We also identified a member of the Reproductive Meristem (REM) family whose knockout mutant exhibits extra QC divisions and a disorganized columella. While the phenotypic change we observe in the REM mutant is logical due to its increased expression in the QC and columella, the protease inhibitor is largely expressed only in the xylem. This suggests that either the inhibitor is moving through the cells or is acting on a protease that moves through cells to reach the QC and its surrounding niche. These results give us more insight on how genes and their proteins may interact and influence the stem cells in Arabidopsis roots.
**IMSD IRTP - IMSD Intensive Research and Training Program**

Poster Number: 130

**Should Connected Land Structures Be Conserved?**

**Janiaya Anderson**  
*Psychology* NC State University

*Mentors and/or Co-Authors:*  
**Christine Hawn**  
College of Biological Sciences NC State University

The basis of this project begins with the idea of conservation and what type of land structures we should conserve with those structures being connected (corridors) or fragmented (patches). In corridors there is a larger community and more resources (food and space) afforded to a species that lives there. In patches there is a smaller community and not enough resources because of overcrowding and not much room for movement. So to test the question of whether there should be a larger conservation investment on corridor (connected) or fragmented (patch) land structures we asked which land structures would benefit reproduction in predators (production of eggs) particularly in Green Lynx Spiders. We predicted that if the spiders were in corridor (connected) environments, they would have high egg production. To try to answer this question, we took the dry weights and measurements of the spiders and counted their eggs they produced that we collected from both corridor and patch land areas and then did a lipid extraction to see their lipid contents (food intake). After comparing weights of the spiders and eggs in different locations and calculating their percentage of lipids, we found that the highest egg amounts from the spiders and their lipid percentages came from spiders from the corridor land structure. These results suggest that spider egg production is highest in connected land structures. This implicates that the conservation of corridors is important for the reproduction of predators and most evidently the food available to different spiders within a corridor.

Poster Number: 227

**Determining The Regenerative Potential Of Secreted Factors From Lung-specific Stem Cells**

**Dana Asad**  
*Biomedical Engineering* NC State University

*Mentors and/or Co-Authors:*  
**Tyler Allen**  
Veterinary Medicine NC State University

Lung diseases, such as pulmonary fibrosis, are devastating and ranked as one of the top five causes of mortality worldwide. Pulmonary fibrosis is characterized by the damage to the lung that results in the lung tissue becoming scarred, which leads to decreased elasticity of the tissue and increased difficulty in breathing from the stiffness. While treatments are limited and there are no cures for pulmonary fibrosis, stem cell therapy remains a promising advancement to aid in lung regeneration. Many therapies currently use mesenchymal stem cells to treat lung diseases. However, these cells do not possess the same qualities as lung specific cells and secrete different proteins. In this study, we addressed this limitation and observed the regenerative potential of the neonatal and adult stages of two types of lung specific cells: explant derived cells and spheroid-derived stem cells. Conditioned media was created containing the secreted factors of each cell type and compared using a cell model composed of Alveolar Type-1 cells from whole lung explants. By determining which cell type has the most regenerative potential, it can be further determined which factors secreted have the greatest ability to diminish disease progression, increase recovery and renew an individual’s quality of life.

Poster Number: 138

**Mechanisms Establishing Left-right Asymmetry In The Developing Heart Tube**

**Evan Brooks**  
*Biological Sciences - Molecular, Cellular, and Developmental Biology* NC State University

*Mentors and/or Co-Authors:*  
**Nanette Nascone-Yoder**  
College of Veterinary Medicine NC State University

The heart is a left-right (LR) asymmetric organ. It develops from a straight tube that undergoes rightward looping to form a four-chambered structure. The importance of these asymmetric events to normal heart function is indicated by the fact that many congenital heart defects are a direct effect of disrupted LR asymmetric development. While it is known that the TGF-β family member Nodal and its downstream transcriptional target Pitx2c are required for asymmetric morphogenesis, very little is known about the molecular and cellular mechanisms that underlie the initial development of cardiac LR asymmetry. We hypothesized that the development of LR asymmetry in the heart is mediated by asymmetric
changes in the cardiac jelly, an extracellular matrix-rich region located between the endocardial and myocardial layers of the early heart tube. Indeed, morphometric measurements of the endocardial-myocardial space throughout the developing heart tube of *Xenopus laevis* embryos reveal that the cardiac jelly has greater volume on the left side than the right at stages prior to the rightward looping event. To ascertain whether Nodal-Pitx2c signaling was required for this difference, we dosed embryos with the TGF-β inhibitor SB505124 or ectopically expressed Pitx2c. Both experiments resulted in abnormal heart looping, accompanied by a loss of LR asymmetry in the volume of the cardiac jelly. These results demonstrate that the cardiac jelly is asymmetric and that this asymmetry is dependent on conserved LR patterning.

Poster Number: 60

**Characterization Of Intestinal Porcine Enterocytes**

**Justin Davidson** Biological Sciences (IPN) NC State University

*Mentors and/or Co-Authors:*

**Liara Gonzalez** College of Veterinarian Medicine NC State University

**Introduction:** Many major advances in gastrointestinal research have been derived using cell culture. Many commonly used cell lines are derived from cancerous cells that proliferate indefinitely and provide a constant source of cells for experimentation. Intestinal porcine enterocyte (IPEC-J2) cells are a non-transformed jejunal cell line that divide indefinitely. However, the source of cellular renewal in the IPEC-J2 cell line remains unknown. Intestinal stem cells are responsible for replenishing cell populations within the normal intestinal tract.

**Hypothesis:** The IPEC-J2 cell line is composed of stem cells that are the source of cellular renewal.

**Methods:** IPEC-J2 cells were grown on plastic, in Matrigel, and on collagen to observe differences in growth and structure based on the cells environments. Immunofluorescence was used to identify biomarkers for intestinal stem cells and post-mitotic epithelial cells; qRTPCR was used to determine relative expression of genes associated with stem cells (Hopx, Sox9) as well as post-mitotic cell types (Muc2, EpCam).

**Results:** Our results show that IPEC-J2 cells are a self-renewing cell line, exhibit contact inhibition, and have the potential to create mini lumens. Results from Immunofluorescence and qPCR are pending.

**Conclusion:** The IPEC-J2 line exhibits traits similar to both stem and post-mitotic cell types found in the intestine and serves as a useful tool to study the intestine.

Poster Number: 139

**The Effect Of Permutation Clustering Time Course Gene Microarray Data**

**Ricardo Germain** Physics NC State University

*Mentors and/or Co-Authors:*

**Cranos Williams** College of Engineering NC State University

Gene expression is a biological mechanism that effects the adaptability of living cells. There are several different techniques for studying gene expression, ranging from traditional methods that focus on analyzing one gene at a time, to microarray analysis, which focuses on determining the expression levels of many genes at once. When a certain technique is selected to be implemented, the data can be acquired in different ways. For example, microarray data can be taken across time points or across various experimental conditions. Variety in technique coupled with the natural complexity of the process, makes interpreting gene expression data difficult. Clustering is a technique commonly used to analyze microarray data. It’s a type of unsupervised machine learning that groups, (in this case), genes deemed similar into the same cluster, and genes deemed dissimilar into different clusters. There are various clustering algorithms which use different factors, (such as time point correlation, distance, etc.), to define similarity. Some clustering techniques group genes based on implicit assumptions about how the data was obtained. For example, time course microarray data measures expression over time, and not all clustering algorithms account for the between time point correlation inherently present in the data. To see how the consideration of time effects the outcome of the clustering, two algorithms were compared. One algorithm, k-means, is invariant to the effects of data permutation, and one algorithm, smoothing spline clustering (SSC), is not. Yeast gene expression data was clustered using both algorithms, and the outputs were compared using gene ontology.
Infection Of Osteosarcoma Cells With Canine Distemper Virus Enhances The Anti-tumor Immune Response

Abdulla Hida Human Biology NC State University

Mentors and/or Co-Authors:
Jonathan Fogle Veterinary Medicine North Carolina State University

Osteosarcoma (OSA) is the most common malignant bone tumor in people (children and young adults) and dogs. There have been no significant therapeutic advances over the past thirty years and for people and dogs with metastatic disease, the prognosis is particularly bleak. Recent studies have demonstrated infection of brain tumors with poliovirus can stimulate an immune response to the tumor. Based upon these findings we asked if infection of OSA cells in vitro with canine distemper virus (CDV) could induce an immune response to the tumor. Our hypothesis is that CDV infection enhances the immune response to primary and metastatic OSA, specifically, CDV infection will induce lymphocyte proliferation. Canine peripheral blood mononuclear cells (PBMCs) were isolated from healthy dogs and were cultured with the following: OSA cells, OSA cells and CDV, OSA cells plus ConA (positive control for proliferation), and CDV supernatant alone. Following a culture of 2-3 days, lymphocyte proliferation was measured by flow cytometry using a CFSE dilution assay. In support of our hypothesis, preliminary results suggest that infection of tumor cells with CDV enhances lymphocyte proliferation in response to OSA. These results may lead to new therapies for dogs with OSA and as a translational model for human OSA.

“Mate Masie!” Examining The Role Of Culture In The Well-being Of College-aged Students Of African Descent

Tierra Knight Psychology NC State University

Mentors and/or Co-Authors:
Elan Hope College of Humanities and Social Sciences NC State University

“MATE MASIE” is a Ghanaian Adinkra symbol that translates to “what I hear, I keep” and emphasizes the importance of cultural socialization to individual well-being and development. Mental-health research in resource-scarce contexts has focused on individuals’ psychological deficits, while positive psychological experiences and overall well-being have remained largely neglected (Wilson & Somhlaba, 2016). The traditional cultures in Ghana West Africa remain very strong in both formal and informal cultural socialization experiences. The goal of this study was to better understand the relationship between the self-identified culture of a person and how it has contributed to their identity development and overall well-being. Using a qualitative method and individual interviews, the present study explores the role of culture in the mental and emotional representations of psychological well-being in six college-aged adults, who attend the University of Ghana at Legon. The findings will contribute to our understanding of how traditional and emerging cultures may be used to build positive ethnic identities and overall well-being with African-descended youth. This presentation represents the first half of an ongoing research study to understand how ethnic and racial identities are influenced by cultural socialization experience. Subsequent interviews with a comparable African-American sample are currently being conducted.

Understanding The Ph Effect On The Degradation Behavior Of Polylactic Acid Using Md Simulations

Andria Lesane Materials Science and Engineering NC State University

Mentors and/or Co-Authors:
Melissa Pasquinelli College of Textiles NC State University
Brian Messina Psychology NC State University

Polylactic acid (PLA) is a biodegradable material used for many biomedical applications such as drug delivery, surgical sutures, and bone fracture repair. PLA degrades through hydrolysis, and the pH environment can affect the degradation process. Thus, the purpose of this study is to analyze the pH effect on the degradation behavior of PLA. To replicate the environment, molecular dynamics (MD) simulations were done on a system that contained atactic PLA chains containing 20 repeat units and a salt solution containing either hydroxide ions (alkaline) or chlorine ions (acidic). The MD simulations were done with a constant temperature of 310 K and constant volume and number of atoms (called the NVT ensemble) using a reactive force field, ReaxFF. We will discuss how the pH level impacts the degradation rate of PLA and its degradation products.
Zika virus is an RNA virus that is transmitted by mosquitos and spreading from the tropics to more temperate regions of the planet. Zika virus induces mild disease in most of the population, however in pregnant women its effects can be devastating causing birth defects such as Guillain-Barré Syndrome and microcephaly. Currently, vaccines and effective antiviral drugs are not available to combat this disease. In this study, we are screening a series of plant extracts for activity against Zika virus. The extracts we collected have been reported to display activity against viruses whose life cycle and genetics are similar to Zika. Five of the extracts are high in polyphenols (with known anti-viral activity) and were produced from common fruits and herbs while six extracts were produced from traditional Chinese herbs. Each extract will first be tested for its ability to cause cytotoxicity in host Vero cells, since this result would reduce viral titers and mimic a true anti-viral effect. Extracts which fail to cause cytotoxicity will then be tested for their ability to inhibit virus growth using a virus plaque assay. Samples that yield positive results will then be examined for mechanism of action; including, inhibition of virus binding, inhibition of virus replication, and indirect effects involving the host cell, interferon-dependent, anti-viral response. In future studies, positive extracts will be subjected to chemical fractionation and the active compounds identified with the goal ultimately of using those compounds clinically to treat infections by Zika virus.
classroom behaviors, and then were asked to describe exactly what happened in the vignettes. Our first goal was to determine how much of an interpretive lens the preservice teachers added to classroom events, and whether that predicted teachers’ feelings of empathy toward the student, their evaluation of the student hostility, and their assumption about past behavior and future outcomes. Our second goal was to assess how the preservice teachers applied emotion words to the events, and how this related to teachers’ feelings of empathy toward the student, evaluation of student hostility, and their assumption about past behavior and future outcomes. These results may be useful in outlining the ways in which teacher perception impacts their classroom management.

Poster Number: 249

Quantification And Application Of Environmentally Benign Nanoparticles (ebnps) In Agriculture
Jeelan Rahhal Chemical Engineering NC State University
Mentors and/or Co-Authors:
Orlin Velev College of Engineering NC State University

Environmentally Benign Lignin Nanoparticles (EbNPs) are engineered nanoparticles with a degradable lignin core. EbNPs can act as carriers for active ingredients. In this study, droplets containing defined concentrations of EbNPs were placed on hydrophobic and hydrophilic glass slides at three different elevations: 5 degrees, 25 degrees and 45 degrees. The nanoparticle accumulation during droplet drying is observed by adding FITC dye. Once the nanoparticle solution has fully dried, we observe the FITC-labeled nanoparticles using fluorescence microscopy. Specifically, we look for the formation of coffee-ring pattern. The same methods are used, after the addition of a solution containing chitosan, which coats the nanoparticles. The chitosan-coated nanoparticle solution dried deposits overall have fewer aggregates of nanoparticles, and a less prominent coffee ring. By looking for the drying patterns of the nanoparticle solutions, one can better understand how and where the nanoparticles are likely to dry on different surfaces. This information helps us understand how similar solutions would behave in biological systems, such as on the surface of leaves. By testing out EbNP solutions on the surface of a leaf, we will be able to correlate the characteristics of the deposition pattern that we saw on the hydrophilic and hydrophobic glass slides to ones in realistic applications. In future testing, we hope to control where the nanoparticles bind based on the leaves’ different surface characteristics and the functional nanoparticle coatings that we use in the solutions.

Poster Number: 174

Computational Modeling Of The Endogenous Opioid Met-enkephalin To Improve Voltammetric Detection At A Carbon-fiber Microelectrode
Deepthi Rao Computer Science NC State University
Mentors and/or Co-Authors:
Leslie Sombers College of Sciences NC State University

Drug abuse is a global, societal problem that is difficult to treat because little is known about the neurochemical mechanisms that govern drug addiction. The endogenous neuropeptide, Met-enkephalin, is heavily implicated in motivated behavior as it binds to opioid receptors within the brain. This agonist heavily influences primitive responses associated with drug addiction, including satiety, euphoria, and analgesia. An electrochemical technique was recently developed to detect real-time fluctuations of this neurochemical in the brain with a carbon-fiber microelectrode. The goal of this work is determine how this peptide interacts with the electrode surface, in order to advance this technology towards more chemically selective information and lower limits of detection. Computational modeling of endogenous met-enkephalin was our initial focus; however, the complexity of the intact peptide necessitated a simplified approach. As tyrosine and methionine are the amino acid residues that are electrochemically active, their structures were the focus of gas and aqueous phase zwitterion calculations. Two dimensional energy plots show the global energy minima for conformations of these structures upon manipulation of two or more bonds. The minimal energy structures were analyzed and electrostatic potential maps were generated to reveal their relative conformations in an electric field. By focusing on the electrochemically relevant sections of the molecule, meaningful assumptions can be made about how the peptide may orient at the electrode surface. This will guide future research to further develop electrochemical detection, and will ultimately help to shed light on the nature of this peptide in motivated behavior and addiction.
**Drosophila melanogaster As A Model For Stimulant Use Disorder**

**Shaunaci Stevens** Biological Sciences Molecular Cellular and Developmental NC State University  
**Mentors and/or Co-Authors:**  
**Chad Highfill** College of Sciences NC State University

Stimulants, such as amphetamines, are often prescribed for people with conditions such as attention deficit disorder or narcolepsy. Recreational use of stimulants can lead to addiction, as defined by DSM-V criteria. Meeting at least 2 of the 11 criteria is a diagnosable stimulant use disorder. Currently, the genetic basis of stimulant use disorder is unclear. Models such as mice and humans are often utilized, but are expensive and suffer from a lack of statistical power. *Drosophila* is an ideal model because it has statistical power, it is inexpensive to generate, and its natural genetic variation is easy to study. Our experiment is designed to uncover any genes or combination of genes that may be connected to addiction through three phenotypes: consumption, tolerance, and preference. We used the CApillary FEeder assay to examine these traits with previously selected candidate genes revealed in a genome-wide association study. We employed the GAL4-UAS system to decrease expression of the selected genes and compared them to a common background control. The CAFE assay allowed for free feeding, letting a group of flies in the same genetic line to choose between a caloric reward of sucrose or deleterious reward of cocaine or methamphetamine. Trends have shown a few distinct genes that may contribute to general addictive habits and overall addiction. Sexual dimorphism is clear from the previous work, overall showing more addictive tendencies in females than males. Finding genes that may contribute to addiction could be vital in future addiction studies.

**Differential Promoter Alleles Affecting Expression Of Genes Influencing Lifespan And Reproductive Senescence In Drosophila Melanogaster**

**Ananya Talikoti** Genetics NC State University  
**Mentors and/or Co-Authors:**  
**Mary Anna Carbone** College of Sciences NC State University

Lifespan varies immensely among species, including *Drosophila melanogaster*. *D. melanogaster* are commonly used in a laboratory setting due to their short generation interval, short lifespan, easy maintenance and well-documented genome. Using a genome-wide association assay, the genes *abo*, *Dredd*, *wds*, *CG3326*, and *CG4452* were shown to be significantly associated with lifespan and/or reproductive senescence between long and short-lived flies. To analyze which of these candidate genes may contribute to changes in lifespan and reproductive senescence, RNA interference (RNAi) mediated suppression of gene expression will be used. Using these RNAi knockdown lines, lifespan and reproduction assays will be conducted. The deaths of experimental flies will be counted to measure lifespan, and their offspring counted to obtain weekly and lifetime productivities. Next, the impact of the differential alleles between the long-lived and short-lived flies in the promoter regions of these genes will be assessed. Promoter regions are aligned, cloned into a luciferase reporter vector, mutagenized to obtain alternative alleles, and transfected into *D. melanogaster* S2 cells. Sanger sequencing will be performed to ensure correct sequences of each construct. The activity of each promoter will be measured using the promoter-luciferase reporter assay, which will express promoter activity as light. Promoter activities are then compared between allele-1 and allele-2 (representative of the long and short lived flies, respectively.) These experiments are aimed at understanding whether these candidate genes affect lifespan and/or reproductive senescence and if alternative promoter alleles affect gene expression that leads to the observed differences in lifespan or reproduction.
Kelman Scholars - Plant Pathology

Poster Number: 144
Development Of Molecular Diagnostics For Detection Of Pseudoperonospora Humuli Using Next-generation Sequencing
Samuel Cude Molecule Biology Cal State Monterey Bay
Mentors and/or Co-Authors:
Lina Quesada College of Agriculture & Life Sciences NC State University
Alamgir Rahman College of Agriculture & Life Sciences, NC State University

Pseudoperonospora humuli is the causal agent of downy mildew on hop plants (Humulus lupulus). It is one of the most widespread diseases in hop yards in the Pacific Northwest coast of the United States, causing significant loss of yield. Early detection of the pathogen would allow for more effective disease management, it could help guide timing of fungicide applications and identify infected planting material. P. humuli is a closely related sister species of P. cubensis, the causal agent of cucurbit downy mildew. The two are morphologically identical and share an almost identical ITS (internal transcribed spacer) region, making them difficult to differentiate. Through use of NGS data, a bioinformatics pipeline and a diverse panel of P. humuli and P. cubensis isolates, 242 candidate genomic markers were identified that are uniquely present in P. humuli but not in P. cubensis. These candidate genomic regions were validated through designing primers and PCR using multiple isolates of P. humuli, P. cubensis, and other oomycetes. Identification of such unique genetic marker(s) capable of detecting only P. humuli DNA could potentially be used in the future to monitor airborne inoculum with real-time PCR and spore traps.

Poster Number: 212
Plant Cell Gene Expression In Response To Effector Proteins From Plant-parasitic Nematodes
Cole Dunbar Genetics NC State University
Mentors and/or Co-Authors:
Eric Davis College of Agriculture & Life Sciences North Carolina State University

Plant-parasitic nematodes, such as the soybean cyst nematode (Heterodera glycines) and the root-knot nematode (Meloidogyne incognita), are microscopic roundworms that penetrate and parasitize the roots of their host plant species. These nematodes use a hollow mouth spear called a stylet to ingest nutrients from plant cells and deliver effector proteins that are produced in the esophageal gland cells of the nematode. These nematode effector proteins have the ability to modify the host plant cell into an elaborate feeding site that serves as a permanent source of nutrients for the nematode to feed as an obligate biotroph. Some of these nematode secreted effector proteins have been found to augment defense response in the host plant that can be measured as expressed pathogenesis-related (PR) genes. PR gene expression is related to restricting the development and spread of pathogens in plants, and nematode effectors may stimulate or suppress PR expression in plant cells. The goal of this project is to identify specific nematode effectors that cause a defensive response in plants. This was done by monitoring the expression of PR genes when proteins encoded by individual root-knot and soybean cyst nematode effector genes (2G02, 8D05, Misp40, 16D10) were expressed in the leaves of petite tobacco (Nicotiana benthamiana). PR gene expression was subsequently measured in the infiltrated N. benthamiana leaves using real-time PCR. Since the nematode effectors tested encode novel proteins with unknown functions, results of these experiments will shed new light on their potential roles in modulating defense response in plant cells.

Poster Number: 191
Monitoring The Colonization And Disease Progress Of Tomato Verticillium Wilt By A Green Fluorescent Protein Labelled Verticillium dahlia Strain.
June Graham Biochemistry Mount Holyoke College
Mentors and/or Co-Authors:
Yeonjee Oh College of Agriculture and Life Sciences NC State University

Verticillium dahliae is a fungal vascular wilt pathogen that infects many agriculturally valuable crops including tomato. Certain isolates of tomato possess a resistance gene known as Ve1, which provides the resistance against race 1 strains of V. dahliae. In susceptible lines however, a mutation disrupts the Ve1 gene. As a soil born pathogen, V. dahliae enters
tomato through the roots and appears to travel through the xylem causing stunted growth and wilting and drying of leaves within weeks. However, it is currently unclear exactly how the pathogen moves through the plant following inoculation and whether there is a significant difference in infection between resistant and susceptible lines. In this study we explore the growth and movement of *V. dahliae* through the tomato vascular structure using a green fluorescent labelled strain of *V. dahliae* race 1 strain, Le1087 through resistant LA2428 and susceptible LA3247 tomato lines. Our results show that spores of *V. dahliae* appear to attach to the surface of roots, germinate, and extend mycelia through the epidermal cells, eventually reaching the xylem within ten days post inoculation. We also explore whether the fungus is able to travel through a graft union and whether grafting a resistant root with a susceptible scion or a susceptible root with resistant scion alters the severity of infection. Additionally, we perform pathogen assays on the susceptible and resistant lines to see if there is an observable difference in plant growth.

Poster Number: 142

**Effects Of Abamectin, Fluopyram, Fluxapyroxad, Penthiopyrad On Sting Nematode In Vitro**

*Kat Nunez* Plant Science California State Polytechnic University, Ponaoma

*Mentors and/or Co-Authors:

*James Kerns* College of Agriculture and Life Sciences NC State University

The control of plant-parasitic nematodes in turfgrass system is difficult due to the lack of efficacious nematicides. Older nematicides were either organophosphates or carbamates were highly effective but were also exceptionally toxic or presented risk to non-target organisms and habitats. Consequently, these older nematicides have been selectively removed from the market. Without viable nematicides, growers and golf course superintendents are forced to manage their plants in the presence of an economically damaging number of nematodes. Cultural management leaves little room for error; growers and golf course superintendents are submitted to sudden environmental changes and unpredictable plant growth. As such, the search for alternatives to these chemicals is imperative. This study was focused on the control of *Belonolaimus longicaudatus*, a major pest of turfgrasses. *B. longicaudatus* populations from three different golf courses and an agronomic field in North Carolina were studied. Four different pesticides (abamectin, fluopyram, fluxapyroxad, and penthiopyrad) were tested using a bioassay that monitored nematode motility. The nematodes were monitored at 24-hour intervals for three days to assess when the chemicals inhibited motility. Abamectin was the most effective and quickest acting chemical, while sting nematode showed the least sensitivity to penthiopyrad. However, in vitro sensitivity of sting nematode to the various pesticides varied by location. Nematodes from RGA and Landfall courses were less susceptible to abamectin and penthiopyrad. This presents new information for the management of these pests and stresses the need for an integrated approach to nematode management.

Poster Number: 117

**Chlorate And Fungicide Sensitivity Of The Fungal Pathogen Macrophomina Phaseolina From Stevia**

*Layne Rogers* Biochemistry NC State University

*Mentors and/or Co-Authors:

*David Shew* College of Agriculture & Life Sciences NC State University

*Sarah Mckenzie* Psychology NC State University

*Stevia (Stevia rebaudiana)* is a perennial crop harvested for leaves containing glycosides that are extracted for use as nonnutritive sweetening agents. *Macrophomina phaseolina*, the causal agent of the disease charcoal rot, is a fungal plant pathogen with a host range of over 500 species. *M. phaseolina* was first isolated from stevia roots in spring 2016 and was consistently isolated throughout the growing season and winter at two field sites in Kinston and Rocky Mount, NC. In total, 99 isolates were collected and verified as *M. phaseolina* by sequencing the ITS4-5 region. To better understand the physiological and biochemical characteristics of *M. phaseolina* from stevia, chlorate and fungicide sensitivity trials were conducted. Chlorate is a nitrate analog used to observe nitrate assimilation in fungi. Thirty *M. phaseolina* isolates were selected and grown on minimal media containing potassium chlorate and compared to growth on minimal media without potassium chloride. Of the 30 isolates, 16.7% were chlorate sensitive and 83.3% were chlorate resistant, indicating most stevia isolates of *M. phaseolina* were of the corn pathotype. Fifteen isolates, representing the two field sites, were assayed for sensitivity to the fungicides azoxystrobin, pyraclostrobin, and tebuconazole. Effective dose to inhibit 50% of growth (ED50) was calculated for each fungicide. ED50 values for Kinston isolates were 100 ppm (azoxystrobin). ED50 values for Rocky Mount isolates were 0.15 ppm (tebuconazole), 10.67 ppm (pyraclostrobin), and >100 ppm (azoxystrobin). Future studies will investigate the role of *M. phaseolina* on stevia growth and overwintering.
Sequence Determination Of A Mild Strain Of Tobacco Mosaic Virus
Jessica Saganowich Biology Penn State University

Mentors and/or Co-Authors:
Tim Sit College of Agriculture and Life Sciences NC State University

A strain of Tobacco mosaic virus (TMV) displaying a milder systemic phenotype was discovered at a NC State University greenhouse. To characterize this milder TMV strain, virions were extracted from systemically infected tobacco plants (Nicotiana tabacum var. Hicks). Viral RNA was then extracted from purified virions using TRIzol. The terminal sequences were obtained via 5’-RACE and 3’ ligation-anchored PCR. Based on these obtained sequences, primers were designed to generate full-length cDNA copies of the viral genome. Full-length PCR products were sequenced and 98% of the genome sequence was obtained. The 5’ non-coding region (68 nucleotides) and the 3’ non-coding region (204 nucleotides) displayed 97% and 95% identity respectively in comparison to the wild type strain. At the amino acid level, the movement protein displayed 87-97% identity when compared to all TMV strains while the coat protein displayed 89-96% identity in the same comparison. It is currently unknown which of these differences may be responsible for the milder strain phenotype.

Fungicide Sensitivity And Population Analysis Of Phytophthora Capsici In North Carolina
Zachary Shea Zoology NC State University

Mentors and/or Co-Authors:
Lina Quesada College of Agriculture & Life Sciences NC State University

The oomycete soilborne pathogen Phytophthora capsici affects a wide range of vegetables, including watermelon, pepper, cucumber, squash, and pumpkin. P. capsici is detrimental to the vegetable industry across the United States. The amount of genetic and phenotypic variation present in North Carolina (NC) populations of P. capsici remains unknown. In this study, we collected 92 P. capsici isolates from vegetable farms across 7 NC counties to determine variation in mefenoxam, fluopicolide, dimethomorph, and oxathiapiprolin resistance in vitro. In addition, isolates were assayed for mating type distribution and population structure was determined using 11 microsatellite loci. Data suggest that resistance to mefenoxam and fluopicolide is common in isolates from NC. Most of the isolates from 7 counties were found to be sensitive to dimethomorph and oxathiapiprolin. Both mating types A1 and A2 were found in all counties but P. capsici A2 isolates were the most common in NC. Population analysis revealed genetic differentiation across NC counties but no structure was detected based on fungicide sensitivity. Our results indicate that P. capsici is highly diverse in NC, and that isolates remain structured by geographical location. These results highlight the importance of understanding pathogen genetic and phenotypic diversity when deploying fungicides and resistant cultivars.

Identifying Inoculum Sources Of Pythium Spp. In Tobacco Greenhouse Systems
Essence Vinson Biology Coppin State University

Mentors and/or Co-Authors:
Lindsey Thiessen College of Agriculture & Life Sciences NC State University

Pythium spp. are oomycetes that thrive in warm, wet conditions and affect tobacco seedlings in greenhouse float beds. Untreated, it can spread easily among other float trays and can reduce fitness of transplants or result in death of seedlings. The purpose of this experiment is to determine differences in greenhouse inoculum sources, and assess chemical treatment with regards to each inoculum source. Greenhouse float trays were cut into 13.5 x 8 cm sections, filled with potting media, and seeded using K326 tobacco seed. The float bins size are 42.5 x 30.2 x 17.8 cm and were filled with 2 gallons of water, and water was refilled to 2 gallons daily to account for evaporation. Used and clean trays were used to compare trays naturally-infested with Pythium spp., inoculated soil, inoculated water, or no amendment with Pythium spp. Inoculum was produced on clarified V8 agar, then sporangia and zoospores were collected in a water suspension, and was pipetted either into float water or soil prior to planting. Etridiazole (Terramaster) was used as a chemical control for this trial on each treatment, and a non-treated control was used to compare the impact of treatment on inoculum source. Diseased plants were used to compare each inoculation method and chemical treatment using a general linearized model.
Cucurbit Downy Mildew (CDM), caused by the obligate oomycete pathogen *Pseudoperonospora cubensis*, is an economically devastating disease on a variety of cucurbit hosts. CDM re-emerged in 2004 after being previously controlled through host resistance in cucumber and fungicide applications in other cucurbits, and now poses a significant economic threat to growers especially in the Southeast United States (US). In order to examine any genetic shift in *P. cubensis* populations, samples from pre-2004 (herbarium isolates) and post-2004 epidemic in US as well as isolates from Europe, India, Mexico, and Puerto Rico, were investigated using two genetically conserved regions namely, cox-2 (cytochrome c oxidase subunit 2) and ITS (internal transcribed spacer). These samples include isolates from a variety of hosts, including *Cucumis sativus, Cucurbita moschata, C. maxima, Cirtullus lanatus, Luffa cylindrica*, and *Mormordica charantia*. Following amplification and DNA sequencing of each genetic region from all isolates, multilocus sequence analysis (MLSA) was employed to detect any changes in the genetic structure of *P. cubensis* population in US. Results from these experiments show a population shift in *P. cubensis* populations and significantly improve our knowledge of this devastating pathogen, which will help to develop effective management strategies of CDM.

*Sclerotinia sclerotiorum* is a necrotrophic plant pathogen that affects a wide variety of vegetables. Romaine lettuce growers in North Carolina (NC) suffer loss from lettuce drop caused by *S. sclerotiorum*. Lettuce drop initially appears as wilted leaves as the mycelium and ascospores spread up the stem of the plant, but will ultimately cause death to lettuce plants that are infected. Preventative measures that growers can use to control lettuce drop are planting resistant lettuce varieties and using fungicide treatments. However, different strains of *S. sclerotiorum* can be found in NC fields and there is no information available regarding the susceptibility to lettuce drop of romaine lettuce varieties available to growers. The objective of this study was to identify host resistance and crop protection strategies to control lettuce drop in NC. A greenhouse experiment was conducted to identify resistant lettuce varieties to virulent NC isolates of *S. sclerotiorum*. Varieties: Sparx and Parris Island were inoculated with six isolates: SW122, SW121, SW120, SW119, NM379, SS69. The variety most resistant to lettuce drop was Sparx and the isolates that caused the most disease were SW120, NM379, and SS69. A field experiment was also conducted to identify effective fungicides for disease control. The Sparx variety was planted and the SW120 isolate was used to inoculate the field five times. Our study identified combinations of lettuce variety and fungicide applications that are effective at preventing lettuce drop in grower fields.
MAE REU in Composites

Poster Number: 19

**Reconstructing Out-of-plane Deformation Of Silicone Specimen From Fbg Measured Strains**

**Annette Gray** *Mechanical Engineering* NC State University

*Mentors and/or Co-Authors:*

**Mark Pankow** College of Engineering NC State University

**Matthew Sharp** *Food Science* NC State University

**Blake Svendsen** *Food Science* NC State University

**Ryan Power** *Food Science* NC State University

**Hishaam Rashidi** *Bioprocessing Science* NC State University

Knowing the back face deformation (BFD) of ballistic fabrics during a high velocity impact is important in determining a user’s survivability of the impact; however, there is currently no experimental method in place to measure BFD during the impact event. This research examines the use of strains measured by fiber Bragg gratings (FBGs) at quasi-static speeds to reconstruct the BFD shape. FBGs are gratings written into an optical fiber that filter and reflect back a single wavelength of light, called the Bragg wavelength, from a broadband spectrum. As an FBG is strained, the wavelength it reflects shifts, and this shift can be used to calculate the strain experienced by the FBG. A mold that fits into the quasi-static testing clamp was designed, fabricated, and used to cast SORTA-Clear® and Smooth-Sil™ samples with thicknesses of 1mm and 2mm. Samples were produced with no fibers as controls and with optical fibers to ensure there would be no loss of light intensity through the fiber during the tests before samples with FBGs were produced to measure strain. The deformation on the sample during each test was independently measured using a digital image correlation (DIC) setup, which used two cameras to take digital images of the specimen before and after deformation to determine the shape of the deformation. Silicone samples with FBGs integrated into them were deformed out-of-plane. The strain measured by the FBGs was used to determine deformation in the sample and then compared to the deformation measured using the DIC setup.

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Poster Number: 143

**Design Of A Lightweight Drag Sail Deployment Device For Cubesat Satellites**

**Rakesh Halder** *Mechanical Engineering* Rutgers University

*Mentors and/or Co-Authors:*

**Mark Pankow** College of Engineering North Carolina State University

Drag sail systems for small satellites in lower Earth orbit currently utilize metallic rollable booms as deployment structures. Metallic materials are heavy and prone to thermal effects from the sun. Rollable booms constructed of a carbon fiber/epoxy composite offer a high strength to weight ratio in addition to being thermally inert. Currently, satellites must deorbit 25 years after completion of a mission; without the use of drag sails, they are constrained to low altitude orbits in order to naturally deorbit. This work is focused on the development of a deployment mechanism for a carbon fiber boom that will fit within a 3U sized CubeSat satellite. The proposed mechanism allows deployment of a boom through many revolutions while keeping the coiled boom in constant tension. This prevents blossoming, jamming, and gives knowledge as to how far the boom is extended. A set of rollers that conform to the boom’s cross section will support the boom as it exits the mechanism. The rollers lower friction and stress concentrations, as well as add torsional resistance. Testing will characterize the composite’s response to different loads. Rectangular material samples are tested in a bending fixture with the aid of digital image correlation software. Booms are subject to torsion in another fixture to test the material’s stiffness. This work highlights the strength that a carbon fiber composite offers in a microgravity environment. The lightweight mechanism can help optimize weight constraints that satellites face, allowing for more efficient missions.
MEAS - Wake Tech Program

Poster Number: 176
High Resolution Sampling Of Bottom Water At Falls Lake
Brian Eigenberger Geology Wake Technical Community College
Mentors and/or Co-Authors:
William Showers College of Sciences NC State University

The objective of this research project was to study the influence of lake-bottom morphology on nutrient flux in the Falls Lake reservoir. The project was conducted by members of the RiverNet program, a program designed to understand nitrogen fluxes in watersheds. Monitoring at Falls Lake previously determined low nitrate, high ammonia, and oxycline development occurring in the summer. We used a Sontek Hydrosurveyor to produce a high resolution bathymetric map of the lake. From the bathymetric maps, water samples were taken at various depths across a channel. This detailed sampling will allow us to assess the relationship between ammonia concentration, depth, dissolved oxygen, and location (channel or off-channel). Preliminary results show that there is a correlation between the ammonia concentration and depth. Using the LaChat QuickChem 8500 analyzer, water samples from a station in upper Falls Lake were analyzed. At the time of sampling, the depth of the channel was 6.7 meters with an ammonia concentration of 1.040 mg/L, conversely, outside the channel where depth was the shallowest the ammonia concentration was 0.084 mg/L at 3.9 meters. The goal moving forward is to gather more data from different sections of the lake to determine the relation between ammonia and depth along with dissolved oxygen in-channel versus off-channel.

Poster Number: 184
Dunaliella Growth With Bacteria And Varying Amounts Of Glucose
Rachel Hanley Biology Wake Technical Community College
Mentors and/or Co-Authors:
Karen O'Connell College of Agriculture & Life Sciences NC State University
Bridget Peed Environmental Technology and Management NC State University
Austin Council Environmental Technology and Management NC State University

Dunaliella salina is a relatively fast growing salt-water dependent microalga that produces oil (glycerol) and carotene. The lipids produced by this microalga could potentially be harvested for biofuel. The majority of the strains coexist with bacteria that benefit the Dunaliella growth. The bacteria grow along side the majority of strains of Dunaliella and do not interfere with normal growth. However, in 4 strains bacteria is absent from the known samples of Dunaliella. This poses the question; If adding bacteria to most strains is beneficial to growth, could adding bacteria to a strain without it help it to increase in size and lipid production? In this study bacteria was extracted from 5 strains of Dunaliella. These bacteria were added to a sample of Dunaliella containing no bacteria. The samples of Dunaliella and bacteria were placed in a salt-water media alongside varying amounts of glucose. The bacteria feed off the glucose and generally thrive best when glucose is added. Each sample of Dunaliella and bacteria were separated into tubes with 0mM, .5mM, or 1mM of glucose. All conditions were monitored for cell growth consistently using a micro plate reader. The growth patterns show that the bacteria did not harm the Dunaliella but did not benefit it either. The results were expected but there was a small increase in growth of the tubes containing 0mM of glucose. It is possible that the increase in growth of Dunaliella was due to a lack of overpopulation of bacteria, therefore allowing the Dunaliella to thrive.

Poster Number: 173
Visualization Of Dorothea Dix Park Development Through Virtual Reality
Jonathan Lane Wake Technical Community College
Mentors and/or Co-Authors:
Helena Mitasova College of Sciences North Carolina State University

In 2015 the city of Raleigh acquired 306 acres of Dorothea Dix property for development of a destination park. This project’s goal is to utilize virtual reality technology for immersive visualization of the parks development over time. Environments have been captured during the winter of 2016 and this segment captured the same locations but during the summer of 2017. Locations were determined and georeferenced using handheld GPS unit Trimble geoXT Handheld.
GeoExplorer 2008. To create the immersive virtual environments a single lens reflex camera mounted to a Gigapan Epic Pro robot was used to capture around 54 precise images per location. The images were then stitched together into equirectangular panoramas that were then processed to be viewed in Oculus Rift virtual reality. Video was also captured at the sites via 360 degree video camera. The handheld GPS was used to find the exact logged location that the images for winter of 2016 had been taken so that the new images were taken at the same location. This immersive media can be used to provide information for park planners and will allow for virtual visits of the park while it is being planned and developed.

Poster Number: 247


Melanie McCaskey  
*Geology* NC State University  
Dean Loughridge  
*Geology* Wake Tech Community College  

*Mentors and/or Co-Authors:*

Adam Lee  
*College of Sciences North Carolina State University*

It is well documented that Post-European settlement agricultural practices led to the aggradation of large volumes of sediment along valley bottoms, causing streams to be impaired, incised, and unable to support the previous aquatic ecosystem. We hypothesize that the impairment of Piedmont streams may have its roots in the complete eradication (c. early 1800’s) of beavers in central and eastern North Carolina from overhunting. The purpose of our research is to compare channel morphology of beaver impounded streams with incised streams in the Piedmont and better our understanding of channel morphology prior to anthropogenic interference. We conducted unmanned aerial vehicle (UAV) flights of five streams within Wake and Johnston County, North Carolina. A geographic information system (GIS) was used to compare channels from high-resolution orthophotos generated from the UAV flights. Results indicate that Piedmont valley bottoms without beavers contain nearly straight, incised streams while those inhabited by beavers are characterized by beaver impoundments interconnected by multi-channel streams. We propose that Piedmont valley bottoms prior to anthropogenic interference contained more anastomosing multi-channel streams rather than single-threaded channels that are prevalent today. Furthermore, anastomosing channel morphology could promote greater wetted area, higher water table, and generally healthier ecosystems within the Piedmont of North Carolina.

Poster Number: 242

**Beaver Influences On Channel Profile And Ecosystem Health Within The North Carolina Piedmont**

Steven Newchurch  
*Geology* Wake Technical Community College  
Joseph Bolla  
*Geology* Wake Technical Community College  
Dustin Travel  
*Geology* NC State University  

*Mentors and/or Co-Authors:*

Adam Lee  
*College of Sciences North Carolina State University*

Streams across the Piedmont of North Carolina have been impacted by historic land-use alterations. Post-European settlement agricultural practices led to the aggradation of large volumes of sediment along valley bottoms. Today, these “legacy” sediments have left streams impaired, incised, and no longer able to support the aquatic ecosystems they once did. The purpose of our research was to investigate how beaver impoundments contribute to stabilizing and restoring stream channels in the North Carolina Piedmont. We compared two stream reaches along Miery Branch Creek, a tributary of Historic Yates Mill Pond. We conducted a Rosgen stream classification, Pfankuch stream stability assessment, and Bank Erosion Hazard Index (BEHI) estimate for an incised reach up-stream of a beaver dam and a reach closer to the beaver dam. The Rosgen assessment revealed that there were two different stream profile classifications within a short range along the same channel. Results from the Pfankuch stream stability test indicated unstable banks up-stream of the beaver dam and significantly more stable banks down-stream closer to the beaver dam. The BEHI estimate also indicated that up-stream banks were high on the hazard index while the down-stream banks were significantly lower. From our results, we interpret that the presence of a beaver impoundment has had an overall positive impact on the stream by allowing the aggradation of sediments over a larger area. We conclude that the introduction of beavers into unstable, incised stream channels could potentially restore the stream and surrounding ecosystem.
Microplastics In The Neuse River
Christopher Strang Geology Wake Technical Community College
Tyler Horton Geology Wake Technical Community College
Simone Waller Geology Wake Technical Community College

Mentors and/or Co-Authors:
John Fountain College of Sciences NC State University

This study sampled multiple locations along the Neuse River and two of its tributaries to determine the abundance, identity(s), and origin(s) of the microplastics found in the river. Plastics, specifically microplastics (particles < 5 mm), are becoming a major issue among aquatic environments, the short and long-term hazards are yet to be understood. In previous studies, samples from the Neuse River contained possible microplastics. The leading hypothesis, based on published studies, is the contamination of the river from microplastics is coming from waste water treatment plants. This study’s samples were taken specifically above and below three treatment plants, located along the Neuse River and two of its tributaries: the Eno River and Ellerbe Creek. The samples were filtered through a 300µm sieve. Raman Spectroscopy was used to analyze fibers collected during sampling. The samples were analyzed at 10 power magnification using the 532 and 785 lasers. The laser strength and integration time used varied, and was dependent on the individual fiber. Analysis of the samples indicate there were no significant differences in the amount of microplastics detected above and below the treatment plants, although there were a few more fibers found in samples taken below the plants. This evidence suggests that major microplastic contamination of the Neuse River is not coming from waste water treatment plants. It is not known why there was an apparent major decrease in fibers found between the summers of 2016 and 2017. More work is needed to determine the origin of microplastics in the Neuse River.

Spatial Variations In The Granulometry And Shape Distributions Of Bedload Sediment From Piedmont Streams
Callan Swafford Geology NC State University
Katherine Havey Accounting NC State University

Mentors and/or Co-Authors:
Adam Lee College of Sciences North Carolina State University

Post-European settlement land clearing and agricultural practices along with widespread valley-bottom damming for water power has caused large volumes of sediment to be deposited along valley bottoms in the Piedmont of North Carolina. Today, these sediments have left streams incised, impaired, and with altered channel characteristics. The purpose of our research is to further current understanding of the form and function of pre-European stream channels prior to their impairment. We hypothesize that incised stream channels have amplified storm water discharge which has led to larger, more angular clast size distributions in comparison to pre-European channels. We analyzed bedload samples from stream bars, wetted perimeter, and pre-European bars exposed along the banks of Sycamore Creek located in Umstead State Park. One hundred bedload samples were randomly collected at each sample site using a gravelometer to calculate the coarse bedload distribution. A total of twenty clasts were collected from each sample site and were analyzed for roundness using a Matlab script developed by Zheng and Hryciw (2015). Clast size analysis suggests that bed load distribution in modern bars is larger than those found in pre-European bars; however, roundness analysis suggests little to no difference between gravels of the two bars. Future research is needed to further analyze clast distributions in stream bars that have been anthropogenically impaired and incised throughout the Piedmont.

Look Before You Dig: Using Geophysics At The Pot Creek Pueblo Archaeological Site
Jeffrey Weis Geology NC State University

Mentors and/or Co-Authors:
DelWayne Bohnenstiehl College of Sciences NC State University
Anne Elkins Marine Sciences, Biological Oceanography NC State University
Melanie Hardee Biological Sciences, Human Biology NC State University

The Pot Creek Pueblo archaeological site outside of Taos, New Mexico has been studied for over 50 years. The site is known to have been the location of adobe room block structures and ceremonial kivas during the 13th and early 14th centuries. The purpose of this study was to use geophysical tools to help locate these structures prior to future
archeological excavations of the site. Structure-from-motion photographic data were collected with a small drone and used to generate a high-resolution map of the entire site. Electromagnetic induction and direct current resistivity techniques were used to measure the subsurface conductivity. Results indicate that the ruins of the adobe room block structures are delineated as areas of high topography and high conductive, whereas the kivas are observed to be small depressions that are filled primarily with lower conductivity aeolian material.
Modeling and Industrial Applied Mathematics NSF REU

**Optimal Investment Strategies For Leveraged Exchange-traded Funds**

Melanie Abel *Mathematics* University of Maryland  
Jalen Harris *Mechanical Engineering* California State University - Fresno  
Jay Iyer *Mathematics* Washington University in St Louis  
Daniel Maes *Mathematics and Statistics* Williams College  

*Mentors and/or Co-Authors:*  
Tao Pang College of Sciences NC State University

An exchanged-traded fund (ETF) provides a convenient vehicle for an individual investor to seek return from a stock market index or sector. A leveraged ETF (LETF) with a leverage ratio of aims to replicate times the underlying index returns on a daily basis. Market size for ETFs and LETFs has been growing since their introduction in 2006. In 2015, the US ETF industry consisted of 1,600 funds with over $2.1 trillion in assets under management. Despite their recent popularity, there is a scarcity of models available to predict and analyze the returns of these assets. In this project, we constructed a model for the expected return and risk of these securities by deriving a probability density function (PDF) in terms of the underlying ETF. Different distributions of the underlying ETF are tested in order to determine the most precise fit with historical data. Our model can show investors when it is optimal to invest in an LETF with positive or negative , and whether or not they should take a long or short position. We also created contour plots to help investors determine their investment strategy when considering LETFs. Utilizing mean-variance optimization, we derived the efficient frontiers and calculated the sharpe ratios to understand the effect that LETFs have on a portfolio. Lastly, we completed some risk analysis with LETFs.

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**War-gaming Applications For Achieving Optimum Acquisition Of Future Space Systems**

Brittany Dyer *Mathematics* Ithaca College  
Claire Goldhammer *Mathematics* Washington University in St Louis  
Scott Mahan *Mathematics* Arizona State University - Tempe  
Daniel Chertock *Applied Mathematics and Economics* George Washington University  

*Mentors and/or Co-Authors:*  
Hien Tran *Mathematics* College of Physical and Mathematical Sciences NC State University  
Rebeca Gottfried *Nuclear Engineering* NC State University  
Charles Tait *Nuclear Engineering* NC State University  
Matthew Ingram *Nuclear Engineering* NC State University  
Zachary Morey *Nuclear Engineering* NC State University

This project contributes to The Aerospace Corporation’s development of a Unified Game-based Acquisition Framework - Advanced Game-based Mathematical Framework (UGAF-AGMF) and associated War-Gaming Engine (WGE) models by building a framework that solves for optimum acquisition strategies and contract parameters. The UGAF-AGMF combines game theory, probability and statistics, nonlinear programming, and mathematical modeling to integrate Defense Acquisition Authority (DAA) and contractor perspectives into a mutually beneficial contract. During the 2016 NCSU Summer REU, the team developed a program that maps technology and market risk factors into Aerospace’s Program and Technical Baseline (PTB) and associated acquisition strategies. Our project enhances the mapping algorithm to produce strategies with low Total Ownership Cost (TOC), low risk, and innovative design while still meeting warfighter needs. Once the PTB model selects the optimum contractor and acquisition strategy, our contract models employ Monte Carlo simulations to solve for the optimum parameters for the given contract type. The models we designed will be implemented in the larger WGE models to procedurally optimize contracts based on warfighter needs and industry factors.
Physiologically Based Pharmacokinetic (pbpk) Modeling For A Persistent Chlorinated Water Contaminant: 1,2,3-trichloropropane

Jolie Even Mathematics Coastal Carolina University
Lee Spence Mathematics Kennesaw State University
Frederick Law Mathematics-Statistics University of California - Berkeley

Mentors and/or Co-Authors:
Marina Evans Environmental Protection Agency

The compound 1,2,3-Trichloropropane (TCP) has been used during the production of pesticides and polysulfide rubbers, and traces of TCP can be found in ground water. TCP shares structural similarities with toxic compounds, and it therefore is considered as possibly toxic. A physiologically based pharmacokinetic (PBPK) model was developed to model internal doses of TCP in the body of F344 rats who were given a 0.684 mL intravenous dose of TCP. Physiologic parameters were taken from literature or found from experimental data. Metabolism was modeled using Michaelis-Menton kinetics, and unknown parameters for metabolism (maximum rate of metabolism and Michaelis-Menton constant) were optimized for using data from a 1984 intravenous study. Concentrations of TCP in each tissue with respect to time were predicted. The model was then altered to track internal doses of TCP in the bodies of F344 rats that ingest TCP from contaminated drinking water. The drinking patterns of a F344 rat were modeled using a periodic intake function, and ground water concentration of TCP was assumed to be 0.11 µg/L.

Evaluating Iodide Concentrations And Its Effect On Neurological Development

Heidi Whiteside Mathematics Winston-Salem State University
Marina Mancuso Chemical Engineering University of Dayton
Dominique Forbes Applied Mathematics Coastal Carolina University
Daniel Finkelstein Mathematics, Computer Science Georgia Institute of Technology

Mentors and/or Co-Authors:
Hisham El-Masri United States Environmental Protection Agency

In this study, a biologically based dose-response (BBDR) model representing iodide concentrations circulating through the lactating dam and nursing pup body compartments is modified to model a dam and fetus scenario. Iodide plays an essential role in developing thyroxine (T4) and triiodothyronine (T3) hormones. These hormones are secreted by the hypothalamic-pituitary-thyroid (HPT) axis and are suggested to impact fetal neurodevelopment. This model analyzes the dynamics of iodide interacting between a dam and fetus. Optimizing parameters and sensitivity analysis allow increased understanding of the factors that influence the development of T3 and T4 hormones due to iodide deficiencies. Further research will evaluate the impact of iodide deficiencies in fetal neurodevelopment.
Liquid Metal Stability In Soft And Stretchable Micro-channels

Raudel Avila  
Mechanical Engineering  
University of Texas at El Paso

Mentors and/or Co-Authors:
Michael Dickey  
College of Engineering NC State University

The geometric stability of liquid metals inside soft and stretchable micro-channels is discussed. Liquid metals have attracted significant interest for implementation in the next generation of soft functional devices for their ability to retain their metallic properties while behaving as a liquid. A rapidly growing area of research in materials, mechanics, and chemical engineering is the ability to fabricate and pattern soft and stretchable electronics to enable fundamentally new applications where conventional electronics are unable to operate (e.g., wearable and transient electronics, soft robotics, e-skin, bio-integrated electronics). Recent advances in wearable electronic technology established a foundation in micro-fluidic technology that revealed the importance of design and stability when fabricating micro channels to ensure a proper manipulation of the fluid inside the device. Whereas most micro-fluidic devices operate with non-metallic fluids, the liquid metal micro-channels represent a mechanical and electrical design challenge for both its metallic and fluidic properties. Micro-fluidic devices operate in a wide range of applications, with multiple degrees of freedom, that could potentially collapse the micro-channels carrying the fluid. Attentive engineering design is required to ensure proper manipulation of the fluid once the device is subjected to single or multiple states of stress that might initiate channel collapse. Experimental testing followed by computational design were performed in order to optimize micro-channel design and ensure device functionality. This analysis shows the critical (i.e., smallest) cross sectional area of the micro-channel before it completely collapses; also, the change of resistivity in the device as a function of the induced strain.

The Effect Of Surfactant On Structure And Interfacial Dynamics Of DNA On Graphene Surfaces: Combined Computation And Experiment Study

Nate Brown  
Chemical Engineering  
NC State University

Mentors and/or Co-Authors:
Yaroslava Yingling  
College of Engineering NC State University

Understanding the behavior of DNA on the graphene surface in the presence of surfactants is directly connected with the desire for template driven tuning of its shape and properties and integral for further applications of DNA-functionalized materials. The purpose of this research is to understand the interactions that dictate the overall structure of double stranded DNA (dsDNA) in the presence of a surfactant, Octadecylamine with varying concentrations (0%, 10%, and 100%) per surface area, and furthermore how this impacts the interfacial interactions between dsDNA and a Graphene surface. Octadecylamine was selected based on its known interactions with DNA. All-atom molecular dynamics simulations ran at 300 kelvin in implicit solution, while dsDNA and Graphene interactions were quantitatively calculated using Visual Molecular Dynamics. The results of the simulation indicated that the surfactant at 10% was capable of hydrogen bonding with dsDNA base pairs while selectively disrupting interfacial interactions, therefore allowing the strand to maintain a majority helical structure. At higher concentrations, interfacial interactions between dsDNA and Graphene decreased while lower concentrations displayed no splitting. The findings of this study can not only shed a light on the role of surfactant on the behavior of DNA but also provide an insight for developing applications such as, DNA sensors capable of accurately sensing Glucose or cancerous cells and flexible, but strong bionanocomposites.

The Role Of Hydrophobic Block Properties On The Morphology Of Amphiphilic Diblock Copolymer Self-assembly

Lukas Harries  
Biochemistry  
Vassar College

Mentors and/or Co-Authors:
Yaroslava Yingling  
College of Engineering NC State University

Amphilic diblock copolymers (DC) possess the ability to self-assemble into an array of morphologies including spherical
micelles, cylindrical or worm-like, and vesicles. These materials have shown promise for various practical applications such as drug delivery, biosensing, and nanolithography. However, their wide-spread implementation has been hindered partly due to an inability to consistently resolve size and shape properties of the aggregates creating the need for a greater understanding of the impact of DC properties on the resulting self-assemblies. DCs are composed of hydrophilic and hydrophobic segments making up the two blocks of the polymer chain. We examine the role of hydrophobic block length and rigidity in micelle assembly. The impact of hydrophobic block length and rigidity on DC phase separation can be quantified by understanding its influence in relation to the other interactions in an DC-aqueous system. In order to model these interactions, the coarse-grained method of Dissipative Particle Dynamics (DPD) was implemented. In order to model the interactions between DCs in aqueous solution while implicitly varying the ionic concentration. By keeping the remaining coarse-grained forces constant, it was possible to compare the resulting morphologies for both flexible and stiff hydrophobic blocks and a varying hydrophilic block length. Furthermore, these trends were assessed quantitatively utilizing the concept of a packing parameter: a widely used means of predicting the conformation of aggregates using molecular parameters. We were able to show that by altering the hydrophobic block, the morphology can be tuned with various combination of length, rigidity and solution ionic concentration.

Poster Number: 105  
**Self-propelling “star Trek” Active Particles Empowered By Ac Electric Fields**  
**Caroline Kieffer** Chemical Engineering Louisiana State University  
**Mentors and/or Co-Authors:**  
**Orlin Velev** College of Engineering NC State University

Recent advances in the fabrication of non-spherical particles have provided an effective solution to convert external energy into controlled locomotion. One such shape is a lithographically defined equilateral triangle with a small notch carved out of the center of one side, which we term the “Star Trek” particle. In this research, we focus on the dynamic behaviors (e.g., active propulsion and reconfigurable assembly) of such Star Trek particles depending on the frequency, orientation and strength of an external AC electric field. In the case of a vertical electrical field, the particles were predominantly directed by imbalanced electrohydrodynamic (EHD) flows between the surface of the particles and the conducting substrate, which allows the particles to directionally self-propel and assemble into crystalline structures. In the case of a horizontal electric field, imbalanced induced charge electroosmotic (ICEO) flows and particle dipole-dipole interactions dominate. For low frequencies (i.e., < 10 kHz), the nonlinear distribution of induced charges across the anisotropically shaped particles causes the stronger ICEO flows to push the particle away from its notch. For high frequencies (i.e., ≥ 10 kHz), the induced dipole-dipole interactions between the particles lead to a linear chain-like assembly with a dominant face-to-face configuration as well as a head-to-tail configuration that are densely packed due to negligible EHD flows. Understanding the fundamental mechanisms of propulsion of such Star Trek particles will allow us to eventually use these particles, and future self-propelling microdevices using these principles in innovative applications, like self-healing materials and drug delivery vehicles.

Poster Number: 153  
**Battering Bacteria Against A Barrier**  
**Chad Province** Chemical Engineering University of Southern California  
**Mentors and/or Co-Authors:**  
**Karen Daniels** College of Sciences NC State University  
**Olivia Sandin** Social Work NC State University

The introduction of active matter into a colloidal system leads to ill-defined parameters in the behavior of formed colloidal solids. In order to better understand the influence of active matter in industrial and medical applications we form flow-stabilized colloidal solids (FSS) with both active and passive particles. We hypothesize that these FSS will illuminate the influence of particle shape and motility of active matter on the dynamics. Three strains of bacteria, motile and non-motile *Escherichia coli* and *Staphylococcus epidermidis*, were chosen to isolate the influence of activity from that of particle shape. In order to form FSS, a bacterial suspension flows through a quasi-2D microchannel. The bacteria encounters a barrier perpendicular to the direction of fluid flow where shear and compressive forces cause pile formation. These bacteria are suspended in a nutrient broth to sustain the bacteria with an added polymer, polyvinylpyrrolidone, which reduces adhesion to the barrier, the walls of the channel, and other bacteria. It has been previously shown in colloidal experiments that above a critical flow rate triangular, solid-like piles form on the barrier. When using non-motile *E. coli* we observe formation of piles. We have observed that the motile bacteria avoid the barrier thus preventing pile formation; illustrating the influence of motility on pile formation.
Humidity Swelling Of Surface-anchored Poly (dmaema-co-mabp) Networks

Diego Vargas Biomedical Engineering University of Michigan

Mentors and/or Co-Authors:
Jan Genzer College of Engineering NC State University

We investigate the swelling behavior of surface-anchored hydrogels under extreme humidity conditions. A copolymer comprising of N, N-Dimethylethylmethacrylate (DMAEMA) and UV-active Methacryloxybenzophenone (MABP) units is employed. A thin layer (~200 nm) of poly DMAEMA-co-MABP copolymer is deposited on a silicon wafer containing benzophenone (BP) silanes and then irradiated with UV light at 365 nm (UV dose ~9 J/cm²) to form cross-linked and surface-anchored gels. The simultaneous cross-linking and attachment reactions to the wafer surface occurs due to the presence of BP in the polymer and on the silicone substrate. The film thicknesses are measured using spectroscopic ellipsometry (SE) in a closed chamber at various relative humidities (RH). The RH in the chamber is controlled using saturated salt solutions, i.e., potassium hydroxide (KOH) for low RH (~12-15%) and potassium sulfate (K₂SO₄) for high RH (~96-98%). From the thickness measurements, we estimate the swelling ratio (α), i.e., the ratio of the film thickness after swelling and the thickness of a dry film, at various RH. Early experimental data suggests that α increases with RH. This project is a part of a larger study to understand the physical properties of these surface-attached hydrogels, leading to their application as anti-biofouling coatings. Future research will conclude the swelling behavior of the hydrogels submerged in water and organic solvents.
Electrodeposition Of Tungsten Oxide Thin Films

Klarissa Baranyk Material Science Engineering NC State University

Mentors and/or Co-Authors:
Veronica Augustyn College of Engineering NC State University

Tungsten oxide (WO3) exhibits interesting electronic, electrochromic, and energy storage properties. In order to further investigate the properties of WO3, this research focused on the electrodeposition and characterization of WO3 thin films. Electrodeposition is a technique that utilizes an electric current to deposit solid films onto an electrode from an ionically-conductive electrolyte. The electrodeposition of WO3 was carried out with a 3-electrode cell containing a solution of WO3, hydrogen peroxide, nitric acid, and deionized water. Electrodeposition was performed using a pulsed-current technique. The obtained thin films were characterized with cyclic voltammetry and Raman spectroscopy to understand their electrochemical properties and structure. This research provides additional understanding for the electrodeposition of WO3 which will be useful for further research into the properties of this material.

Ozone Detection In The Atmosphere With Room Temperature Sensors

Tashana Flewwellin Electrical Engineering NC State University

Mentors and/or Co-Authors:
Javon Adams College of Engineering NC State University

Three sensors made of nanocellulose, silicon, and porous silicon were explored at room temperature. The three different sensors, each made of a different substrate, are able to detect O3 at room temperature and notify a person if they are within a hazardous environment. Many O3 sensors today need to be heated to a certain temperature before they can accurately sense O3 in the air. Each sensor made of nanocellulose, silicon, and porous silicon react to O3 differently. Throughout the testing of the sensors, UV light is used to return the sensor back to its normal condition before testing it with a different concentration of O3. The testing the sensors in room temperature makes it different from other previous O3 sensors. If the sensor can detect O3 while at room temperature, it can be used throughout many different applications. A sensor such as this one can be made into a wearable technology. When a person wears this sensor, they will be able to tell if they are in an environment with O3 in real time. Other previous O3 sensors must be heated to detect amounts of O3 in the air, which could possibly delay results. We conduct this research with the hopes of making a low power wearable sensor that allows a person to monitor their environment real time.

Effects Of Recombinant Clotting Factor Viia On Neonatal Hemostasis

Sydney Floryanzia Biomedical Engineering NC State University

Mentors and/or Co-Authors:
Ashley Brown College of Engineering NC State University

One major cause for early infant death is complications following cardiovascular surgery. Because neonates have underdeveloped blood clotting systems until they reach the age of one, they can bleed extensively around suture sites after the procedure. Attempts to give neonates blood transfusions with adult blood products to strengthen their clots correlates with the patient having a worse prognosis and adverse outcomes. These transfusions also produce “mixed clots” which are quantitatively and qualitatively different from both adult and neonate baseline pre surgical clots. There is interest therefore in affecting the neonatal clotting process, or coagulation cascade, from the beginning. This would directly affect the production of neonatal clots as opposed to adding and the subsequent mixing in of adult blood products. My research centers around the effects of a novel prothrombotic therapeutic on neonatal hemostasis. I specifically examined recombinant factor VIIa, which is currently FDA approved for adults with bleeding complications, to see how it affected the stiffness, and structure of post surgical neonatal clots.
Microsensors To Quantify Light In Photobioreactors

Nyawira Nyota  
Environmental Engineering  
NC State University

Mentors and/or Co-Authors:
Joel Ducoste  
College of Engineering  
NC State University

The extraction of lipids from microalgae to produce biomass could revolutionize the energy industry both economically and environmentally. The goal of this research is to optimize this process by developing a method for accurately measuring the amount of light absorbed by algae inside a photobioreactor (PBR) since light is important for the photosynthesis process and algal growth. Once this method is developed, it becomes much easier to figure out the best amount of light to expose the algae to in order to produce the most biomass at the lowest price. Light is a variable that is hard to quantify, especially since the algae are moving throughout the reactor the whole time, making it hard to tell how much light each microalgae particle has been exposed to. To solve this issue, the researchers use microspheres to mimic the microalgae particles’ movement through the reactor. The microspheres are coated in a special dye that will change in fluorescence when exposed to light that is optimal for photosynthesis. The microsensors are first exposed to uniform, measured light in a collimated beam apparatus. The fluorescence of the microsphere particles is then measured in a flow cytometer. After this step, the microspheres will be tested in bench-scale PBRs with 1) Water only, 2) Water and algae, and 3) Water and nitrogen bubbling. The results from this test will show how the overall light changes for these conditions and will also tell us about the light distribution of that the algae particles see.

Practical Application Of Piezoelectrics

Julian Prosser  
Mechanical Engineering  
NC State University

Mentors and/or Co-Authors:
Jacob Jones  
College of Engineering  
NC State University
Madison Alman  
Bioprocessing Science  
NC State University
Tanya Ansari  
Bioprocessing Science  
NC State University
Alexa Neithercut  
Food Science  
NC State University
Hanqing Zhao  
Food Science  
NC State University

Piezoelectrics are special materials that conduct electricity when mechanical stress is applied. Conversely, when an electric current is run through the material, it causes the piezoelectric to move. These materials have many current uses in a variety of items such as in cell phones, earbuds, ultrasound, sensors, micro-robotics, and with energy harvesting. This project shows one of the other uses of piezoelectrics. One specific way that piezoelectrics are used are in minuscule robots. The Army Research Lab is making micro-robots whose movement is powered by piezoelectrics. This project was focused on creating a larger scale model of a wing to show how these wings actually operate. It will be created using a 3D printer to make the framing of the wing and then by attaching piezoelectric strips onto the frame. Piezoelectrics are also important because of their potential use in energy harvesting. Piezoelectric materials can be used to make energy from vibrations or change in shape. This has broad implications because it has the potential to be a renewable source of energy by using everyday movements such as walking or from naturally occurring weather patterns which in turn may help decrease the carbon footprint created by non-renewable sources.
**Effects Of Low Level Gestational Cadmium Exposure On Juvenile Obesity**

**Kelby Beam** Biological Engineering NC State University

*Mentors and/or Co-Authors:*

**Scott Belcher** College of Sciences NC State University

Cadmium (Cd) is a ubiquitous environmental contaminant that increases the risk for cardiovascular disease, hypertension, diabetes, osteoporosis, impaired kidney function, and cancer when at high exposure levels in adults. Epidemiological studies of mother/child pairs from Durham, NC suggest an association between maternal Cd levels during gestation with increased weight gain and obesity during childhood. The hypothesis that elevated Cd exposures, similar to those observed in the human population, result in increased weight gain in an experimental mouse model. This hypothesis was examined in outbred CD-1 mice, a strain known to be sensitive to the toxic effects of Cd. Female mice were exposed to 500 ppb of Cd in drinking water, or water containing no Cd for 2 weeks prior to mating and continued through gestation until their offspring were 10 days old. This exposure period in mice is equivalent to human gestation. Water consumption, food consumption, and body weights were monitored on dams while offspring bodyweights were monitored and analyzed throughout the study. Additionally, tissue and blood samples were collected from control and exposed animals at different ages to determine how Cd exposure alters metabolic function. Analysis of body weight data indicates that birth weight of both males and females exposed to 500 ppb were significantly heavier than unexposed controls. Juvenile females that had been exposed to Cd were significantly heavier than unexposed controls, but not juvenile males. These results suggest that females are the primary target to the gestational Cd and males are affected through indirect exposure.

**Modeling The Lignin Biosynthesis Pathway**

**Maria Boada** Physics NC State University

*Mentors and/or Co-Authors:*

**Cranos Williams** College of Engineering NC State University

The Lignin Network Analysis project is focused on identifying and modeling how genetic modifications impact the physiological characteristics of lignin in the tree Populus trichocarpa. Lignin, an organic polymer that is entangled with the cellulose and hemicellulose in plant secondary cell walls, is crucial to a plant’s structural integrity. However, it proves difficult to break down, impeding our ability to convert the cellulose and hemicellulose in plants like P. trichocarpa into efficient, carbon-based fuels. A current mathematical model developed at NCSU of the lignin biosynthesis metabolic pathway simulates the effects of metabolic changes in the pathway when given a transcript or protein abundance profile. Our efforts are focused on identifying the regulatory relationships between proteins within the pathway with the goal of incorporating them into the model. This will allow us to simulate the effect of genetic modifications on the pathway without needing to provide the specific transcript or protein measurement profiles. The NCSU Forest Biotechnology Group conducted a series of systematic gene knockdown experiments that targeted the expression of each gene in the lignin biosynthesis pathway. Absolute transcript and protein abundances of the lignin genes were collected for each of these experiments. I have begun creating and analyzing directed networks of the differential expression results from these experiments for the transcript and protein data sets. The similarities and differences of these networks will be analyzed to improve our understanding of potential points of regulation for the pathway and how these regulatory points differ between the transcript and protein layers.

**New Pathway To The Formation Of Alumina Oxide Aerogels**

**Abigail Carbone** NC State University

*Mentors and/or Co-Authors:*

**Paul Maggard** College of Sciences NC State University

Aluminum oxide aerogels are useful as heterogeneous catalysts. Although previous synthetic methods required high
temperatures and pressures, a new method has been discovered that greatly simplifies its preparation and is performed at room temperature and atmospheric pressure. This research focused on removing the passivating layer on aluminum using a liquid metal alloy, rendering the previously chemically-inert aluminum to become more highly reactive. This activated aluminum was reacted using a flowing wet carbon dioxide stream for the direct fabrication of the alumina aerogel with high surface area and porosity. Characterization of the resultant aerogel was performed using scanning electron microscopy, energy dispersive x-ray spectroscopy, and powder X-ray diffraction, while the downstream gases were measured using gas chromatography. The ability to produce aluminum-oxide aerogels at ambient conditions in tandem with the production of gases has many potential applications that fall within green chemistry and the chemical fuels industry.

Poster Number: 64

Non-stick Surfaces For Liquid Metal

Cassidy Clifton Chemical Engineering NC State University

Mentors and/or Co-Authors:
Michael Dickey College of Engineering NC State University
Chuck Floyd Nuclear Engineering NC State University
Victoria Hagopian Nuclear Engineering NC State University
Ronald Morin Nuclear Engineering NC State University
Stephen Langellotti Nuclear Engineering NC State University
Kevin Horlback Nuclear Engineering NC State University

Liquid metals are promising materials because it is easy to change their shape and therefore function. Under atmospheric conditions, liquid metal alloy eutectic gallium-indium (EGaIn) rapidly develops a characteristic outer skin that encompasses the liquid, known as its “oxide layer.” Although this casing allows for desired shape-deposition of the material and holds importance in liquid metal patterning, the oxide layer becomes problematic in the interior of a microchannel as it promotes the adherence of liquid metal to the walls and leaves a residue that results in limited mobility within a microfluidic device. This poster will describe efforts to create non-stick surfaces for EGaIn. The technique utilizes surface roughness to avoid adhesion of the metal as well as surface chemical modification. The method is capable of being employed in microchannels. We characterized the advancing and receding contact angles of the metal and show that it does not stick to these surfaces. We also demonstrate the ability to reconfigure the liquid metal shape upon injection into treated channels, significantly reducing adherence as the metal moves in and out of the channel.

Poster Number: 146

Religious Routes In A Contemporary Mayan Community

Jamie Collier Psychology NC State University

Mentors and/or Co-Authors:
Tim Wallace College of Humanities and Social Sciences NC State University

The San Jorge la Laguna community located on Lake Atitlán Guatemala is home to four religious disciplines: Catholicism, Charismatic Catholics, Evangelicalism, and Mayan Spiritualism. The dynamic between Christianity and Mayan spirituality is complex due to a history of oppression and the recent acquisition of legal religious freedom. This study looks into the various religions in the San Jorge, how they practice their faith, what they think about each other, and their relationships with God. In addition, how this religious relationship dynamic reflects the teachings of the Mayan 2012. Mayan spiritualism looks at the balance of the universe and the role of the day keeper in Mayan ceremonies. Catholicism and Charismatic Catholicism prioritizes the Trinity and reverence for the doctrines of the church. The Evangelic beliefs solely focus on the Bible and what it teaches them. Many people in San Jorge focus on their own religious doctrine before thinking about others, but the Mayan spirituality has existed in Guatemala for thousands of years and is a large part of their culture. Thus, the Mayan faith and the Christian faith have a shared respect for each other. Christians will still go to Mayan ceremonies and Mayan priests will use the Christian prayers in their ceremonies. Despite religious differences, all people in San Jorge have a relationship with God and have seen him work miracles in their lives. As we move into the new era of 2012, we see the coexistence flourish.
Direct Access To Highly Functionalized Heterocycles Through The Condensation Of Cyclic Imines And α-oxoesters

Alexander Cusumano Chemistry NC State University

Mentors and/or Co-Authors:
Joshua Pierce College of Sciences NC State University

Herein we report a unique condensation/cyclization between α-oxoesters and cyclic imines to yield the highly versatile 3-hydroxy-1,5-dihydro-2H-pyrrol-2-ones. These transformations can be carried out on gram-scale and under mild reaction conditions. Biologically relevant molecules such as natural products, β-amino acids and β-lactams can be accessed in 2-3 steps from these functionalized cores and these efforts will be discussed.

Novel Carbon Fiber Microelectrodes For Quantitative Long-term Measurements Of Glucose And Dopamine In Rat Brain Tissue

Matt Dausch Biomedical Engineering NC State University

Mentors and/or Co-Authors:
Leslie Sombers College of Sciences NC State University

Carbon-fiber microelectrodes insulated with fused silica have been combined with fast-scan cyclic voltammetry to create a robust electrode suited for the long-term implantations necessary for measuring neurochemical fluctuations in live brain tissue during behavioral studies. However, the fused-silica electrodes are permanently implanted and cannot be calibrated at the end of an experiment. This leads to imprecise quantification, as electrode sensitivity is known to drift over time. Addressing this problem, we propose a design for a chronic electrode that can be removed, calibrated, and returned to the previous recording location to resume electrochemical recordings of molecular dynamics over weeks-months. With our novel design, we will be able to investigate the molecular dynamics underlying intracranial self-stimulation (ICSS), a Pavlovian behavioral paradigm designed to study learning and motivational behavior, at discrete recording sites in rat striatum over multiple recording sessions. In ICSS, dopamine dynamics have already been well characterized. However, little is known about fluctuations of glucose, a molecule critically involved in the regulation of extracellular dopamine. To meet the need for this important data, we aim to fabricate and characterize novel carbon-fiber microelectrodes that can be modified with a reporter molecule producing enzyme, glucose-oxidase, allowing for electrochemical glucose detection. The novel electrodes will be chronically implanted for dual-molecule detection at discrete recording sites in rat striatum, and will be periodically removed for calibration to ensure accuracy in quantification. Precise measurement of these chemical dynamics will advance neuroenergetics research and promises to inform therapeutic strategies for treating drug addiction and related motivational disorders.

Flex-to-stretch Electronics

Steven Erlenbach Chemical Engineering NC State University

Mentors and/or Co-Authors:
Michael Dickey College of Engineering NC State University

Stretchable electronic devices maintain electrical connections when subjected to stress or strain and are therefore useful for enabling electronics with new mechanical properties. However, these devices often require power or electrical signals from non-stretchable components. Connecting flexible and stretchable substrates is a possible solution that maintains the electrical connection within a medium that can withstand deformation and prolonged use. The ability to create a robust electrical connection between these mechanically disparate components may enable new types of hybrid devices. In this study we present a basic method to fabricate such new hybrid devices, utilizing liquid metals that form fantastic stretchable interconnects because they are both conductive and fluidic. We characterized the mechanical and electrical properties of these hybrid devices. While we focus on silicon elastomers and liquid metals, there are numerous other methods of fabricating stretchable devices that share many properties with the devices in this work.
Quantitative Comparison Of Enzyme Immobilization Strategies For Real-time Glucose Detection Employing Fast Scan Cyclic Voltammetry
Saahj Gosrani Biochemistry NC State University
Brandon Stone Food Science Technology NC State University

Mentors and/or Co-Authors:
Leslie Sombers College of Sciences NC State University
S.K. Smith, L.Z. Lugo-Morales, G. S. McCarty, S. Khan

Electrochemical detection is particularly useful in neuroscience because it enables researchers to study neurochemical dynamics by making measurements that are in real time. However, non-electroactive species, such as glucose, require biosensors which are stable, selective, and have physiologically relevant sensitivities to targeted analytes. We have demonstrated sub-second electrochemical detection of glucose fluctuations by combining glucose oxidase modified carbon fiber microelectrodes with fast-scan cyclic-voltammetry (FSCV). The sensing surface of the microelectrode can be enzymatically modified with glucose oxidase to create biosensors sensitive to glucose. Glucose oxidase enables the electrochemical detection of glucose through the production of hydrogen peroxide, which is electroactive and serves as the glucose reporter molecule. Work presented herein quantitatively compares three approaches for enzyme immobilization - physical adsorption, hydrogel entrapment, and electrospinning - on a carbon-fiber microelectrode that can be implanted in spatially discrete locations of the brain. The data suggest that each of these methods can be used to create functional microbiosensors; however, of these, hydrogel entrapment is the most effective approach to glucose oxidase immobilization on the carbon electrode surface. This finding should be broadly applicable to other enzymes, and thus will provide the means for researchers to study topics in neuroscience involving the detection of non-electroactive molecules.

Tgf-β2 Downregulates Mhc Expression And Cytotoxicity Of Bone Marrow-derived Mesenchymal Stem Cells
Alex Grobman Animal Science NC State University

Mentors and/or Co-Authors:
Lauren Schnabel College of Veterinary Medicine NC State University

Allogeneic mesenchymal stem cells (MSCs) would provide a time and cost-effective therapy for the treatment of musculoskeletal diseases in horses. However, major histocompatibility complex (MHC)-mismatched MSCs can be recognized as foreign and rejected by the recipient’s immune system. We hypothesized that TGF-β2 inhibits IFN-γ-induced MHC expression levels and decreases cytotoxicity of MHC-mismatched MSCs. Bone marrow was obtained from the sternum of two healthy horses and MSCs were isolated and cultured to passage 3 in standard MSC media or media containing 1 ng/ml TGF-β2. Untreated and TGF-β2-pretreated MSCs were stimulated with IFN-γ over a 72-hour period before MHC surface expression was measured. The results revealed that TGF-β2 partially blocks IFN-γ-induced upregulation of MHC surface expression on MSCs. To test our second objective, effector cells (ECs) will be generated in a one-way mixed leukocyte reaction (MLR) and then used in a Chromium-51 (51Cr) release assay. Untreated or TGF-β2-treated autologous and allogeneic MSCs will be incubated with 51Cr for two hours and then cultured with ECs for four hours. Lysed target cells will be used as a maximum release control. 51Cr will be measured in the supernatant of experimental and control cultures to determine percent cell lysis. Although the full capacity of TGF-β2 to reduce the immunogenicity of MSCs is still unknown, these studies demonstrate that it may help to promote allogeneic stem cell therapy.

Engineering Multi-scale Materials To Optimize Wound Healing Responses
Chinmaya Joisa Molecular Cellular and Developmental Biology NC State University
Amber Hochstetler Material Science and Engineering NC State University

Mentors and/or Co-Authors:
Ashley Brown College of Engineering NC State University

Here we report the engineering of micron scale microgel thin films conjugated to nano-scale programmable self-
assembled DNA origami used to pattern TGF-β affinity peptides with the intention of pre-clustering TGF-β receptors and modulating wound healing responses. Our goal is to create thin films that direct cell migration responses with microgel films comprised of building blocks with varying degrees of crosslinking coupled to randomly distributed or DNA origami pre-patterned TGF-β affinity peptides to determine how durotactic and receptor clustering cues synergistically influence wound healing phenotypes, including cell migration and TGF-β signaling. Ultralow crosslinked (ULC), 2% and 7% N,N'-Methylenbisacrylamide (Bis) poly(N-isopropylacrylamide) (pNIPAM) microgels co-polymerized with acrylic acid (AAc) were synthesized using precipitation polymerization. Microgels in suspension or in films were then conjugated to the p*-anchor DNA strand, and then to a secondary fluorescent p-probe DNA strand. Fibroblast cell adhesion and spreading were determined via cell membrane staining and microscopy. Negative (without peptide-binding extensions) and positive (with peptide binding extensions) control DNA origami were assembled by annealing component strands, purified and validated using Atomic force microscopy. After polymerization, DLS size characterization of ULCs and crosslinked particles demonstrated that the microgels had a hydrated diameter of about 1µm. Fluorescence microscopy illustrated that the fluorescently labeled p*-anchor DNA strand successfully conjugated to the microgels and standard curves were prepared for analysis. Atomic force microscopy images illustrated that both the negative positive control tall rectangular DNA origami had formed.

**Morphological And Genotypic Characterization For Management Of Septoria Leaf Spot In NC Stevia Production**

**Maximo Larkin** Plant Biology NC State University  
**Layne Rogers** Biochemistry NC State University  
**Mentors and/or Co-Authors:**  
**David Shew** College of Agriculture & Life Sciences NC State University

Stevia (*Stevia rebaudiana*) is a new crop in North Carolina, harvested for leaves containing glycosides that are extracted for use as nonnutritive sweeteners. Septoria leaf spot is a foliar disease of many plants, including stevia. *Septoria stevae* was reported in Japan in 1982 and Canada in 1996. The original host of the pathogen was not determined in either location. The disease was first observed on stevia in NC in 2015. Leaf lesions occurred throughout the growing season, but rapidly increased in number and size during favorable environmental conditions in late summer and early fall leading to extensive defoliation. Due to its economic importance, identification of the pathogen is needed so that the source of initial inoculum can be determined. Morphological and genetic features of *Septoria* isolates collected from NC fields were compared to type culture isolates of *S. stevae* obtained from collections in Japan. Pycnidia (15) and conidia (198) were measured microscopically. Pycnidia of NC isolates averaged 70.2 x 75.4 µm compared to *S. stevae* pycnidia reported as 70.3 x 75.4 µm. Conidia from NC isolates averaged 57.3 x 1.81 µm compared to *S. stevae* conidia reported as 41.3 x 2.11 µm. NC isolates (12) and the *S. stevae* type isolates were characterized using five regions, including the Internal Transcribed Spacer (ITS), translation elongation factor-1alpha, beta-tubulin, RNA polymerase II second largest subunit, and large subunit RNA (LSU). Regions were amplified and submitted for sequencing. The NC isolates were identical to the type culture isolates in all five regions.

**Pilot Study On Behavior Of Sand Tiger Sharks In North Carolina Aquarium At Pine Knolls Shore**

**Michael Mann** Physics NC State University  
**Mentors and/or Co-Authors:**  
**Carol Price** N/A North Carolina Aquariums

This study used direct visual observation to assess tank use and behavior of sand tiger sharks *Carcharias taurus* in a large ocean tank at the NC Aquarium at Pine Knoll Shores. The behavior of sand tiger sharks has been rarely studied in aquariums and efforts to care for them will greatly benefit from studies investigating their normal behaviors and social interactions. *ZooMonitor*, a free software developed at Lincoln Park Zoo, was used to collect data in a consistent format. In addition to providing the best care for these sharks, aquariums hope to support a captive breeding population of the species to move away from wild capture. To support a healthy captive breeding population, it is important to understand how sharks utilize the space inside their aquariums, including information about normal swimming patterns, social interactions and the display of behaviors including those associated with reproduction. Collecting this baseline behavior will lead to future work in understanding and establishing captive breeding populations of sand tiger sharks. This was a pilot study that will expand for implementation at multiple aquariums in 2017-2018.
Real-time Striatal Measurements Of Oxidative Stress And Dopamine In The Dyskinetic Rat During Chronic L-dopa Treatment For Parkinson's Disease

Catherine Mason Neurobiology NC State University

Mentors and/or Co-Authors:
Leslie Sombers College of Sciences NC State University

Parkinson’s disease (PD) is a neurodegenerative disease characterized by the slow degeneration of dopaminergic neurons found in a region of the midbrain called the substantia nigra. Dopamine (DA) plays a key role in regulating motor function. Thus, the destruction of these neurons and the consequential decrease in DA concentrations in the striatum leads to the deterioration of motor control. The drug Levodopa has been used to treat PD by helping to increase the concentration of DA in the brain. This drug has been proven to alleviate the motor symptoms of PD; however, after a short period of time, dyskinetic symptoms can develop. It is thought that oxidative stress is a principal contributor to the destruction of dopaminergic neurons, and possibly to the development of dyskinesias, in PD and its treatment. To date, oxidative stress has been difficult to measure due to the high reactivity of oxygen radicals, however the generation of hydrogen peroxide (H₂O₂) can serve as an indicator of the presence of oxidative stress. This experiment uses fast-scan cyclic voltammetry coupled with carbon-fiber microelectrodes to simultaneously monitor rapid, real-time, fluctuations of DA and H₂O₂ in the dorsal striatum. These neurochemical dynamics can be time-locked to dyskinetic episodes. Overall, these studies will aid in our understanding of how oxidative stress modulates nigrostriatal DA signaling, as well as the behavioral consequences of this interaction. The results will inform improved therapeutic strategies for the treatment of PD.

Optimization Of Ido And Ldoa Growth And Purification

Meredith McNamee Biochemistry NC State University

Mentors and/or Co-Authors:
Wei-chen Chang College of Sciences NC State University
Megha Ganatra Human Biology NC State University

L-leucine-5-hydroxylase (LdoA) and L-isoleucine-4-hydroxylase (IDO) are enzymes that show hydroxylation reactivity. These reactions include the hydroxylation of the amino acids L-leucine, L-norleucine, and L-isoleucine, but it has been proposed that IDO and LdoA may be used to catalyze other reactions as well. *E. coli* cells were transformed with IDO and LdoA gene-containing plasmids, then grown in broth cultures to produce the enzymes. The over-expression and purification of IDO and LdoA have been optimized over the research project’s course. It was found that for both enzymes, terrific broth (TB) is the most effective growth medium. A 0.5 mM concentration of IPTG added to the media is most effective for protein over-expression. Centrifuging the cell cultures for 30 minutes at 4°C instead of 15 minutes at room temperature was also found to increase the total weight of cells harvested. The process and methods of lysing harvested cells was the factor that has been observed to have critical impact on concentration of protein purified. For IDO, the mixture of cells and lysis buffer could be sonicated at level 9 power for as many as eight 30-second cycles without any significant damage to the protein, but LdoA was found to precipitate out from solution after approximately five cycles of the same length and power level.

Adaptation Of The Communication Module Of A Sexual Health Program Based On Qualitative Feedback

Brian Messin Psychology NC State University
Irene Ball Business Administration NC State University

Mentors and/or Co-Authors:
Laura Widman College of Humanities & Social Sciences NC State University

Project HEART, a web-based sexual health intervention for teenage girls, was created to address the increased STD risk of adolescents due to their tendency to engage in risky sexual behavior. Seeking to broaden the scope of the program to address the need for adolescent male-targeted sexual health interventions, qualitative interviews were conducted to determine how HEART should be adapted to benefit teen boys. This study explores the analysis of qualitative
Mirror Self Recognition (MSR) is the ability of an individual to recognize themselves in a mirror. When individuals do not recognize their reflection, they usually act aggressive, thinking they are seeing a conspecific. Previous studies have found no evidence that prosimians have MSR. Thus, mirrors were used in a novel object study with five groups of Coquerel’s sifakas (Propithecus coquereli) and ten individual Fat-tailed Dwarf Lemurs (Cheirogaleus medius) from April to August of 2017, at the Duke Lemur Center. Each group/individual was exposed to three 20-minute rounds consisting of four 5-minute trials. One round included observing the group with the following conditions: First trial: no object, second trial: randomly selected item (mirror or cardboard paper towel roll/rock), third trial: second object, fourth trial: no object. A two-tailed paired t-test was run on latency to 1. approach, 2. hold, and 3. time spent staring and holding object. No significant differences were found for age and sex. Both sifakas and dwarf lemurs stared at the novel object significantly longer than the control (p.

Poster Number: 20
The Behavioral Responses Of Coquerel’s Sifakas (Propithecus coquereli) And Fat-tailed Dwarf Lemurs (Cheirogaleus medius) To A Mirror.
McKenzie Nalley Zoology NC State University

Mentors and/or Co-Authors:
Lisa Paciulli College of Sciences NC State University

Mirror Self Recognition (MSR) is the ability of an individual to recognize themselves in a mirror. When individuals do not recognize their reflection, they usually act aggressive, thinking they are seeing a conspecific. Previous studies have found no evidence that prosimians have MSR. Thus, mirrors were used in a novel object study with five groups of Coquerel’s sifakas (Propithecus coquereli) and ten individual Fat-tailed Dwarf Lemurs (Cheirogaleus medius) from April to August of 2017, at the Duke Lemur Center. Each group/individual was exposed to three 20-minute rounds consisting of four 5-minute trials. One round included observing the group with the following conditions: First trial: no object, second trial: randomly selected item (mirror or cardboard paper towel roll/rock), third trial: second object, fourth trial: no object. A two-tailed paired t-test was run on latency to 1. approach, 2. hold, and 3. time spent staring and holding object. No significant differences were found for age and sex. Both sifakas and dwarf lemurs stared at the novel object significantly longer than the control (p.

Poster Number: 205
Quantitatively Characterize The Temporal And Spatial Dynamics Of H2O2 In The Extracellular Space
Tooba Rashid Biological Sciences NC State University

Mentors and/or Co-Authors:
Leslie Sombers College of Sciences NC State University

Hydrogen peroxide (H2O2) is a unique reactive oxygen species (ROS) and signaling molecule that is highly implicated in many neurodegenerative diseases. H2O2 participates in normal modulation of cell function, however under circumstances it can contribute to dysfunction and cell death. H2O2 is membrane permeable, thus once it is formed it is capable of diffusing through cells and into the extracellular space. To date, changes in dynamic concentrations of extracellular H2O2 in living tissue are not well known and thus there is a critical gap in understanding the unique role H2O2 plays within the brain. Previous attempts to understand this have been hindered by the absence of sufficiently sensitive and selective detection methods that can sense rapid H2O2 dynamics. However, with fast-scan cyclic voltammetry coupled to carbon-fiber microelectrodes, the reliable detection of changes in H2O2 concentration is possible on a sub-second timescale. This experiment seeks to utilize this approach to investigate striatal H2O2 fluctuations in vivo with changes in dopaminergic pathway activity, elicited through electrical stimulation. This requires the removal of interference from other molecules that influence the signal, such as changes in pH. By applying a novel ‘double’ voltammetric waveform, striatal H2O2 dynamics were monitored at specific locations in rat striatum following electrical stimulation of dopaminergic fibers that innervate the region. Sets of stimulation pulses were delivered at varying frequencies (15, 30, 60, and 90 Hz) for up to 5 seconds. Overall, our preliminary results suggest that H2O2 dynamics correspond with the duration of the stimulation.
The Role Of Vacuole Morphology In The Stomatal Complex Of Maize During Stomata Movements

Jacobo Rozo Posso Plant & Soil Sciences Agribusiness concentration NC State University

Mentors and/or Co-Authors:
Marcela Rojas-Pierce College of Agriculture and Life Sciences NC State University

Vacuoles play an important role in plant cells, occupying more than 90% of the volume in most cells and are essential for cellular homeostasis. Vacuole fusion is important in the formation of the central vacuole, and vacuole morphology is responsive to environmental stimuli. This is observed in guard cells during stomata movements, where vacuoles fuse in open stomata, but they fragment in closed stomata. In this study, we are analyzing the role of vacuoles during stomata movements in maize, a monocot in the grass family. Grasses have guard cells associated with subsidiary cells. Our hypothesis is that the vacuoles in the maize guard cells undergo morphological changes during stomatal opening and closing. This would indicate conservation of regulatory mechanisms for vacuole remodeling between the ancestral two-cell stomata present in dicots and the four-cell complex in the grasses. We developed stomatal assays in maize by incubating leaves in water in dark or light conditions. We stain vacuoles with fluorescent dyes, and visualize by confocal microscopy. Preliminary results show fused vacuoles during stomatal opening, and fragmented vacuoles during stomatal closing in guard cells of maize. We will examine the vacuoles in subsidiary cells using green fluorescent protein maize to visualize vacuole membrane. Understanding the role of vacuole morphology in maize stomata is important because stomata movements are associated with increased drought tolerance and CO₂ uptake efficiency that is prevalent in the grasses.

Effects Of Restricted Hay Access On Ewe Body Weight, Body Condition, And Conception Rates

Julia Sheffield Animal Science NC State University
Carole Roman Animal Science NC State University

Mentors and/or Co-Authors:
Carrie Pickworth College of Agriculture & Life Sciences NC State University

Winter feeding costs and poor fertility can negatively impact a sheep farm budget. The objective of study 1 was to determine the effects of restricted hay access on ewe body weight, body condition score, and determine hay utilization. Fifty-four ewes were divided into four groups based on breed, age, weight, and body condition prior to study initiation. Two groups were randomly assigned to each treatment. Treatments included a control group with continual access and restricted group with 2 hour access daily for a total of 42 days. Ewes were weighed and body condition scored every seven days. Throughout the study mean body weight was not different between treatments. The mean body condition score decreased over time (3.5 and 2.4, day 0 and 42 respectively). Hay use was reduced by 30% in the restricted treatment. The objective of study two was to determine if an increased feeding rate of low body condition score ewes prior to breeding would improve conception rates. Forty six ewes were allocated to two treatments based on body condition score (2.097 and 2.553, respectively). On day 42 ewes began a 10-14 day estrus synchronization protocol followed by natural mating. At breeding the mean body condition scores were (2.7 and 2.9 respectively). Forty five days after ram removal ewes were ultrasounded for pregnancy detection. Mean pregnancy rate was 72% and did not differ by treatment. Restricting hay feeding reduced winter feed but increased flushing requirements to yield similar conception rates in ewes.

Evaluation Of Loss Mechanisms In Organic Solar Cells

Johnathan Turner Physics NC State University

Mentors and/or Co-Authors:
Abay Dinku College of Sciences NC State University

Organic solar cells are a cheap, easy to produce, and fast growing field in renewable energy. This research takes a look at one of the contending acceptor-donor bulk heterojunction material systems to determine how the charge transport and recombination properties are changed with active layer processing conditions and device structure. Measurements such as charge extraction by linearly increasing voltage (CELIV) and current-voltage characteristics (JV) are used to study recombination, while impedance spectroscopy (IS) is used to study the surface, bulk, and resistive effects of the previously mentioned processing conditions.
**Genetic Diversity And Therapeutic Agent Sensitivity Of Fusarium Fungi Associated With Equine Keratitis Disease**

**Ian Vanderschel** Microbiology NC State University

*Mentors and/or Co-Authors:*

**Marc Cubeta** College of Agriculture & Life Sciences NC State University

Fungal keratitis is a severe inflammatory disease of the eye, resulting from invasion and growth of Fusarium fungi into the cornea following injury. It is the most common cause of blindness in horses of the Southeastern US. More than 50% of fungal keratitis cases do not respond to medical therapy with anti-fungal agents and either requires surgical repair or eye removal (enucleation). 10 isolates of Fusarium were sampled from horses with fungal keratitis at the NCSU Equine Ophthalmology Service and Diagnostic Clinic. Isolates were examined for spore characteristics and subjected to multi-locus DNA sequence analysis with the Tree-Based Alignment Selector toolkit. Eight and two isolates belonged to the *F. solani* (*F. falciforme*) and *F. fujikori* (*proliferatum*) complexes, respectively. Two isolates of *F. falciforme* and one isolate of *F. proliferatum* were evaluated for sensitivity to fluconazole, metconazole, moxifloxacin, natamycin, and voriconazole using a MIC plate bioassay. All isolates displayed similar sensitivity to metconazole (0.25 ppm), natamycin (1.25 ppm), and voriconazole (1.25 ppm). Fluconazole and moxifloxacin were not effective in inhibiting isolate growth at 156 ppm. Further therapeutic agent sensitivity assays will be conducted with a larger sample of isolates.

**Poster Number: 157**

**The Role Of Nodal Signaling In Left-right Asymmetric Gut Morphogenesis**

**Rachel Walter** Biological Sciences NC State University

*Mentors and/or Co-Authors:*

**Nanette Nascone-Yoder** College of Veterinary Medicine NC State University

The vertebrate stomach arises from a primitive gut tube which lengthens and curves to result in the J-shaped adult form. Previous work shows that TGF-b protein *nodal* and downstream transcriptional target Pitx2 are required to orchestrate cellular rearrangements effecting these architectural changes. Our lab has shown that endoderm rearrangements in the stomach’s left wall precede similar right-sided rearrangements, causing the left side to thin and lengthen while the right side stays the same, thereby initiating stomach curvature and ensuring proper placement within the abdominal cavity. These left-right (LR) asymmetric differences in tissue morphogenesis are abolished by treatment with a drug (SB505124) that inhibits *nodal* activity. To extend these findings, we sought to determine if later events in stomach morphogenesis are also *nodal* dependent. We hypothesized that *nodal* signaling activates glandular and smooth muscle differentiation earlier on the stomach’s left side than the right. Utilizing immunofluorescence, we optimized a panel of antibodies directed against proteins expressed during stomach differentiation and gland formation (acetylated tubulin, atypical PKC, islet-1, smooth muscle actin, integrin, and laminin) to highlight cell shape and differentiation in both endoderm and mesoderm, and then compared right and left sides in both wild-type and SB505124-treated embryos. Our images suggest that cell differentiation markers occur on the left side of the stomach earlier in development than the right, and that mesoderm cell arrangement and shape on the right versus left sides are different. Furthermore, these differences are absent in SB505124-treated embryos, suggesting that later events in stomach development are indeed *nodal*-dependent

**Poster Number: 194**

**Total Synthesis Of Melokhanine B**

**Peyton Williams** Chemistry NC State University

*Mentors and/or Co-Authors:*

**Joshua Pierce** College of Sciences NC State University

The melokhanines are a family of pentacyclic natural products isolated in 2016 from the Chinese plant *Melodinus khasianus*. Displaying potent antimicrobial properties against *Pseudomonas aeruginosa*, *Escherichia coli*, and *Enterococcus faecalis*, the melokhanines represent a promising target for total synthesis. Development of a facile route to the synthesis of the melokhanine family and the development of a small designed library of analogs will facilitate the development of the melokhanines into novel infectious disease lead compounds.
Fescue toxicosis in beef cattle is caused by consumption of ergot alkaloids produced by endophyte-infected tall fescue and results in chronic decreases in productivity, welfare, and growth performance. Weaned calves (n=36) were used in a 2x2 factorial treatment design to measure post-vaccination immune responses during chronic exposure to ergot alkaloids over 56 days. Factors investigated include diet type (endophyte-infected fescue diet [EI] or non-infected fescue diet [EF] to induce fescue toxicosis) and level of dietary crude protein (14% or 18%), resulting in a total of four treatment groups: EF-14, EF-18, EI-14, and EI-18. Weekly measurements including body condition score, hair coat score, hair coat shedding score, body weight, average daily gain, and rectal temperature were recorded. Additionally, subcutaneous body temperature was recorded hourly via internal temperature data loggers. Lastly, to evaluate immune function, calves were vaccinated on days 28 and 42 of the feeding period. Body condition score, body weight, core body temperature, and average daily gain were not significantly different among treatment groups. Significant differences in hair coat shedding score, hair coat score, and rectal temperature were observed among some treatment groups, namely between EI and EF groups (p
NC State Undergraduate Independent Researchers

Poster Number: 152

Band Motion And Precipitation Type Tendencies In Northeast U.S. Winter Storms

Luke Allen, Meteorology NC State University

Mentors and/or Co-Authors:
Sandra Yuter College of Sciences NC State University

Forecasting snow accumulation in storms affecting the northeastern U.S. is a significant challenge. In these storms, locally heavy snow is associated with long, narrow bands and groupings of smaller bands termed multi-bands. One purpose of this research is to better understand the causes of formation and movement of both single-bands and multi-bands. In particular, the causes of multi-bands are poorly understood. Another purpose is to determine which areas and environments in the region tend to receive more rain than snow during storms. Seven storms between 2003 and 2014 were studied. Data from six National Weather Service radars in the Northeast were used to determine where bands occurred and whether they were single-bands or multi-bands. Data from the North American Regional Reanalysis (NARR) were used to find the location of the mean sea-level pressure minimum for a given storm at different times and the track of the low pressure center was determined from that. NARR data were also used to examine temperature and wind fields. Five types of band motion were defined as bands moved relative to the overall storm movement: quasi-stationary, radial without convergence, radial with convergence, along-axis, and mixed. We found that the surface air temperature was often close to the freezing point near the coastline, so offshore areas were more likely to receive rain than onshore areas. The motion of snow bands in these storms was found to generally follow the 700 mb wind field with few minor deviations.

Poster Number: 275

Genetics Of Host Resistance To Lethal Salmonella Infection

Mara Balch Genetics NC State University

Mentors and/or Co-Authors:
Johanna Elfenbein College of Veterinary Medicine NC State University

Salmonella is a global health issue that causes millions of illnesses and hundreds of thousands of deaths each year worldwide. Outside of the immunosuppressed, it is impossible to determine which individuals are at the highest risk of death. The purpose of this study is to use Drosophila melanogaster to identify genes that are associated with resistance to lethal Salmonella infection. We used a line of Drosophila melanogaster, derived from the Drosophila Genetic Reference Panel, representing maximal genetic diversity within the population. Flies were separated by sex and placed in vials with minimal nutrition. Flies were fed Salmonella Typhimurium suspended in sucrose. To control for the effects of starvation, we also fed heat-killed Salmonella. Flies were fed new suspensions of Salmonella and viability was monitored daily. Median survival for flies fed live Salmonella was 2.5 (males) and 3 days (females). Median survival for flies fed killed Salmonella was 3 (males) and 4 days (females). When 10% of flies in a group remained viable, they were collected and frozen, with the same number of control flies. In future work, we will sequence the genomes of surviving flies to establish the gene(s) needed for survival. We expect to find genes that may contribute to host resistance against Salmonella Typhimurium infection. Candidate genes with orthologs in humans will be prioritized for further work. This work will help to determine which individuals are at highest risk of death from Salmonella infection and will improve treatment success in this high-risk group.

Poster Number: 285

Larvae And Lasers: The Dynamics Of Active Particles

Emily Brown, Physics NC State University

Mentors and/or Co-Authors:
Karen Daniels College of Sciences NC State University

A pile of baking flour on a table does not move, but rather sits immobile as a solid. However, by introducing insect larvae into the flour, the mixture begins to flow, acting as a liquid. This is a different response than the traditional solid, liquid, and gas model of matter—grains with active particles move in unusual ways. How does the wriggling of larvae...
help us understand how motion of an active particle affects the macroscopic motion of its environment? The goal of this project is to quantify the correlation of the motion of particles within a medium of granular material. For our active particles we used the larvae of Tribolium confusus, the confused flour beetle. T. confusus is a model organism and lives in flour, a granular material, making it a convenient choice. In order to quantify wiggliness, we used Diffusing Wave Spectroscopy (DWS) to quantify the motion of larvae within the flour medium. By observing the changing scatter from a diffuse 633 nm laser on the larvae we determined the amount of correlation in the larval movements. We found that increasing the proportion of larvae increases the rate of decorrelation in the material, a property associated with fluidity.

Poster Number: 35

Evaluating Soil Nutrient Availability In Areas With And Without Chinese Privet

Austin Cary Forestry Tuskegee University

Mentors and/or Co-Author(s):
Zakiya Leggett College of Natural Resources NC State University

Invasive species can present challenges for natural resource managers that have the goal of managing their landbase while attempting to maintain biological diversity. Chinese privet (Ligustrum sinense) is an invasive species commonly found in the forest of the southeastern US. This species is successfully invasive because it outcompetes native vegetation and can stop germination of the native plants. For over forty years, Chinese privet has invaded the forest in Shelby Farms Park, particularly in the Burch Natural Area. This study focuses on evaluating soil nutrient availability as well as soil temperature in the areas invaded with Chinese privet in comparison with those that have not been invaded. In order to evaluate this objective, soil samples were collected and soil temperature was measured in eight different plots in the Burch Natural Area (four with privet-WP and four without privet-WOP). Additionally, the percent of the ground covered with privet was evaluated in each plot and tree diameters were measured within a 10ft by 10ft area. The plots that were invaded by privet (WP) had 90% of the ground covered in privet as compared to 10% in the contrasting plots (WOP). The soil temperature was about the same on all plots (~76°F). The soil pH was about the same when comparing (5.8 for WP and 5.4 for WOP). The base saturation was higher (85%) in the WP plots WOP plots (78%) while the phosphorus index was lower on the WP plots (20) as compared to the WOP plots (27).

Poster Number: 45

Gpu Acceleration Of Parallelizable Algorithms For Signal Reconstruction In Linear Inverse Problems

Nicholas Casale Electrical Engineering NC State University

Mentors and/or Co-Author(s):
Dror Baron College of Engineering NC State University

Algorithms that reconstruct sparse signals by solving linear inverse problems often utilize large scale matrix multiplication, transposition, and addition. Applications of sparse signal reconstruction include image reconstruction, Internet of Things (IoT) sensing networks, and facial recognition. Matrix operations are a computational burden for Central Processing Units (CPUs). The small number of cores on a typical CPU prevent massive parallelization of matrix computations. With NVIDIA’s CUDA/C++ programming environment, the parallel architecture of Graphics Processing Units (GPUs) can be utilized for many simultaneous matrix operations. This project implements a sparse signal reconstruction algorithm on a GPU called Multi-Processor Approximate Message Passing (MP-AMP). Speedups of 12-16x were achieved with CUDA.

Poster Number: 119

Course-grained Molecular Modeling Of The Phase Behavior Of Random-blocky Copolymers In Solution

Ulises Castillo, Chemistry NC State University

Mentors and/or Co-Author(s):
Erik Santiso College of Engineering NC State University

The monomer sequence of copolymers has been found to affect many physical properties of copolymers including phase behavior. For example, Genzer et al found experimentally that random-blocky copolymers with monomers of differing solubilities exhibited complex phase behavior in solution. They hypothesized that clusters formed as the
solution was cooled from a temperature above the cloud point, based on neutron scattering results and cloud point measurements. This behavior was not seen in random copolymer systems. Our goal is to find out why monomer sequence leads to the phase behavior. Through coarse-grained molecular dynamics simulations of multi-chain systems of random-blocky copolymers run using the Large-scale Atomic/Molecular Massively Parallel Simulator (LAMMPS), we seek to gain a fundamental understanding of this relationship between copolymer sequence and phase behavior seen experimentally.

Poster Number: 276

**Surface-anchored Zwitterionic Coatings For Marine Anti-fouling Applications**

**Austin Champine** *Chemical Engineering* NC State University  
**Mentors and/or Co-Authors:**  
**Jan Genzer** College of Engineering NC State University

Marine fouling is the accumulation of micro/macro organisms on immersed surfaces, e.g., ship hulls. The marine fouling creates surface roughness that increases the drag resistance of the ship and consequently increases the fuel consumption and emission of greenhouse gases. Therefore, we aim to develop the coatings that reduce the settlement of marine organisms. We employed a copolymer incorporating N,N-Dimethylethylaminomethacrylate(DMAEMA) or sulfobetainemethacrylate (SBMA) and UV-active crosslinker methacryloyloxybenzophenone (MABP). A thin layer of such copolymer is deposited on the silicon wafer pre-coated with a monolayer of benzophenone silane. Upon irradiation of the sample with UV light at 365 nm, the BP moieties present in the copolymer (and at the surface of the substrate) are activated, which leads to the simultaneous crosslinking of the polymer chains and surface attachment of the forming gel. The crosslink density of the gels is tuned by varying the mole fraction of MABP in the copolymer ranging from 2.5% to 10.0% MABP. A systematic investigation of the network properties, such as gel kinetics, swelling behavior, and cell adhesion, have been performed. Our results instigate the gel formation, and swelling behavior strongly depends on the MABP %, i.e., a copolymer with 20% MABP forms a densely crosslinked network, which swells less than that of 2.5% MABP and vice-versa. In contrast, no such effect of MABP is noticed in the cell adhesion, i.e., all DMAEMA copolymers are found to be cell attractive, while all SBMA copolymers are cell repellent. We are currently continuing further research along these lines.

Poster Number: 134

**Developmental Effects Of Diethylstilbestrol Exposure On The Male Reproductive System**

**Harlie Cope**, *Genetics* NC State University  
**Mentors and/or Co-Authors:**  
**David Aylor** College of Sciences NC State University

Diethylstilbestrol (DES) is a synthetic estrogen that was identified as an endocrine disrupting compound after being prescribed for women to prevent pregnancy complications between 1940 and 1971. Daughters of mothers treated with DES have an increased risk of developing a rare vaginal cancer, but less is known about the adverse effects on DES sons. Some mouse studies have shown that DES exposure was associated with decreased testosterone levels and sperm counts, but we found normal sperm counts in other DES-treated from different genetic backgrounds. These observations suggest a difference in individual susceptibility to DES exposure. We used the Collaborative Cross (CC), a population-based mouse model, to understand the effects of DES exposure across a genetically diverse population. In this study, CC mice exposed to DES neonatally were evaluated at postnatal day (PND) 21 to characterize the development of the male reproductive system following DES exposure. At PND 21, DES-treated mice exhibit smaller body and testis weights compared to control. Normal testicular structure is observed in control mice, but DES-treated mice exhibit smaller seminiferous tubule diameters and a lack of round spermatids. Since DES is known to bind estrogen receptor alpha (ERα), we will measure the mRNA level and protein localization of ERα in the testis and epididymis using qPCR and immunohistochemistry. We will also measure the mRNA expression of cytochrome P450 aromatase, an enzyme involved in estrogen biosynthesis. We expect our results to provide insights into the genetic and molecular mechanisms of DES-associated abnormalities in the developing male reproductive tract.
Microwave Extraction Of Eugenol From Cloves: A Greener Undergraduate Experiment For The Organic Chemistry Lab

Brittany Crouse, Chemistry NC State University
Brittany Hubbard Chemistry NC State University
Emily Vernon Biochemistry NC State University
Stella Kim Green Hope High School

Mentors and/or Co-Authors:
Maria Gallardo-Williams College of Sciences NC State University

The extraction of eugenol from cloves is a common experiment in organic chemistry labs at the sophomore level. In this study, the most commonly used procedure (steam distillation) has been modified to use microwave extraction with a CEM MARS 6 Synthesis microwave as a replacement for the steam distillation setup. This change results in a simplified procedure, a reduction in the amount of sample required, and an increase in the efficiency of the extraction of eugenol from dried cloves. These modifications fulfill two of the twelve principles of Green Chemistry, prevention of waste and design for energy efficiency. Variations of the solvent composition, solvent volume, and amount of cloves were tested to compare the effectiveness and efficiency of this procedure. It was found that a 50/50 mixture of ethanol and water with whole cloves produce satisfactory results for the selective extraction of eugenol with 1g of whole cloves. A detailed experimental procedure, as well as a video describing the operation of the microwave system, have been produced.

Listen To Your Heart: Beat Detection For Ecg Signals

Michelle Dai, Enloe High School

Mentors and/or Co-Authors:
Cranos Williams College of Engineering NC State University
Kelsie Gardner Zoology NC State University

Cardiovascular diseases (CVD’s) are a growing health risk in both developed and developing countries. They are commonly diagnosed by electrocardiogram (ECG) signals, which are detailed measurements of the heart’s activity. Though ECG is a preferred tool for detecting and analyzing CVD’s, a persistent issue is having to extract a high-quality signal out of contaminating background noise caused by various factors, such as power line interference and muscle movement. This summer research project seeks to implement a real-time QRS-detection algorithm in existing literature using MATLAB, which extracts the peak locations of the QRS complexes of ECG signals. This detection algorithm contains the following key steps. The first step is bandpass filtering, a function that removes signals beyond certain frequencies as to mitigate the effects of background noise. Taking the derivative and squaring the signal emphasize the QRS complexes. Finally, adaptive thresholding facilitates peak identification. The final product pinpoints the locations of these QRS-peaks relative to the signal. Evaluation of our implementation is done through tests on the ECG signals in the MIT-BIH arrhythmia database, where high sensitivity and predictivity results are obtained. Our implementation facilitates the adoption of this high-quality detection algorithm in real cardiac assistive devices to help improve diagnostic accuracy.

Inhibition Of Itch Post Fear Induction In Mice

Sandy Drye Materials Science Engineering - intended NC State University

Mentors and/or Co-Authors:
Santosh Mishra College of Veterinary Medicine NC State University
Blake Mangum Molecular and Structural Biochemistry NC State University
Karly Davis Biological Sciences NC State University
Calia Harakaly Biological Sciences NC State University

Fear-induced analgesia is gaining momentum; however, its effects on the itch sensation are completely unknown. In the current proposal, we have attempted to answer the question of how acquired fear and itch are related in mice. To induce fear in mice, we used two different methods: visual fear and predator odor-induced fear. Both of these responses are
known as acquired fear but occur via two different sensory systems. For visual fear, we introduced mice to a fox movie played on the computer screen and measured the freezing response (an innate response to fear in mice) to validate if our visual fear method was working. For predator odor-induced fear, we used a well-known synthetic chemical mediator trimethylthiazoline (TMT) in mice. Here, we showed that mice exposed to visual fear stimulation had significant reductions in behavioral responses to itch-inducing agent. Similarly, we found that mice selectively lost significant behavioral responses to the itch-inducing agent histamine when exposed to the chemical agent TMT. Histamine alone induced potent scratching when injected subcutaneously in wild-type mice and was used as an itch mediator. We found the stronger effect of itch inhibition with predator odor-induced fear than with visual cues. Thus, our results show a connection between itch inhibition and fear and further establish visual and predator-induced odor as an anti-itch mechanism.

Poster Number: 185
**Evaluating Ecoliteracy: Does It Vary Based On Where You’re From?**
Rosemary Edberg, Textile Engineering NC State University

*Mentors and/or Co-Authors:*
- Zakiya Leggett College of Natural Resources NC State University
- Stephen Cox Fisheries and Wildlife Science, Fisheries Concentration NC State University

Ecological literacy, often coined ecoliteracy, is a term that defines the total amount of knowledge and competence one has about the environment. Through a combination of academic pursuits, pro-environmental behaviors and experiences with nature, one can become ecologically literate. Competency in ecological literacy is a challenging concept, because there are different standards on what it means to be ecologically competent. There are many small-scale studies that evaluate the ecoliteracy of certain populations, but a small number of studies that evaluate it on a large scale, with the goal of finding correlations between ecoliteracy and certain demographics. This study involved an extensive literature review to determine if there was an existing body of knowledge related to the specific demographic of urban versus rural as it relates to ecoliteracy. Because of the lack of studies, a multiple-choice survey was created that evaluated ecological knowledge, behavior, and beliefs, similar to past relevant surveys that have been conducted around the world. The survey also required participants to include demographics: the type of area (rural, suburban, urban) where they have lived most of their life, how much time they spend outside, and their age. This project analyzes this survey and evaluates if there are any correlations between these demographics and ecological literacy. The survey evaluated over 150 people, with 47% from rural areas and 53% from urban/suburban areas. The results suggested that people who spend more time outside have 12%-17% more pro-environmental behaviors than those who spend small amounts of time outside.

Poster Number: 259
**Development Of A Soft Sensor For Cleaning Cycles Used In Biopharmaceutical Processing**
Griffin Fiedler Chemical Engineering NC State University

*Mentors and/or Co-Authors:*
- Gary Gilleskie College of Engineering NC State University

Currently, operations in the biopharmaceutical industry are monitored extensively, and the volume of data is continuously increasing due to innovations in the area of process analytical technology. Integration of automated data collection allows for rapid data analysis and model generation, which is useful for development of soft sensors, in which multiple measurements are combined. Using principal component analysis (PCA), Umetrics’ SIMCA software was used to develop a multivariate model of a clean in place process (CIP) for a bioreactor to better interpret process variables and monitor process health. Principal component analysis uses multiple variables to convert them to a set of orthogonal linear components. The result is a single operating trend that considers all the process variables from the unit operation. A range is automatically generated using three standard deviations above and below the average. In this work, a CIP cycle for a 300-liter bioreactor was modelled using SIMCA incorporating process parameter data, including supply flow, temperature, and conductivity, from 11 previous runs. The model was tested for its suitability as a soft sensor by intentionally creating failures during CIP cycles and assessing the model’s ability to detect the failure.
Poster Number: 89

Novel Methods For Synthesis Of Thiazolines

Yonghe Ge, Chemistry NC State University

Mentors and/or Co-Authors:
Joshua Pierce College of Sciences NC State University

The work described here focuses on the synthesis of thiazoline-containing compounds by coupling of thioamide and allyl bromide. Over the course of this summer I have explored various reaction conditions to construct these heterocycles from readily available starting materials, in addition to the substrate scope of different thioamides and allyl bromides. Further applications of this reaction have also been explored. This poster describes our efforts to date as well as our future plans.

Poster Number: 211

Investigation Of Novel Cellulose-binding Tāpirin Proteins In Caldicellulosiruptor Species

Will Hart, Chemical Engineering NC State University

Mentors and/or Co-Authors:
Robert Kelly College of Engineering NC State University

The genus *Caldicellulosiruptor* represents a group of extremely thermophilic bacteria with potential for production of biofuels and chemicals. Traditional methods of producing biofuels incorporate chemical and thermal pretreatment of plant biomass, followed by enzymatic degradation, to produce fermentable sugars. The use of *Caldicellulosiruptor* could consolidate these processes into a single step, requiring no biomass pretreatment. The ability of *Caldicellulosiruptor* to bind to cellulose biomass is due in part to novel proteins known as tāpirins. Once bound, *Caldicellulosiruptor* solubilizes the recalcitrant cellulose biomass, an important step in the degradation of sugars needed for processing. In order to study these unique proteins, tāpirins from several different species were expressed in *Escherichia coli*. These proteins were then purified via immobilized metal ion affinity chromatography (IMAC), tested for their ability to bind different substrates, and prepared for crystallography. The C-terminal domains of two tāpirins, Calkro_0844 and Calhy_0908, have been successfully crystallized. These two proteins, despite their low homology, bear significant structural resemblance. To determine the specific role of tāpirins and pili in binding to cellulose and complex biomasses, a series of genetic knockouts are also being performed in *Caldicellulosiruptor bescii*. Overall, tāpirins and pili likely play an important part in the ability of *Caldicellulosiruptor* to bind and degrade cellulose biomass, which is crucial in the consolidated bioprocessing approach to biofuel production and chemical synthesis.

Poster Number: 75

Allele-specific Gene Expression In Hybrid Drosophila

Meredith Hemphill, Genetics NC State University

Mentors and/or Co-Authors:
Trudy MacKay College of Sciences NC State University

Hybrid offspring of two breeds or species, while mostly resembling their parents, can have unique traits that are unlike either parent. Sometimes this leads to hybrid vigor, wherein the hybrid has higher fitness than either parent. However, the hybrid’s distinct biology can also manifest as decreased fitness, or outbreeding depression. Overdominance and the interaction of novel combinations of dominant alleles may contribute to this phenomenon, but the causal genes remain unknown. In this study, we address the genetic basis of hybrid vigor and outbreeding depression by profiling allele-specific gene expression (AGE) in *Drosophila melanogaster/Drosophila simulans* hybrids. AGE profiling compares the mRNA levels of each transcript from the respective parents to the hybrid offspring. We crossed females from a homozygous *D. melanogaster* strain (CSB) to males from 20 lines of *D. simulans* from the *Drosophila simulans* Reference Panel which had a wide range of hybrid viability with CSB females. The offspring of these crosses were sterile females which often exhibited wing abnormalities. We collected third instar larvae from the hybrids and the pure species parents and performed whole-genome RNA sequencing for AGE analysis. The hybrids are expected to have transcript values similar to one parent or within the range of both for most loci, but extreme values are likely at loci associated with female fertility and wing development. This study will lead to a deeper understanding of the mechanism of unique hybrid phenotypes, which in turn could aid the improvement of animal and plant breeding programs.
Melting Layer Properties And Precipitation In Wintry Mix Storms

Daniel Hueholt, Meteorology and Mathematics NC State University
Mentors and/or Co-Authors:
Sandra Yuter College of Sciences NC State University

Storms that produce a wintry mix of precipitation—a combination of snow, rain, sleet, graupel, and/or freezing rain—are responsible for much of the winter weather experienced across the eastern US. The complexity of these storms represent a significant challenge for weather forecasters, with important economic and safety implications. Wintry mix storms often feature the presence of at least one layer of above-freezing temperatures embedded within an otherwise subfreezing atmosphere. The properties of the melting layer(s) influence the precipitation type experienced at the ground. For example, if precipitation remains frozen, then it reaches the ground as snow, but if it melts and refreezes, it arrives as sleet. We use temperature data from weather balloons in the Integrated Global Radiosonde Archive and from aircraft in the Aircraft Communications Addressing and Reporting System dataset to find the vertical temperature profile within the storm, and reference that against precipitation data from our Micro Rain Radar (MRR) and Multi-angle Snowflake Camera (MASC) instruments. Five general types of storm are defined based on the number of melting layers (we have observed up to three) and their location within the atmosphere (whether they are in contact with the ground or positioned aloft). We find that the melting layers match up well with MRR observations of storm structure and often determine the type of precipitation observed with the MASC. Future research will focus in more detail on properties like layer depth and maximum temperature, and their effect on surface precipitation type.

Covalently Linking Chromophores For Synergistic Effects

Cameron Jackson Chemistry NC State University
Mentors and/or Co-Authors:
James Yarnell College of Sciences NC State University
Adam Pecoraro Molecular, Cellular, and Developmental Biology NC State University
Casey White High School Science Education (Biology) NC State University
Malena Howerton Life Sciences First Year Program NC State University

The photophysical properties of a series of new Re(I)-carbonyl diimine complexes are reported. The ligand is based on a 1,8-naphthalimide that was covalently attached to a 1,10-phenanthroline. Previous results demonstrated that these types of systems exhibit "ping-pong" energy transfer mechanisms between the metal-to-ligand charge transfer (MLCT) and the ligand-centered (LC) excited states. In this series, the energy level of the LC state was modified through the addition of various functional groups at the 4-position of the naphthalimide chromophore to study the effects on the excited state equilibrium between the MLCT and LC states. Evidence of the excited state equilibrium is provided via emission and temperature dependent transient absorption spectroscopy. As demonstrated using absorption spectroscopy, these bichromophores also display increased light harvesting capabilities as a result of linking a naphthalimide chromophore to the Re(I) complex.

Life Cycle Modeling Of Microalgae-to-biofuel Systems

Mathew Jacob Environmental Engineering NC State University
Mentors and/or Co-Authors:
Jim Levis College of Engineering NC State University
Nicholas Herring Nuclear Engineering NC State University
Patrick Povinelli Nuclear Engineering NC State University
Shaniqua Young Nuclear Engineering NC State University
Jessica Rhodes Nuclear Engineering NC State University

There is growing interest in developing low-carbon renewable biofuels. Production of microalgae-based biofuels in photosynthetic biorefineries (PSBRs) has the potential to reduce fossil fuel consumption and greenhouse gas emissions.
compared to conventional fuels. Microalgae have higher growth rates and lipid concentrations compared to terrestrial fuel crops, and microalgae-based biofuels have the potential to reduce land and freshwater consumption compared to corn or soybean-based biofuels. There are currently no industrial-scale microalgae PSBRs due to the relatively high cost of large-scale cultivation and harvesting of microalgae. Previous studies have shown that algae harvesting is an expensive and energy intensive step in the converting microalgae into fuels. Therefore, it is important to optimize the harvesting process to reduce system costs, resource consumption, and environmental impacts. The objective of this research was to develop a dynamic life-cycle model of the microalgae-based biofuel production process. With each step of the process (e.g., cultivation, harvesting, and fuel production), there are multiple alternatives, each with their own advantages and disadvantages. The model estimates the mass flows, costs, emissions, and energy consumption/production from each process in the microalgae-to-biofuel system. Preliminary results indicate that among the harvesting methods, electrocoagulation has lower costs and emissions compared to electroflocculation and centrifugation. Among the lipid extraction and fuel conversion methods, combined hydrothermal liquefaction and catalytic hydrothermal gasification costs more than wet extraction but produces more fuel. The dynamic life-cycle modeling framework is a valuable tool for estimating the trade-offs among cost, energy production, and environmental impacts associated with alternative microalgae-to-biofuel systems.

Poster Number: 82

**Abcc11 Variants Influence Skin Microbes And Earwax Type**

**Katie Jenkins**, Genetics NC State University

**Mentors and/or Co-Authors:**

**Reade Roberts** College of Sciences NC State University

Skin microbiota are affected by many factors including gender, age, habits, and host genetics. Our interest is exploring how host genetics and a person’s habits influence their microbiota and may influence health. *ABCC11*, a gene whose product is active in human apocrine glands, contains a single nucleotide polymorphism that determines whether a person has wet or dry earwax. Individuals with African and European ancestry typically have wet earwax, while those with Asian and North American ancestry more often have dry. Based on preliminary findings from the Roberts and Horvath labs, the *ABCC11* variant determining earwax type also affects which microbes live in apocrine sites, but it is unknown if non-apocrine sites are also affected. To test if *ABCC11* genotype affects microbes in both apocrine and non-apocrine sites, we swabbed the skin of volunteers at both types of sites to collect skin microbes and collected participants’ DNA to genotype *ABCC11*. It is also unknown if *ABCC11*-related differences in microbes are universal between populations with different daily habits and lifestyles. To test for universal differences between different populations, we collected samples from both US and Malagasy people at the same body sites. *ABCC11* genotype frequency in the Malagasy was previously unstudied, and we have genetically confirmed that Malagasy people do have different types of earwax, making them perhaps a unique sub-Saharan population with *ABCC11* variation. We predict *ABCC11* variation to affect the types of microbes living in apocrine and non-apocrine sites, with trends common to both human populations despite different lifestyles.

Poster Number: 70

**Application Of Bodipy Dyes As Nerve Agent Detectors**

**John Drake Johnson**, Chemistry NC State University

**Mentors and/or Co-Authors:**

**Walter Weare** Sciences NC State University

An amino-alcohol substituted BODIPY chromophore is designed through two different pathways as a detector for phosphate-containing nerve gases. While the unreacted dye is non-fluorescent, the presence of a nerve agent will cause an intermolecular cyclization with a dramatic color change and quantum yield enhancement, apparent to the naked eye. As the eye is most sensitive to green wavelengths, the conjugation length has been tailored to meet such an emission to ensure ease of detection by the operator. The water-solubility of the sulfonated dye allows for convenient transport and deployment in the field. Further functionalization of the dye to prevent false positives is possible at sites susceptible to Knoevenagel chemistry on the BODIPY core.
Fibrosis, the formation of excess scar tissue, manifests in multiple tissues of the body with drastic y impedance to organ function. Fibrosis has been linked to cell contractility, although the underlying mechanisms of these events are not well characterized. Cells sense changes in their mechanical microenvironment, such as stiffness changes associated with fibrosis, through transmembrane proteins. Such responses are commonly studied through the use of linear elastic substrates, such as polyacrylamide gels. Most tissues display nonlinear elastic properties, however, few materials exist to controllably mimic the nonlinear elastic properties of physiological tissues. We aim to utilize microgel thin films as a novel platform for studying cellular responses on nonlinear elastic substrates to characterize the role these properties play in fibrotic responses. Microgels are colloidal particles with tunable properties that can be combined with linear polyelectrolytes to create multilayer thin films with controllable viscoelastic properties. The viscoelasticity of these multilayer thin films can be controlled through the intraparticle crosslinking density. In this series of experiments, we examined spreading and migration responses of human dermal fibroblasts on microgel thin films displaying a range of viscoelastic properties. The contractility of single fibroblasts on varying substrates was examined through traction force microscopy, a methodology that allows for quantification of cell contractility through indirect correlation to generated traction forces. Highly viscoelastic films were found to induce the highest degree of cell contractility while lower contractility was observed on intermediately viscoelastic substrates. Future studies will aim to characterize the underlying mechanisms contributing to these responses.

Supernova explosions start with the core-collapse of massive stars, in which the spherical accretion shock instability (SASI) has been shown to play a key role. The origin of the SASI is under inquiry. To investigate the physics of the SASI, we use two-dimensional hydrodynamic simulations to quantify its growth rate and wave speed. We utilize the flexibility of the simulation model to adjust the number of radians in a circle in order to distinguish between radial and transverse propagation. For circular sectors (circles redefined to have maximum central angles that are not 2π radians) where we find single arm (m = 1) spiral modes, we analyze the growth rate of the SASI. We observe a linear correlation between the angular speed of the SASI and the sector angle size. We also also observe a near linear correlation between the growth rate of the SASI and the sector angle size for sectors with large angles, but observe a nonlinear increase in the growth rate for small sector angles.

Airflow downstream of a standard bladed fan experiences increased turbulence due to the mixing of outgoing airflow. The Dyson bladeless fan exudes a less turbulent flow than the standard desk fan due to it’s unique design, and therefore presents the opportunity for more suitable testing of small-scale models. The experiments in this research included the use of a CTA, hot-wire probe, and movable mechanical frame to test for turbulence intensity in the wake of a bladeless fan. The turbulence intensity was tested in seven equally positioned fields at a rate of 200 Hz for five seconds. Splining techniques were used for the calibration of hot-wire voltages correlated to dynamic pressure changes in the flow, and turbulence intensity was measured the standard deviation of the flow velocity over the mean flow velocity at any given point. Because the air speeds of the bladeless fan are very low, the experiments were conducted inside an anechoic chamber to reduce additional turbulence caused in the flow by sound distribution.
Snowflake Mixtures In Coastal Northeast United States Winter Storms
Levi Lovell, Meteorology NC State University

Mentors and/or Co-Authors:
Sandra Yuter College of Sciences NC State University

Heavy snow and ice from cold-season extratropical cyclones in the northeastern United States can shut down major cities for extended periods. Snow and mixed-phase precipitation accumulation are influenced by many characteristics including the number and sizes of particles, particle crystal shape, degree of riming, and density. Previous work indicates that specific types of snow particles fall within different regions or sectors of cyclones. Denser, more rimed snow is expected close to the cyclone low-pressure center while less dense, less rimed snow occurs along the northwest edge of the storm. We use a vertically pointing radar and a multi-angle snowflake camera to examine storm structure and surface precipitation at Stony Brook University on Long Island in New York. Our data show that heavily rimed particles (i.e. graupel) can occur in weakly forced environments and unrimed snowflakes can occur near developing cyclones. The radar data reveal generating cells and fall streaks marked by narrow bands of locally increased reflectivity and spectral width. These features originate from instability near cloud-top. Increased reflectivity is typically associated with increased snow rate, but variations in any number of snowflake characteristics, including whether snow is partially melted, can affect reflectivity. During some storms, snow particles that fell to the surface concurrently originated from different places within the storm, likely formed at different times, and took different paths to the surface. This is a result of turbulent eddies and updrafts that disperse and circulate particles.

Zoonotic Tick-borne Diseases In Lemurs
Khushbu Madhiwala, Biochemistry NC State University

Mentors and/or Co-Authors:
Barbara Qurollo College of Veterinary Medicine NC State University
Jasmine Haltam BA in Biology NC State University

Tick-borne parasites (TBPs) can cause significant illnesses in numerous species across the globe. Advances in genetic sequencing have helped to discover emerging diseases in wildlife. Unfortunately, little information in known about the impact of TBPs on human and animal health in developing countries. In a previous study led by Duke University, researchers used next-generation sequencing to screen for blood-borne diseases in wild lemurs (which are distant primate cousins to humans). New TBPs, including a Babesia sp., Borrelia sp. and Neoerlichia sp. were discovered. The objective of this project was to determine if the new lemur TBPs infected dogs from Madagascar. Furthermore, we aimed to identify TBPs in ticks that were collected from the wild lemurs. Using PCR designed to amplify TBPs, we tested the blood of ten dogs that lived on farms near forests where the wild lemurs live and 11 tick samples, collected from wild lemurs. We hypothesize that we will detect at least one of the TBPs the dogs and ticks and that it will be identical or genetically similar to strains identified in wild lemurs.

Predicting Uv-vis Absorption Spectra Of Organic Dyes With Td-dft
Drew Marshburn, Computer Science NC State University

Mentors and/or Co-Authors:
Elena Jakubikova College of Sciences North Carolina State University
Shuhua Yin Statistics NC State University
Caroline Mann Statistics NC State University

The Max A. Weaver Dye Library at North Carolina State University contains well over 90,000 organic dyes that have potential applications as solar energy harvesters, cancer therapy agents, or textile dyes, among many others. The library is also an excellent source of synthesized dyes that can be used to benchmark computational approaches for predicting the UV-Vis absorption spectra of various dye families. We created two test sets with representative complexes from the dye library; one set containing azobenzenes, and the other containing cyanoethylene dyes. Density functional theory (DFT) and time-dependent DFT (TD-DFT) were utilized for structure optimization and generation of UV-Vis
absorption spectra. The UV-Vis spectra for each compound was measured experimentally and compared with the TD-DFT results to gauge the error in the model chemistries. It was found that the magnitude of the error was affected by the amount of explicit HF exchange included in the functional, as well as the charge transfer (CT) character of the transition, and was different for each dye family.

Poster Number: 32
A Solution To Peto’s Paradox: P53 Copy Number In Large-bodied Marine Mammals
Elaina Martz Genetics NC State University
Mentors and/or Co-Authors:
Seth Faith College of Veterinary Medicine NC State University

Peto’s Paradox describes the observation that large animals have relatively low rates of cancer incidence, in comparison to the large amount of cell divisions required to reach their large size. This requirement for a massive number of cell divisions should theoretically result in higher rates of cancer-causing mutations. Because high rates of mutation and cancer are not found in nature, it is proposed mechanisms must exist to protect large animals from mutations acquired during cell division. Two independent studies of African elephants provided a partial solution to Peto’s Paradox. African elephants have 20 copies of the tumor suppressor protein TP53, while humans have just one copy (Ablegglen et. al. 2015; Sulak et. al. 2016). These TP53 copies increase the rate of apoptosis with exposure to DNA-damaging radiation, choosing the survival of the organism over that of damaged cells (Ablegglen 2015). Based on these studies, we hypothesize that other large animals, such as cetaceans, evolved protective mechanisms similar to elephants. In order to test this hypothesis, we will determine the TP53 copy number in cetaceans as a possible evolutionary mechanism for survival of large species through quantitative and Droplet Digital Polymerase Chain Reaction. Our preliminary results indicate elevated TP53 copy number in cetaceans, supporting copy expansion as a common protective mechanism. This study will help us understand mechanisms through which large-bodied animals have evolved. Future work will use unbiased whole-genome approaches to identify other genes involved in tumor suppression.

Poster Number: 216
Using The Collaborative Cross To Identify Eqtls In Tce Response
Connor McKenney Genetics NC State University
Mentors and/or Co-Authors:
David Aylor College of Sciences NC State University

Trichloroethylene (TCE) is a known carcinogen that has been used as a general anesthetic and an organic solvent. To better understand why individuals respond differently to treatment with TCE, we sought to locate regions of DNA that regulate gene expression in response to TCE. These regions are called expression quantitative trait loci (eQTLs), and the idea that eQTLs can explain variable responses to toxins has become increasingly popular. Using 50 strains of mice from the Collaborative Cross, a mouse genetic reference panel for complex trait analysis, we measured the response to four different doses of TCE along with control mice that did not receive TCE. Each mouse received a single oral dose, and organs were collected 24 hours after dosing. Liver transcripts were measured, and transcript abundance was compared to single nucleotide polymorphisms (SNPs) throughout the genome. For each gene-SNP pair, a LOD score was calculated to express the likelihood that the SNP was located in an eQTL for the gene. The genome-wide significance threshold was determined by a permutation test.

Poster Number: 230
Hplc Method Development And Validation For Purity And Quantity Of Green Fluorescent Protein
Alison Mull Biomedical Engineering NC State University
Mentors and/or Co-Authors:
Nathaniel Hentz College of Agricultural and Life Sciences NC State University

The goal of this study was to develop a method for purity determination and quantitation of green fluorescent protein (GFP) using size-exclusion high performance liquid chromatography (SE-HPLC). GFP is the model bioprocess protein at the Golden LEAF Biomanufacturing Training and Education Center, where this research is being
conducted. Method development included column screening, mobile phase screening, and molecular weight linearity testing using protein standards. Based on these results, the AdvanceBio SEC 300Å column was chosen as the stationary phase, while phosphate buffered saline (PBS) was chosen as the mobile phase. The method was then subjected to validation testing, which included linearity, instrument precision, analyst precision, accuracy, and robustness. The detection techniques used in the selected method included UV absorption and fluorescence. The chromatogram data collected for UV absorption was analyzed at two different wavelengths: 280 nm and 379 nm. Absorbance at 280 nm is used to monitor all proteins, while absorbance at 379 nm is very specific to GFP. A ratio between the peak areas at these two wavelengths gave the purity of GFP in the given sample. Further validation and purity results will be presented in the poster.

Poster Number: 165
Exploration Of Active Rotation: From Motility To Clustering
Michael Murphy Physics NC State University
Mentors and/or Co-Authors:
Karen Daniels College of Sciences NC State University
Shane Henderson Nuclear Engineering NC State University

Active matter is a field of physics which prescribes equations of motion to movements and interactions of self-propelled, or living, organisms. At present, little work has been done in the exploration of objects which exhibit both translational and rotational motion. With this research, we seek to explore this paradigm by examining the emergent property of clustering in the system. Our “active spinners” allow clustering in the limit of geometric friction, motility, and noise. We perform experiments on rigid circular shapes which have five rigid circular bumps out from their main body. By varying the amount the bumps protrude, we effectively increase or decrease the geometric friction between particles. Using video capture and machine vision methods, we examine the particles in a closed region. By identifying the velocity distributions and mean-squared displacement where clustering occurs in the system we establish a framework for looking at the clustering dynamics of dilute systems.

Poster Number: 83
Localized Buckles Manipulated By Polymeric Patterns Printed On A Laminated Metal/polymer Bilayer
Umaash Nallainathan, Chemical Engineering NC State University
Mentors and/or Co-Authors:
Michael Dickey College of Engineering NC State University

Patterning via mechanical buckling instabilities is a promising approach to generate micro-scale features in thin films. Laminated metal/polymeric films on a rigid substrate can form a buckled topography over the entire surface. This is caused by compressive thermal stresses induced by the difference of thermal expansion of the individual layers. Here, buckles spontaneously formed in a bilayer on a silicon wafer by exposing it to infrared (IR) light. The light heats the film and causes it to buckle. Micro-contact printed stiff polymer patterns on the surface physically suppress buckling, resulting in buckling only in non-patterned regions. This approach can be implemented in several prospective applications in microelectronic mechanical systems, thin film metrology, and facile small-scale fabrication.

Poster Number: 189
The Effects Of Flooding On The Growth Of Bald Cypress In Freshwater Restored Wetlands.
Elea Reyna Ocampo, Environmental Science NC State University
Mentors and/or Co-Authors:
Marcelo Ardon Sayao College of Natural Resources NC State University

Significant ecological changes are occurring in the wetlands of eastern North Carolina caused by climate change and more specifically, sea level rise. Understanding the changes happening in forested coastal wetlands is critical to planning successful wetland restoration projects. Bald cypress (Taxodium distichum) are commonly planted in restored wetlands in this region because they are native to eastern NC, play a major role in the ecology of wetlands, and are commercially viable to propagate. The question remains whether this species will be resilient to the effects of increased flooding due to sea level rise. This study examined the effects of water level on the growth of bald cypress.
We compared the diameter at breast height (DBH) of 258 bald cypress trees in 2017 to measurements collected in 2012 in the Timberlake Observatory for Wetland Restoration in Tyrell County, NC. Sampling plots were grouped in three classes: “low” (30cm), according to their water depth. Analysis of variance showed no significant differences in tree growth between water level classes (F(2,254)=0.14, p=0.87). High water levels did have a negative effect on the DBH of bald cypress trees (F(2,250)=23.89, p.

Hydrogen peroxide (H$_2$O$_2$) has been implicated in the slow destruction of dopaminergic neurons in Parkinson’s disease (PD). This neurodegenerative disease affects more than one million people in America, creating a critical need to identify the mechanisms through which H$_2$O$_2$ interacts with dopaminergic neurons. Real-time detection of this analyte in vivo has recently been described using fast-scan cyclic voltammetry at carbon-fiber electrodes. However, distinguishing H$_2$O$_2$ from interferents such as adenosine and pH shifts remains a challenge. Additionally, chemical agents used to pharmacologically verify the presence of hydrogen peroxide production in the brain, such as mercaptosuccinic acid (MCS), have similar oxidation peaks to that of the target analyte, further convoluting the characterization of robust H$_2$O$_2$ dynamics in the brain. We have addressed these problems by fabricating mechanically robust H$_2$O$_2$ selective electrodes. 1,3-phenylenediamine (mPD) was electrodeposited onto the surface of the carbon-fiber electrode to render it insensitive to the larger analytes. Since pH changes generate a well-characterized and distinct voltammogram, they can easily be removed from the signal using principal component regression, leaving an electrochemical signal due solely to the oxidation of hydrogen peroxide. This technology was fully characterized and the work will facilitate the selective detection of H$_2$O$_2$ in vivo, opening the door for further elucidation of the neurodegenerative role it plays in PD, as well as other neuropathies involving oxidative stress.

Knowledge of the many characteristics that affect fish communities and populations is critical to conserving and protecting watershed wildlife. The objective of this study was to investigate the relationship between fish lengths, species present, and land use land cover in watersheds. To identify the different relationships field work such as; collection of water samples, sediment, temperature, oxygen levels, electrofishing, and geographic information system (GIS) analysis to further explore how these watershed characteristics effect fish communities and populations. Electrofishing utilizes direct current electricity streaming between a submerged cathode and anode. This influences the direction of which the fish travel, which increases the probability that the fish will swim towards the anode where they can be captured. GIS is the framework intended to catch, store, control, examine, oversee, and exhibit a wide range and present all types of geographical data. The expected result for this study is to see one or more environmental factor that explains the existence or lack of existence of different fish communities and populations.

Maternal Obesity, Pro-inflammatory Cytokines And Offspring Blood Pressure And Obesity
Benazir Asifa Mohamed Raffi, Microbiology: Health Sciences Concentration NC State University
Mentors and/or Co-Authors:
Cathrine Hoyo College of Sciences NC State University
Arilyn McCoy Evolution, Ecology, and Conservation Biology NC State University
Drew Phillips Inter-College transfer NC State University
Background: Approximately one third of women of childbearing age are obese and ~20% of conceptions occur in obese women. In addition, ~40% of women with a normal pre-pregnancy weight, gain excessive weight during gestation. Both pre-pregnancy obesity and excessive gestational weight gain (GWG) are risk factors for obesity and other cardiometabolic dysfunction in children. While chronic systemic inflammation is hypothesized to link gestational obesity to cardiometabolic dysfunction in offspring, empirical data are limited in humans. Methods: Logistic regression models were employed to examine associations among pre-pregnancy obesity (BMI>30), excessive GWG, systemic inflammatory cytokines/chemokines, and indicators of cardiometabolic function in 356 mother-infant pairs participating in a multiethnic cohort. Maternal obesity, child blood pressure and obesity at 5 years were ascertained via questionnaires and medical records. Cytokines/chemokines were measured using human cytokine EMD Milliplex MAP kit. Results: Among African Americans but not Whites, obese women had a dose dependent increase in TNF-α levels compared to non-obese women. These elevated TNF-α levels were associated with pre-hypertension in African American offspring. In contrast, associations between excessive GWG and IL4 were not dose-dependent in African Americans. Higher IL-4 concentrations were associated with a lower risk of obesity at age five years; associations were somewhat stronger in male offspring. Conclusion: Despite a limited number of cytokines/chemokines examined, these data are consistent with pre-pregnancy obesity influencing immune responses that may be distinct from those influenced by excessive GWG and effects may be race and sex specific. Larger studies are required to confirm these findings.

Poster Number: 257
How Do The Indices Stack Up? Evaluating Drought Indices Against On-the-ground Impacts
Karl Schneider Statistics NC State University
Mentors and/or Co-Authors:
Rebecca Ward College of Sciences NC State University

The State Climate Office of North Carolina (SCO) has developed methodologies to calculate several drought indices on a fine spatial grid (~4.5 km) and a high temporal frequency using multi-sensor precipitation estimates from NOAA’s Advanced Hydrologic Prediction Service (AHPS) and gridded Parameter-elevation Regression on Independent Slopes Model (PRISM) temperature and historical precipitation data. These SCO-generated drought indices include the Standardized Precipitation Index (SPI), Standardized Precipitation Evapotranspiration Index (SPEI), and a weighted SPI (SPI Blend). Various timescales of these indices are evaluated against on-the-ground indicators of drought: streamflow, soil moisture, and groundwater, as well as against subjective wetness/dryness reports from the CoCoRaHS Condition Monitoring program. Data are screened for quality and anthropological influence. Spearman’s correlation coefficient is used to measure association strength between drought indices and indicators. SPEI and SPI Blend are found to associate more strongly with drought indicators than SPI, with the strongest correlations at shorter timescales. Similar results were found for the comparison between condition monitoring reports and drought indices, with the SPEI, which includes temperature in its calculation, having a stronger correlation with condition monitoring reports than SPI, which is based solely on precipitation. SCO is currently developing methodology to generate gridded monthly and daily Palmer Drought Indices (PDI). Ongoing preliminary evaluations of SCO PDI against independent PDI analysis with different data inputs suggest strong agreement for Spring through Fall (Spearman correlations over 0.70) while winter correlations are lower (around 0.40). Future work will be to evaluate the daily gridded PDI algorithm.

Poster Number: 264
Surface Disinfectant Study Of Disinfectants Used In Biomanufacturing
David Stackhouse Chemical Engineering NC State University
Mentors and/or Co-Authors:
Richard Lawless College of Engineering NC State University

The project I worked on is the development of study protocols and analytical methods for surface challenge tests on disinfectants used in biomanufacturing. The protocols and methods are necessary to validate that cleaners and disinfectants are performing according to standards, and that the collection of data and analysis of the cleaners are performed identically. These protocols are required in all pharmaceutical manufacturing facilities. The procedure for making the protocols required first, the development of analytical methods to enumerate bacterial spores from swabs and biological indicators. After the analytical methods were completed, the second step was to create the study protocols and perform surface challenge tests to validate the protocols. The analytical methods that first needed to be
developed were the recovery of spores from the swabs as well as the recovery of spores from the biological indicators. For the spore recovery off of swabs, I used bacillus subtilus spores, and then recovered them by swabbing inoculated surfaces and plating the recovered bacteria on tryptic soy agar (TSA) plates. For the spore recovery off of the biological indicators, I used geobacillus stearothermophilus spores and sonication to get the spores into solution to be plated on TSA plates. The last part of the project involved developing the protocols for the surface challenge tests, where I tested the cleaning efficacy of Spor-Klenz, SporGon, and SteraMist against bacterial spores on stainless steel and vinyl tile surfaces.

Poster Number: 4
**Impact of Plastic Pollution On The Bacterial Pathogen listeria Monocytogenes in A Local Stream, Rocky Branch Creek**

**Connor Stewart** *Microbiology* NC State University  
**Saheli Parekh** *Microbiology* NC State University  

*Mentors and/or Co-Authors:*

**Sophia Kathariou** College of Agriculture & Life Sciences NC State University

The bacterial foodborne pathogen *Listeria monocytogenes* (LM) can cause severe, invasive disease (listeriosis), but its ecology remains poorly understood. While its presence in bodies of water has been documented, little is known about how plastics and other debris may affect its prevalence. The purpose of the study was to investigate possible correlations between LM presence and plastic debris in naturally occurring bodies of water. Styrofoam cups were used as model for plastic debris. They were immersed and later collected in Rocky Branch Creek in Raleigh, North Carolina. Samples of the surrounding water were also collected. Selective enrichments and other microbiological assessments were employed to determine the presence of LM and other *Listeria* species on the debris or in the water. Isolates were tested to determine hemolytic activity (tentatively indicating LM) and resistance against heavy metals (cadmium, arsenic), antibiotics (tetracycline), and a quaternary ammonium disinfectant (benzalkonium chloride) (BC). They were also tested by multiplex PCR to determine serotype designations. *Listeria* was detected in 90 and 47% of the 10 debris and 19 water samples, respectively. Forty of 50 non-LM isolates were resistant to cadmium and BC or arsenic. Multiplex PCR of 21 LM isolates indicated that most (71%) were 4b, followed by 1/2b (19%); 1/2a and 1/2c each accounted for 5%. These serotypes also account for the majority of human listeriosis. These data suggest possible correlations between presence of pathogenic Listeria and plastic debris in surface water bodies. Future research needs to be conducted to extend these findings.

Poster Number: 72
**Assessment Of Survival And Virulence Of Salmonella In Low Moisture Foods**

**Brandon Stone**, NC State University  

*Mentors and/or Co-Authors:*

**Sophia Kathariou** College of Agriculture & Life Sciences NC State University  
**John Fang** Biological Sciences NC State University

Salmonella causes one million foodborne illnesses annually in the U.S (CDC, 2017). Several of these outbreaks are linked to various Low Moisture foods (LMFs). This study assessed the capacity of Salmonella to survive and maintain virulence in LMFs. A five-strain cocktail of Salmonella serotypes Mbandaka, Enteritidis, Agona, Montevideo and Tennessee was used to inoculate 200g chocolate chunks and cornflakes (10% v/w), and in-shell pistachios (4% v/w). Inoculated cornflakes and chocolate were dried for 7d and pistachios for 1 d at 22o C to equilibrate the Aw to pre-inoculation levels. The products were aliquoted in 15-ml centrifuge tubes and stored in the dark at 22o C. Salmonella populations were enumerated after inoculation, after drying and at 1, 3, 7, and 12 d of storage on non-selective (TSA-YE) and selective (XLD) media. To assess virulence, *Galleria mellonella* larvae were injected in the last left proleg with 10 µl of rinsate from inoculated LMFs at 1 and 7d, incubated at 37o C and daily monitored for survival. The population of Salmonella was ~10 LogCFU/g in chocolate and pistachios and ~9 LogCFU/g in cornflakes immediately after inoculation. After drying, there was a 2-log reduction in Salmonella counts in chocolate and cornflakes and 1-log reduction in pistachios but no significant reduction during storage. Percentage mortality of larvae inoculated with 104 cells from LMFs at 1 and 7 d were 20-50% at 5 d. Findings show that Salmonella can survive and maintain virulence in the low moisture foods tested.
Hydrodynamic Simulations Of Kepler’s Supernova Remnant
Jessie Sullivan  Physics  NC State University
Mentors and/or Co-Authors:
John Blondin  College of Sciences NC State University

Kepler’s supernova, observed in 1604, is the most recently observed thermonuclear supernova. Understanding these explosions of white dwarf stars is important as these events produce much of the iron in the universe in addition to playing other roles. We present 3D hydrodynamic simulations that hope to match observations of Kepler’s supernova remnant. These models attempt to recreate the conditions around the progenitor at the time of the explosions as well as the blast wave using the VH-1 hydrodynamics code. We first modeled the bowshock created by the anisotropic wind the progenitor appeared to emit, then the blast wave from the supernova. The final simulation combines the two and allows the blast wave to expand into the bowshock. We controlled various properties of the model through manipulating parameters like the density contrast between the poles in the presupernova wind. This allowed models to be produced that contained similar features to those seen in Kepler. We analyzed these models by comparing x-ray observations to 2D images created from the model that simulate what would be seen through an x-ray telescope, and the motion of individual parts of the model to the movement seen in observations taken at different times. By determining the validity of the model, we hope to gain better understanding of the system that created Kepler.

Solubilization Of Phosphate In Amorphous Ferrihydrite Solution In Response To Co-added Avail® Polymers
Maggie Thompson, Environmental Engineering  NC State University
Mentors and/or Co-Authors:
Sarah Doydora  College of Agriculture & Life Sciences NC State University

Phosphate retention is high in soils with more than 60% of this applied macronutrient rendered unutilized by many crops in one growing season. AVAIL® polymer systems have been commercially developed to aid in phosphate availability and plant uptake. However, results from field tests showed inconsistent crop responses. Moreover, limited work has been done in determining their mode of action. The objective of this research was to determine the major chemical mechanisms on how the original and the new AVAIL® polymers solubilize phosphate in soil. A given level of phosphate was reacted with different levels of the polymers to a ferrihydrite suspension. After 42 h of reaction, the suspensions were centrifuged, filtered and the filtrate was analyzed for dissolved phosphate, and other parameters. The original AVAIL dissolved up to 34 to 49% more phosphate compared to the new polymers except for the new formulation designated as VLS 9101. Concentrations of dissolved, complexed Fe also increased with increasing levels of added polymers. However, their trends did not necessarily follow those observed for dissolved phosphate, suggesting that dissolution of the ferrihydrite may not be the main driver for the increasing dissolved phosphate. It is likely that competitive sorption between the phosphate and the polymers dominated the polymer responses. Data on competitive sorption will be presented. Results from this experiment could provide understanding on the comparable effectiveness of the original AVAIL and VLS 9101 over the other new formulations in acid soils where phosphate sorbents such as Fe oxides abound.

Evaluation Of Signal Peptides For Optimized Expression Of Rituximab In Chinese Hamster Ovary Cells
Brendan Turner  Chemical Engineering  NC State University
Mentors and/or Co-Authors:
Caroline Smith-Moore  College of Engineering NC State University

Monoclonal antibodies are powerful biopharmaceuticals utilized in the treatment of a variety of conditions. Biomanufacturing of these antibodies is limited by the amount of protein that can be secreted by a cell line. Signal peptides have been shown to be strong determinants of successful protein secretion, and the choice of signal peptide can have varying effects on antibody production. The aim of this research was to determine how altering signal peptides in the heavy chain (HC) and light chain (LC) of Rituximab affected expression levels in CHO-S cells. HC and LC genes were modified through PCR cloning to replace the original signal peptide of Rituximab (IgK) with H7,
RAGE, SA, and GS signal peptides respectively. Signal peptide inserts were ligated into phCMVIII plasmids for transient expression in CHO-S. CHO-S cells were co-transfected in triplicate with plasmids containing the HC or LC genes fused to the same signal peptide sequences and cultured in six-well plates. Culture viability and expression levels were monitored over time using a hemocytometer and BLItz. The expression levels were further validated by ELISA. Western Blot analysis was employed to detect relative proportions of heavy and light chain Rituximab for each signal peptide. The signal peptide found to express the most Rituximab will be utilized in the generation of a stable, monoclonal CHO cell line for the production of high levels of Rituximab.

Poster Number: 81

Digestibility Of A Whey Protein-pectin Particle Designed For Nutritional Beverages
Sarah von Schmeling Food Science NC State University

Mentors and/or Co-Authors:
Allen Foegeding College of Agriculture and Life Sciences NC State University

Whey protein beverages are becoming increasingly popular due to health benefits; however, astringency at low (~3.5) pH and off-flavors at neutral (~7) pH limits their acceptability. A pH of 4 to 5 will lessen these negative effects, but whey proteins at this pH are unstable due to low electrostatic stabilization. Wagoner et al. (2015) developed a process for complexing whey protein isolate (WPI) with high-methoxyl pectin (HMP) that produced electrostatically stable nano-scale particles. While Wagoner et al. (2015) established thermal stability of the particles, it is unknown if complexation would negatively affect protein digestibility. The objective of this study was to compare the digestibility of protein-pectin particles with protein alone in a typical high protein beverage. Particles were formed at a WPI to HMP ratio of 10:1 by titrating from pH 7 to 5. Beverages contained 6% (w/w) protein, 6% (w/w) sugar, and 3% (w/w) strawberry flavoring. Digestibility was assessed using a staged in vitro digestion method and following the loss of proteins. Relative quantities of the two main whey proteins, alpha-lactalbumin and beta-lactoglobulin, were determined after each stage using sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) and densitometry. Pectin caused a decrease in the extent of digestion of both main proteins in the gastric phase, but the extent of digestion was normalized by the end of the intestinal phase. It appears that protein-pectin particles may alter the rate of digestion but the overall digestibility of whey proteins remains the same.

Poster Number: 231

Development Of A Peptide Mass Fingerprinting Method For The Green Fluorescent Protein
Elizabeth Weaver Chemical & Biomolecular Engineering NC State University

Mentors and/or Co-Authors:
Nathaniel Hentz College of Agricultural and Life Sciences NC State University

Peptide mass fingerprinting (PMF) is a protein identification method in which a protein of interest is cleaved into small peptides using a digestive enzyme that cleaves at very specific peptide bonds. The peptides are then separated by high performance liquid chromatography (HPLC) and identified either through UV or mass detection. This study was conducted to create a PMF method for green fluorescent protein (GFP), and then to evaluate variations in the peptide map when the protein was subjected to forced degradation. A GFP digestion method was used involving heat denaturation, a buffer at an elevated pH, and the digestive enzyme, trypsin. The PMF method was developed and validated using HPLC and HPLC-MS. Following validation, degradation studies involving oxidation, hydrolysis, heat, and light were used to determine which peptides were targeted. For example, amino acids such as methionine, cysteine, histidine, tryptophan, and tyrosine are susceptible to oxidation. Theoretically, peptides incorporating these amino acid residues should be oxidized resulting in chromatographic peak shifts. These degradation results helped the understanding of the protein stability and degradation pathways of GFP. More detailed results will be presented.

Poster Number: 250

Exploring Sustainable Coagulation Baths For The Gel Spinning Of Poly(vinyl Alcohol) Fibers
Raquel Megan Weis Polymer and Color Chemistry NC State University

Mentors and/or Co-Authors:
Ericka Ford College of Textiles NC State University
Poly(vinyl alcohol) (PVA) is a water-soluble synthetic polymer that is widely used in the textile industry, particularly in fiber production due to its cost effectiveness, excellent molecular bonding with additives, high elasticity, and resistance to UV degradation. High strength PVA fibers are produced using the gel spinning technique. However, solvents used to form the gel fiber poses a significant health risk to humans and nature. This study addresses the need for greener, more sustainable coagulation baths for the gel-spinning of continuous fiber in a laboratory setting. It is well known that PVA gels will coagulate adequately in 100% methanol. Methanol, though, is highly toxic to biological lifeforms and is incredibly flammable, having a flash point around 12˚C (53.6 °F). Moving away from its use would make the gel spinning process more industrially attractive for commercialization. Acetone is a promising substitute due to its ability to coagulate PVA upon contact. But can acetone adequately replace methanol in the coagulation of PVA fibers and allow those fibers to maintain or exceed their unique characteristics? Within this study, we performed drop tests, where drops of dope were added to 5-10 mL coagulation baths, to determine the appropriate solvent ratios of acetone/methanol for PVA gelation. Based on those observations, promising acetone-containing coagulation baths were used to spin PVA. The mechanical properties and structure of those gel-spun fibers will be discussed.

Poster Number: 261

Characterizing The Affects Of Root Developmental Alterations On Fe Homeostasis In Arabidopsis thaliana

Kenya Williams Biology Shaw University

Mentors and/or Co-Authors:

Terri Long College of Agriculture and Life Sciences NC State University

Iron is a micronutrient essential for the growth and development of all living beings. It is the co-factor of many enzymes and proteins involved in metabolism, respiration and other metabolic processes. Most people obtain nutritional iron from plants. Understanding iron plant homeostasis in plants is important because it could lead to development of tools to improve tolerance to nutrient poor soils and increase plant nutritional content for human consumption. Although abundant in the soil crust in the ferric iron state, dicot plants can absorb iron mostly in the ferrous iron state. Plants have developed mechanisms to acquire, transport, use and store iron inside the plant cells including extrusion of protons into the rhizosphere. One of the first steps in responding to iron deprivation is the reduction of pH in the surrounding rhizosphere due to elevated proton pump activity. This proton pump activity and subsequent acidification of the rhizosphere makes iron more soluble and available to plants and is a marker of a functional iron deficiency response. These and other physiological modification are also associated with root developmental alterations that increase the root surface area for elevated absorption. Here, we have characterized the overall developmental and proton extrusion properties of root developmental mutants in response to iron deprivation. We have also observed the capacity of these mutants to acidify the rhizosphere. We have identified several mutants that exhibit altered growth and rhizosphere acidification properties compared to wild type, which adds another dimension to understanding iron homeostasis mechanism in plants.

Poster Number: 100

Investigation Of The Effect Of Fenton Chemistry On Dopamine Using Fast-scan Cyclic Voltammetry

Nicholas Williams, Green Hope High School Student NC State University

Mentors and/or Co-Authors:

Leslie Sombers College of Sciences NC State University

Parkinson’s disease is a neurodegenerative disorder that involves the degradation of dopaminergic neurons in the substantia nigra, an area of the brain characterized by high basal iron content. Free iron in the substantia nigra could contribute to the production of reactive oxygen species through Fenton-like reactions with endogenous hydrogen peroxide that is present in brain tissue. These reactive oxygen species could then interact with catecholamines, such as dopamine, causing them to undergo chemical oxidation. The goal of this project is to use fast-scan cyclic voltammetry, a rapid detection method, as a tool to assess the potential of physiological concentrations of iron (III) and hydrogen peroxide to promote the chemical oxidation of dopamine. Carbon-fiber microelectrodes were used to perform cyclic voltammetry of each of these species individually and in combination. Preliminary findings for this experiment indicate dopamine is chemically altered when combined with iron (III) alone and when in combination with hydrogen peroxide. Results from this in vitro study will allow us to better understand how Fenton chemistry can modulate neurochemicals in the substantia nigra and potentially contribute to oxidative stress in the brain.
Using Cardiovascular System Models For Deep Phenotyping Of Cardiac Function In Heart Transplant Patients

Payton Woodall Mathematics NC State University
Mentors and/or Co-Authors:
Mette Olufsen College of Sciences NC State University

Clinicians evaluate the function of a transplanted heart via right heart catheterization measurements for a year following transplantation. The measurements allow clinicians to identify problems with the new organ; however, earlier detection of these problems would allow for better results and prevent potential subsequent transplants. We combine clinical measurements with a closed loop cardiovascular systems model from Smith et al. (*Med Eng Physics* 26:131, 2004) with ventricular-ventricular interaction to characterize cardiac function after transplantation. Patient’s data includes systolic and diastolic pressure values at several locations in and around the heart as well as cardiac output. Although we are unable to quantify all parameters, we evaluate several patient-specific parameters to provide a more individualistic approach using the given data. Afterwards, we analyze the model for the most sensitive parameters to take proper precautions when we optimize the model. Optimizing the model provides details that are difficult to gather otherwise and thus provides insight on the physiology of the transplanted heart with readily available measurements.

Quantifying Pulmonary Vascular Morphology In Mice

Anna Yarbrough, Applied Mathematics NC State University
Mentors and/or Co-Authors:
Mette Olufsen College of Sciences NC State University
Dalton Xue Zoology NC State University

This project focuses on devising a new protocol to extract morphometric properties in the pulmonary vasculature under healthy and hypertensive conditions. Specifically, the objective is to determine how hypertension modulates (a) vessel radius, length, and branching morphometry and (b) distensibility. Moreover, we aim to investigate if generalized fractal scaling laws can be devised and related to dimensions of the root vessel. 1D networks connecting vessels of a given length and radius are extracted from micro computerized tomography (micro-CT) images of mice lungs. Data are sampled from three healthy and four hypertensive mice, each perfused at four different pressures ranging from 6.3 to 17.2 mmHg. Hypertension is induced by exposing the mice to 10 days of hypoxia. 3D mesh reconstruction of the main and supernumerary blood vessels is obtained using an image segmentation framework combining ITK-Snap, Paraview, and the Vascular Modelling Toolkit (VMTK). VMTK allows us to extract the center coordinates and radii measurements along each vessel in the network. Finally, a Matlab algorithm has been developed to map the 3D network to a topologically equivalent directed graph. Each edge in the graph is associated with an averaged radius and length measurement of the corresponding vessel in the 3D domain. It is hypothesized that the branching of the hypoxic mice networks will be more sporadic and the overall stiffness will increase compared to the healthy mice.
NSF REU - Evaluating Stream Restoration Approaches

Poster Number: 124

**Investigating The Relationship Between Applied Shear Stress And Erosion Rate Of Cohesive Soils Using Jets**

*Katherine Wardinski* *Environmental Engineering* University of Wisconsin-Platteville

*Mentors and/or Co-Authors:*

*Garey Fox* College of Agriculture and Life Sciences NC State University

*Kathryn Scruggs* *Applied Nutrition* NC State University

*Caitlin Given* *Applied Nutrition* NC State University

The erosion rate of soils is generally simulated assuming a linear relationship between erosion rate and applied shear stress. This model was obtained from erosion rates measured over narrow and low ranges of shear stresses (0-15 Pa). Recent experimental data and mechanistic theories make a case for a non-linear behavior of the detachment process. The accuracy of the linear and non-linear models in predicting erosion at high shear stresses has not been heavily explored. Jet erosion tests (JETs) simulate erosion by a vertical jet to determine the soil erosion properties. The objectives of this research were to: (1) use JETs to analyze erosion rates over wide ranges of shear stresses, (2) determine whether a linear or non-linear model best fits the observed data, and (3) evaluate the extrapolation potential of linear and non-linear models for larger ranges of shear stresses. 19 tests were performed using 5 different mixtures of sandy and clay soils. JET-derived erosion rates and shear stresses were obtained using a JET analysis spreadsheet. Regression analyses were applied to each data set, considering entire ranges of shear stress and specific windows to evaluate model accuracy and extrapolation potential. For certain trials, the linear law performed as well as non-linear laws. Other trials suggest that soil properties such as bulk density and grain size distribution might affect the detachment process. The window analysis showed that if calibrated over narrow ranges of shear stresses, the linear law does not allow for accurate extrapolation.

Poster Number: 127

**Comparison Of Pre-restoration And Post-restoration In-stream Solute Transport And Treatment In A Restored Coastal Plain Stream**

*Dani Winter* *Biological Engineering* NC State University

*Mentors and/or Co-Authors:*

*Garey Fox* College of Agriculture and Life Sciences NC State University

To evaluate the capacity of a stream restoration project to improve water quality and in-stream hydrology during baseflow conditions, solute injection experiments were conducted during pre- and post-restoration states at an Upper Coastal Plain restored stream. Based on ion concentration and specific conductivity (IC-SC) methods and in-situ spectrophotometry methods, downstream monitoring included high frequency specific conductivity and nitrate measurements (2 minutes) and lower frequency discrete samples (15 minutes to 1.5 hours). Potassium bromide (KBr) was injected as a non-reactive tracer to characterize hydrologic transport. Potassium nitrate (KNO$_3$) was injected as a reactive tracer to estimate in-stream first-order decay of nitrate. Results from both experiments were modeled with the USGS’s OTIS transient storage model and a statistical aggregate dead zone model. Two-sample t-tests were performed to compare hydrologic transport and chemical transformation model parameters between pre- and post-restoration states. Model outputs from high resolution and traditional sampling methods were also compared.
REU for Composites in Extreme Components

Poster Number: 192

Investigating The Effects Of Radome Damage On Radar Transparency
Katherine Berkowitz Mechanical Engineering University of Maryland Baltimore County
Mentors and/or Co-Authors:
Landon Grace College of Engineering NC State University

This study investigated how damage to polymer composite radome specimens affected radar transparency. Bismaleimide (BMI) laminates were impacted at four energy levels using a drop tower to simulate hail damage. The relative permittivity, an indicator of radar transparency, was measured before and after impact using a split-post dielectric resonator operating at 2.481 GHz. To determine the effects of impact and subsequent moisture contamination, a sample from each energy level along with four un-impacted samples were dried and then contaminated with water over 15 days to simulate exposure to humid air and precipitation post-impact. A direct correlation was found between impact energy level and relative permittivity at all levels of absorbed water, independent of exposure time. At 0.787% water content by weight, the 12 J impact caused a 10.28% increase in relative permittivity from the dry, un-impacted state and a 6.06% increase relative to un-impacted samples at the same water concentration. This suggests a higher ratio of free, high relative permittivity water corresponding to higher impact energy levels, consistent with formation of microfractures in the composite from impact. Using a 10 GHz SPDR, a reverse trend in relative permittivity was observed during tensile loading of two epoxy laminates and a BMI laminate. A dry and water-contaminated sample of each composite were strained at 0.2 mm/min, and relative permittivity and loss tangent were recorded every 0.1 mm. An inverse relationship was found between strain and relative permittivity, which is potentially due to a strain-induced reduction in the water-containing nanoscale free volume.

Poster Number: 170

Thermography Of Carbon Fiber/foam Composites
Diana Burden Material Science and Engineering Clemson University
Mentors and/or Co-Authors:
Kara Peters Engineering NC State University

Commonly, during manufacturing of any material, a sample of parts is subjected to destructive tests; however, due to safety restrictions in the aerospace industry, every manufactured part must be tested for defects, so destructive tests are supplemented with nondestructive methods including ultrasound and thermography. We studied samples of carbon fiber/foam composites for aerospace applications that have been producing false positive readings with ultrasound and investigated the potential of thermography on these samples. We explored pulsified phase thermography (PPT) which used heat waves to release one pulse of light and a thermal camera to take thermal images of the part cooling. After processing in MatLab, we produced images at different frequencies of the heat wave that were dictated by the phase shift. For simplicity, we examined two seemingly identical, flat sheets with minimal defects of carbon fiber/foam which had sections with different numbers of layers of carbon fiber and a copper foil. We saw that the copper foil had a similar effect in the phase shift as two layers of carbon fiber and that at approximately 0.5 Hz, the differences in the phase shifts of each section were negligible.

Poster Number: 186

Impact Resistance Of Carbon Nanotube Reinforced Polyurethane
Adam Corn Mechanical Engineering Mercer University
Mentors and/or Co-Authors:
Melissa Pasquinelli College of Textiles NC State University

Polyurethanes are a versatile family of polymers used for a variety of purposes. They consist of hard segments and soft segments and are formed by reacting a long chain diisocyanate with a short chain diol. A wide variety of polyurethanes with different properties can be produced by varying the ratio of hard segments to soft segments in the polymer chain. Inserting a filler into the polyurethane chain improves the mechanical properties of the material. Polyurethane composites have increased mechanical properties and are lightweight and biodegradable. More specifically, polyurethane
nanocomposites reinforced with carbon nanotubes (CNTs) have been found to have improved properties including enhanced acoustic damping, excellent breathable properties, and increased tensile strength. CNTs have superb mechanical properties which includes a high Young's Modulus. In terms of composites in extreme environments, polymer nanocomposites can potentially be used to absorb the kinetic energy produced by collisions both in military applications and sport applications. Thus, the goal of our work is to predict how a carbon nanotube filler can affect the impact resistance and mechanical properties of polyurethanes. Using atomistic molecular dynamics simulations, we investigated a form of polyether urethane with varying soft segment concentration (SSC) and both with and without a 1.22 nm single walled carbon nanotube with a loading weight percentage between 12% and 15%. We will discuss the mechanical properties of these systems and their viability for extreme environment applications such as for sports helmets.

Poster Number: 101
**Investigation Of Different Foams For Mitigating Impacts In Sports**
Matt Dwyer  
*Aerospace Engineering* University of Kansas

*Mentors and/or Co-Authors:*
Mark Pankow  
*College of Engineering* North Carolina State University
Mary O'Connell  
*Bioprocessing Science & Food Science* NC State University
Annie Jeong  
*Food Science* NC State University
Katie Srivastava  
*Nutrition and Food Science Double Major* NC State University
Michael Campbell  
*Food Science and Bioprocessing Science Double Major* NC State University

Recent reports have shown a direct link between head injuries such as concussions and their impact on long term health. The impacts that occur in sports such as football and soccer can result in concussions that can slowly deteriorate parts of the brain. To mitigate the threat of impact from these events, new types of protective systems are being developed that change how the energy is transferred from one athlete to another. The purpose of this research is to compare new types of foam for helmets with the goal of discovering a marketable foam that significantly decreases the probability of head injuries when exposed to different types of impact. In this work, different types of foam will be examined on how they are able to mitigate the energy being transferred from one system to another. To test these pads, they will be impacted at different energy levels which was accomplished through a drop tower. Different masses at different velocities were used to simulate a variety of impacts. The data will show how each pad responds differently to mitigating each impact in terms of deceleration and force absorbed. This work will show that there are foams capable of mitigating the energy that can protect athletes that are exposed to these impacts.

Poster Number: 116
**Fabricating Cnt/sic Hybrid Foams Using Polymer Infiltration And Pyrolysis**
Abir Muhuri  
*Mechanical Engineering* University of Maryland

*Mentors and/or Co-Authors:*
Philip Bradford  
*College of Textiles* NC State University
Callie Halchin  
*Biochemistry* NC State University
Jennifer Nguyen  
*Polymer Color Chemistry--Medical Sciences* NC State University
Sarah Smith  
*Zoology* NC State University

Polymer Infiltration Pyrolysis (PIP) is known for its effectiveness in fabricating high-density, low porosity composite materials. In this study we aimed to develop and validate a modified PIP approach for constructing lightweight, low-density Carbon Nanotube/Silicon Carbide (CNT/SiC) hybrid foams. 30g solutions with concentrations of 2, 10, 25 and 25 wt.% of Polysilazane dissolved in hexane were prepared for infiltration. In order to pick the best method that maintained foamy properties after infiltration and minimize dimension change, we tried three different methods. For each of the four solution concentrations, three carbon-coated CNT foams were infiltrated and subject to vacuum drying, fume hood drying and no drying treatment before curing at 140 degrees Celsius for two hours. Mass, volume and density values were tracked following each step of the PIP process for all samples. After evaluating the physical appearance of samples for compactness, uniform color and lack of cracks/fracture, three of the samples were chosen for further microstructural evaluation via Scanning Electron Microscopy (SEM). The morphologies of the 2% directly thermoset, 50% vacuum dried and 25% fume hood dried samples were characterized by SEM both before and after pyrolysis. Finally, the mechanical properties, electrical resistance and thermal conductivity of these three samples were measured.
Survivability Of Silicon Encased Fiber Bragg Gratings Subject To High Rate Impacts  
Andrew Rocco  Mechanical Engineering and Physics  DePaul University  

Mentors and/or Co-Authors:  
Mark Pankow  College of Engineering  NC State University  

Kevlar’s high elastic modulus limits its effectiveness at preserving fiber Bragg gratings (FBGs) because high velocity ballistic impacts exceed the material’s failure strain leading to significant damage or fracture in the FBG. Fiber Bragg gratings use periodic variations in refractive index to block or reflect certain light wavelengths, which can be used to accurately measure applied strain on materials subject to high strain rate ballistic impacts. The FBG sensor is held inside a sensing layer between a Kevlar shot pack and clay backing material. To ensure the sensor survives the impact, there needs to be relative slip between the FBG and the encasing material. Silicon has been investigated as an alternative encasing material in order to increase survivability of the fibers and repeatability of the strain history profile. Silicon offers a lower elastic modulus, which results in less energy transfer, and a lower impact of the overall deformation. This property allows greater deformation in the FBG while increasing the sensor’s survivability. Three different silicon mixes for the sensing layer were tested at thicknesses of 1mm and 2mm, and the resulting damages to the FBG were compared. The results will be used to optimize elastic modulus and other mechanical properties in future FBG sensing layers for better sensor preservation during high velocity, high strain rate ballistic tests.

Controlling Microstructural Mechanisms To Enhance The Ductility Of Indium Titanium Oxide (ITO) Thin Films For Flexible Applications  
Nicholas Sepulveda  Mechanical Engineering  Rice University  

Mentors and/or Co-Authors:  
Mohammed Zikry  College of Engineering  NC State University  

The purpose of this work is to achieve a better understanding of the fundamental factors that affect the behavior of indium titanium oxide (ITO) nano-films that are layered on a polymer substrate (PET). I have worked in Professor’s Zikry’s laboratory to investigate new methodologies to render ITO more ductile to increase its range of applications in digital displays and solar panels. Introducing more dislocations into a crystalline system will increase the ductility of the material by improving its ability to undergo deformations as large as 100-200% of the specimens original length. Large scale finite-element model were used to model the effects of increasing the number of grain structures in a sample upwards from 20 to 40 and observing the effects that come with the decreasing grain sizes. In addition to an increase in grains, the grain euler angles were varied to account for different textures. Euler angles, the degree by which a local grain structure’s coordinate system is distorted from the global coordinate system, were varied in the same computer model for different mis-orientations, such that different dicultilities and behavior could be obtained.

Development And Analysis Of Non-conventional Elastomer Infused Artificial Muscles  
Ethan Williams  Aerospace Engineering  University of Kansas  

Mentors and/or Co-Authors:  
Matthew Bryant  College of Engineering  NC State University  

Conventional fluidic artificial muscles consist of an elastic bladder surrounded by a fiber matrix. One end of the muscle is capped, and the other end features an inlet that allows for pressure to be introduced into the system. The bladder expands and the muscle contracts via the physical limitations of the fiber, creating a linear force like that of a biological muscle. Due to their impressive force to weight ratios, artificial muscles have great potential in both prosthetics and robotics. However, dry friction, threshold pressure, and clamping point stress concentrations result in low life expectancies and inconsistent positioning that have limited wide-scale use. This research investigates the muscle performance implications of impregnating a fiber braid with an elastomer in a variety of configurations. Muscles were fabricated using multiple methods: externally brushed on silicone and an internal bladder, self-capping muscles created via a novel injection mold process, and dual matrix muscles that incorporate both flexible silicone regions as well as stiffened resin sections. The injection molded muscles feature an internal layer of silicone and thus eliminate the need for
an additional internal bladder. Building upon this, the dual matrix muscles incorporate resin to provide structural strength in necessary sections while maintaining the ability to actuate. Using a tensile testing machine, the performance of the muscle variants will be examined by measuring force output and free contraction. Ideally we will create a novel set of artificial muscles that are easily duplicable, have predictable performance characteristics, eliminate conventional limitations, and yield large-scale potential.
RISE - Research Internship Summer Experience in Civil and Environmental Engineering

Poster Number: 133

Using Experimental Water Column Reactors To Explore Effects Of Mixing On Harmful Algal Blooms Suppression

Monica Camacho Environmental Engineering University of Florida

Mentors and/or Co-Authors:
Tarek Aziz College of Engineering NC State University

The occurrence of harmful phytoplankton blooms in freshwater systems is increasing globally. These blooms negatively impact ecosystem and human health. For example, some cyanobacteria produce toxins that can harm both aquatic and terrestrial organisms. Previous researchers have reported that some cyanobacteria thrive in stagnant waters because they can regulate their buoyancy to outcompete other phytoplankton for sunlight. Artificial mixing has been used for decades in reservoirs to help reduce blooms, however our understanding of the effects of mixing on phytoplankton communities is limited due to the numerous variables effecting blooms in nature. This research isolates the role of mixing on phytoplankton community growth and composition. To control for complex variables, our research group developed a laboratory-based Water Column Reactor (WCR). The water columns were initially configured with lake water, nutrients, and inorganic turbidity. One reactor experienced constant vertical mixing, while the other was left stagnant. Daily in vivo chlorophyll fluorescence measurements were taken from each column at four depths. In addition, FlowCam and light microscopy were used to classify the phytoplankton density and community structure. Light profiles were also measured to observe any changes in the light climate. Current in vivo results have shown a difference in phytoplankton growth rate and water column position between the two reactors. In this poster, we will present our results and provide more details about how mixed and un-mixed communities varied. With this knowledge, we can begin to better understand the potential role of mixing to suppress harmful phytoplankton blooms in freshwater bodies.

Poster Number: 239

Evaluating Dna Extraction Methods To Recover The Microbiome Of Materials Exposed To Wastewater

Adriana Dacres Environmental Science Claflin University

Mentors and/or Co-Authors:
Joe Weaver College of Engineering NC State University

DNA extraction is a common and useful technique used across multiple disciplines and is a core part of molecular microbiology. However, extraction methods vary and their suitability for a particular research goal may not have been established. For example, it is unclear which DNA extraction method is most suitable for a 16S rRNA metagenomic analysis of clothing exposed to wastewater. In this project three DNA extraction methods used to recover the microbiome from clothing were examined as the first step towards determining the microbial exposure of pit latrine workers in Malawi. The methods used were indirect DNA extraction, direct DNA extraction protocol and direct Polymerase Chain Reaction (PCR). Prior to the extraction protocols, five different materials (gloves, face mask, lab coat, 100% cotton and 100% polyester) were cut into 1cm² squares and inoculated with either raw wastewater or mixed liquor from an activated sludge basin at the North Cary Water Reclamation Facility. DNA yields were measured using a Nanodrop spectrophotometer. DNA was successfully extracted using both the direct and indirect methods, though DNA yields were low (generally < 5 ng/µl). As a practical matter, indirect DNA extraction allowed for varying, larger sizes of materials to be tested while direct PCR was extremely limited by the microplate well volume. The extracted DNA is being prepared for high throughput sequencing to enable a metagenomic study comparing how well the recovered microbial communities reflect those of the inocula.

Poster Number: 256

The Impact Of Salinity Gradient Seasonal Variability On Reverse Electrodialysis Power Generation

Zoe Gobetz NC State University

Mentors and/or Co-Authors:
Douglas Call College of Engineering NC State University
Reverse electrodialysis (RED) is a promising technology for harnessing salinity gradient energy, as it has the potential to provide a clean and renewable power supply to densely populated areas along the coast. Though RED has been intensively researched recently, little is known about the use of RED using seawater at a local setting through varying seasons. The goal of this project was to determine the effect of seasonal variation of seawater quality on the power output of a lab-scale RED cell. To fulfill our objective, seawater samples were collected over the course of five months spanning the year of 2016-2017 at three different locations along the North Carolina coast and waste water treatment plant effluent was collected for use as the dilute water. The samples were filtered, adjusted to their corresponding temperature and then tested in the lab using a RED cell. The voltage output was measured during duplicate tests for each seawater sample to determine maximum power output. Our results show that the temperature and salinity of seawater can have a strong impact on power output. The warmest samples collected during July had the highest overall power density compared to the other months at each location. The other months did not show a clear trend with power output and temperature. In conclusion, our findings highlight the variability in power output as a function of seasonal changes in temperature and seawater conductivity and indicate that these variations need to be taken into consideration when estimating power predictions from salinity gradients.

**Poster Number: 237**

**Eit Sensing Skin Behavior On Large Surface Area**

Guillermo Gonzalez-Berrios  
*Civil Engineering* Texas Tech University

*Mentors and/or Co-Authors:*

Mohammad Pour-Ghaz  
*College of Engineering* NC State University

The early detection of deterioration of a structural or mechanical systems is essential. By monitoring such systems or structures, it can be safely repaired and the service life of the system or structure can be extended. Electrical Impedance Tomography (EIT) based sensing skin is a large area sensor that can be used for monitoring damage in structures. Sensing skin is made of a thin layer of electrically conductive film that is applied to the surface of the structure. The electrical conductivity of the sensing skin is monitored using EIT to detect the local change of conductivity due to damage. Previously sensing skin has been successfully implemented for detecting damage and corrosion however all these prior results have been obtained on samples that are significantly smaller than the actual structural elements. This is in part because of the loss of resolution of sensing skin with increase in the size of the sensing skin. To overcome this difficulty, in the present work, internal electrodes is used to increase the resolution of sensing skin. The sensing skin with internal electrodes are applied to a large full-scale reinforced concrete beam and a large polymeric substrate. The experimental components of the research has been completed and currently EIT reconstructions are being computed.

**Poster Number: 104**

**Effect Of Chlorophyll Content In Algae Using The Nile Red Fluorescence Assay Measurement**

Shannon Hurtado  
*Environmental Engineering* Benedict College

*Mentors and/or Co-Authors:*

Joel Ducoste  
*College of Engineering* NC State University

Microalgae are potential sources for a large array of valuable compounds such as lipids and carbohydrates. When efficiently cultivated and harvested, microalgae can accumulate a significant amount of lipid that can be used for the production of biofuels. To assess the performance, experimental methods such as nile red fluorescence approach are used to measure the amount of lipids produced by microalgae. However, pigments in the microalgae can have a negative impact on the measurement and quality of the lipid content. Therefore, the present work was performed to develop a protocol for measuring lipid content in Dunaliella viridis , a marine algae, using the nile red fluorescence method.

The nile red fluorescence method can be inhibited by the chlorophyll content in algae because chlorophyll can make the lipid more susceptible to photo-oxidation and decrease the storage stability of lipids. Consequently, the specific objective of this research was to examine the effect of chlorophyll on the nile red fluorescence method. The protocol to reduce the impact of chlorophyll on this method involves degrading the chlorophyll using ethanol, and bleaching the cells prior to fluorescence measurements.
Assessing Strength And Durability Of Grout For Bridge Construction In Cold Climate Regions

Andy Jiang  Civil Engineering NC State University
Mentors and/or Co-Authors:
Mervyn Kowalsky College of Engineering NC State University

Seismic activity from the Pacific-North American plate interaction and frequent low temperatures can affect bridges in Alaska, which can damage a bridge’s integrity, ultimately causing it to fail with the possibility of losing human lives. Grouted keyway joint connections are utilized in bridges to connect decked girders. However, little is known about the behavior of the joint connections due to lateral seismic forces. This study focuses on evaluating the compressive and tensile strengths as well as freeze-thaw durability of different kinds of grout. Through testing and experimentation, results will be obtained and compared quantitatively. Prisms, cubes, and cylinders were cast using different kinds of grout per ASTM C666, ASTM C109, ASTM C496, and ASTM C39. The cubes were subjected to compressive testing, while the cylinders were subjected to both compressive and tensile testing. The prisms were subjected to freeze-thaw cycles with the use of freeze-thaw chambers. Preliminary results indicate that one grout outperformed the others regarding the compressive and durability tests. However, these are only early results, and that tests are still being conducted. Through such methods, this study aims to select a durable grout to be used in bridges that can resist the demands from seismic activity and periodic freeze-thaw conditions. In addition, this study can serve as a framework to other projects for applications experiencing similar environmental conditions.

Geographic Survey Of Residence Time In United States Reservoirs

Melanie Latham  Civil Engineering Brigham Young University
Mentors and/or Co-Authors:
Sankarasubramanian Arumugam College of Engineering NC State University

The main function of reservoirs is storing and allocating water for multiple uses (i.e. agriculture, hydropower, water supply). However, altering the natural flow of water can have negative impacts, especially on the surrounding environment. Often, reservoirs retain water for too long, significantly disturbing the natural flow of downstream water bodies, affecting aquatic life and ecology. Residence time, the time that water remains in a reservoir, serves as an indication of the downstream disturbance of a reservoir. Unfortunately, residence time and its factors (inflows, releases and storages) are not often recorded by reservoir managers. Thus, to study the impact of reservoirs, a methodology has been developed to estimate the residence time of reservoirs which currently do not record inflows and releases. Using ArcGIS (Geographic Information Systems) and a national river map, upstream USGS (United States Geological Survey) streamgages were identified for each dam in the continental US (United States) and then used to estimate the incoming flux for each reservoir. For reservoirs with more than one upstream streamgage, five combination methods were employed for incoming flux estimation: measuring averages, maximum drainage areas, minimum river distances, and weighted averages of the drainage areas and inverse river distances. Using the estimated flux, drainage area and normal storage of each reservoir, residence times were estimated and validated against known residence times for dams operated by the Tennessee Valley Authority. The relative performance of each flux combination methodology is analyzed, and the distribution of residence times and potential impacts across the continental US is discussed.

Household Reverse Osmosis Water Treatment Systems For The Removal Of Perfluoroalkyl Substances

John Merrill  Environmental Engineering NC State University
Mentors and/or Co-Authors:
Detlef Knappe College of Engineering NC State University
Rachel Evans  Life Science First Year NC State University
Heather Hubeli  Genetics NC State University

Per- and polyfluoroalkyl substances (PFASs) are used in the manufacture of numerous industrial and consumer products. Growing evidence of adverse human health impacts associated with exposure to legacy PFASs has led to recent regulatory attention and development of emerging PFASs, such as perfluoro-2-propoxypropanoic acid (“GenX”), with little knowledge of potential health implications. Previous studies suggest that many currently employed centralized
Optimization Of Temperature For Microalgae-based Biofuel Production At Industrial Scale

Sam Paul Civil and Environmental Engineering NC State University

Mentors and/or Co-Authors:
Ranji Ranjithan College of Engineering NC State University
Juliana Viveros Biochemistry NC State University
Sumera Jaleel Biochemistry NC State University

Marine microalgae-based biofuels are promising option for renewable liquid fuel production. Outdoor photobioreactors are commonly considered for photosynthetic bio refineries (PSBRs). To optimize lipid production factors such as atmospheric temperature, pH, nutrient availability and light exposure, must be considered in the design of a photobioreactor. Many location-specific atmospheric factors (air pressure, air temperature, wind speed, Global Horizontal Irradiance (GHI), humidity) affect temperature of the growth medium in an outdoor photobioreactor. Limited research has been conducted to understand the impact of these conditions on algal growth and there is no systematic model to assess their effects. This study explores the effect of location-specific atmospheric conditions on the growth of algae and lipid production by developing a generalizable model to estimate temperature in outdoor photobioreactors. A predictive model was developed to estimate the growth rate of the microalgae based on publicly available meteorological data. A discrete time-step approach to match the time resolution of the meteorological data was applied to estimate temperature (under natural or controlled condition) and consequent algal growth and lipid production rates. This study, further estimates the energy required (for controlled heating and cooling system) to maintain a specified temperature within the system. The total energy input required to maximize the lipid production is currently being assessed. The modelling framework provides valuable estimates of microalgae biomass and lipid production in outdoor photobioreactors to aid the development and assessment of sustainable microalgae-to-biofuel systems.

Poster Number: 12

Retro-reflectivity Traffic Sign Measure: Hardware Analysis For Implementation Of Novel Method

Manuel Jara Perez Civil Engineering University of Evansville

Mentors and/or Co-Authors:
Kevin Han College of Engineering North Carolina State University
Gloria Regalado Statistics NC State University

Retro-reflectivity is a property necessary for the visibility of traffic signs in night conditions, which is of importance to ensure transportation safety. Once this property reaches a minimum standard on a traffic sign set by the Federal Highway Administration (FHWA), it gets replaced. Previous research has demonstrated the success of a computer-vision based approach to measure the retro-reflectivity of traffic signs during daylight, under certain conditions, as a response to financially inefficient methods currently being used by most US Departments of Transportation. As this method was tested on a ground setting, little is known about its accuracy on a moving scenario. This project examines the hardware necessary for the implementation of this new technique in a moving car to determine the accuracy of results obtained in real time. Considering the benefits of open source platforms, three different possible systems were contemplated. Among those, the Raspberry Pi was decided to be the most economically and functionally capable of performing tasks including image processing using OpenCV. The method determined to be the most suitable was SIFT feature detection and matching as it recognizes objects regardless of lighting conditions, shapes, colors, and sizes of the traffic signs. This project is still ongoing, and it looks promising as a first step towards replacing traffic signs efficiently.
Coastal Land Cover And Change Detection With GIS And Remote Sensing Using Multitemporal Color Infrared (cir) Photography: Pea Island, North Carolina

Carter Rucker Civil Engineering NC State University

Mentors and/or Co-Authors:
Elizabeth Sciaudone College of Engineering North Carolina State University

Pea Island is located on the Outer Banks of North Carolina, which is one of the most dynamic morphological systems in the country. Elements such as storms and long term erosion are a constant threat to these islands and raise major concerns for the planning of NC Highway 12. This highway is the only ground-based transportation corridor for several towns, serving as a hurricane evacuation route. Since 2012, researchers at NC State University have monitored changes in vegetative coverage from the road to the beach shoreline. This project expands land cover monitoring across the entire island in order to more thoroughly assess road vulnerability. This study explores image processing methods using color infrared (CIR) photography and photogrammetry-derived digital terrain models to map land cover of Pea Island, NC from 2012-2016 and illustrates land cover changes which affect transportation planning. The location of NC 12 is limited by the narrowness of Pea Island and the presence of manmade impoundments which are a part of the Pea Island National Wildlife Refuge (PINWR). Any actions to relocate or modify the roadway are subject to review and permitting by the U.S. Fish and Wildlife Service which manages the Refuge. The largest event impacting Pea Island over the time analyzed was hurricane Sandy in late October of 2012, which caused overwash and damage to the pavement. This project presents land cover change information that will help assess vulnerabilities throughout the NC 12 Pea Island corridor.

Calibration Of Anaerobic Digestion Model For Co-digestion Of Thickened Waste Activated Sludge With Grease Interceptor Waste Using Gps-x.

Thivani Senathiraja Chemical Engineering National Institute of Technology--Karnataka-India

Mentors and/or Co-Authors:
Joel Ducoste College of Engineering NC State University
Haley Hall Biology and Environmental Sciences NC State University
Kiera Lauler Exploratory Studies NC State University

A recent update from American biogas council states that in the USA less than 20% of digesters at wastewater treatment plant use the produced biogas. Co-digestion of biosolids with high-energy substrate like grease interceptor waste (GIW) helps to improve the economics of biogas utilization. However, to realize this renewable energy portfolio in a full-scale wastewater treatment plant, a model that accurately determines the addition of GIW impact on anaerobic processes should be developed. Such a model would allow engineers to develop plant specific strategies to incorporate GIW into their digester process. This work focusses on calibrating an anaerobic digester model using GPS-X to simulate the co-digestion of thickened waste activated sludge with GIW. Initial biomass concentration and distribution were obtained from the South Durham water reclamation facility. Time course data from a mesophilic semi-continuous lab scale experiment with a solid retention time of 20 days was used to calibrate and validate the model performance. Preliminary results showed that the model reasonably predicts the biogas production and methane yield, effluent COD concentration, effluent pH and alkalinity for the conditions with waste activated sludge only. Future research will explore the increasing addition of GIW to test the point when the digester fails to produce methane and whether the model can mimic different feeding strategies to increase the amount of GIW that can be treated in anaerobic digesters.

A Novel Approach To Testing The Removal Efficiency Of Grease Interceptors Using Microspheres

Tyshonna Sims Biology Shaw University

Mentors and/or Co-Authors:
Joel Ducoste College of Engineering NC State University
Bria Pearson Biological Sciences NC State University

Sanitary sewer overflows (SSOs) are significant public and environmental issues which leads to the discharge of raw
sewage that contains pathogens and contaminants. U.S. EPA estimated that 43% of the SSOs per year are due to pipe blockages from the formation and accumulation of insoluble fats, oils, and grease (FOG) deposits. To reduce these FOG related blockages, grease interceptors (GIs) are used to separate FOG from waste streams. However, GIs struggle to remove residual FOG that take the form of smaller droplets due to the detergents and elevated temperatures released from food service. GI manufacturers are not equipped to consistently produce FOG droplets at specific sizes to adequately test the removal performance of these devices. The main purpose of this research was to find innovative ways to test the removal efficiency of GIs using surrogates to oil. In this preliminary study, we evaluated the removal efficiency of a bench scale GI using microspheres, which are hollow spheres of protein or synthetic polymer. The effect of diameter size of microspheres, inlet concentration, and flow rate will be investigated. A tracer experiment was performed to evaluate the fluid mixing characteristics of the GI. We hypothesize that these microspheres will serve as a substitute to characterize the removal efficiency of the GI at the various experimental conditions. Based on the initial tracer experiment, the mixing characteristics of the GI is similar to a single complete mix tank reactor with a mean hydraulic retention time of 13 min at a flow rate 6.0 ml/s.

Poster Number: 62
Life Cycle Modeling Of Home Composting Of The Organic Fraction Of Municipal Solid Waste
Kirstin Szogas Environmental Engineering NC State University
Mentors and/or Co-Authors:
Jim Levis College of Engineering NC State University

There is increasing interest in policies and strategies for diverting the organic fraction of municipal solid waste (OFMSW) from landfills in order to reduce the overall emissions associated with solid waste management (SWM). Each proposed method for managing OFMSW (e.g., anaerobic digestion, waste-to-energy, centralized composting, or home composting) has its own advantages and disadvantages that must be systematically assessed to ensure the best alternative is chosen for a given SWM system. Life-cycle assessment provides a framework for quantifying the costs, resource consumption, and environmental impacts associated with alternative SWM systems and processes. The Solid Waste Optimization Life-cycle Framework (SWOLF) includes life-cycle process models for all of the previously listed OFMSW treatment alternatives except for home composting. In this study, a home composting process model was developed. Home composting is a low-cost OFMSW treatment alternative that avoids the energy consumption and emissions associated with waste collection and centralized processing. The process model was used to estimate the following environmental impact factors: the global warming potential, acidification, eutrophication, photochemical oxidation, cumulative energy demand, ecotoxicity and human toxicity. Parametric and Monte Carlo sensitivity analyses were performed to determine the inputs with the largest impact on these factors. The results indicate that home composting could be a cost-effective way to reduce the emissions associated with landfilling OFMSW. These results will serve as a basis for future quantitative comparisons with other OFMSW management alternatives.

Poster Number: 243
Sludge Process For Producing Aerobic Granules In Wastewater Treatment
Genele Tulloch Engineering (Mathematics) NC State University
Mentors and/or Co-Authors:
Joel Ducoste College of Engineering NC State University

Developing a sludge process to produce granules is the most promising biotechnology we have to treat wastewater. Granules have been formed successfully in sequencing batch reactors (SBR), but problems are encountered when trying to produce efficient granules in a continuous flow system. Some problems encountered include maintaining the granule structure and the settling time of the granules. Most real world systems are continuous flow. The inability to make granules work in a continuous flow system is preventing this technology from being adapted. Environmental engineers have been trying to figure out ways to produce granules in systems closer to those already used at full scale. The goal of this work is to evaluate a lab-scale flow through reactor design to understand and improve granulation during continuous flow. Specific goals of this research are to develop a CFD model to evaluate the reactor’s behavior using a tracer test, and to simulate the solids settling process in the clarifier. The software being used to develop the model is called Phoenics. A Solidworks® STL file has been imported into the program where different objects were created and added to make the model run more efficiently. The results allow a view of the velocity’s vector field in the reactor. The results will be validated against data from experiments performed with the lab scale reactor. Once the CFD velocity model of the reactor has been performed, a simulated tracer test can be conducted on many more configurations to assess specific experimental conditions to perform.
Evolutionary Computation For Generating And Designing Water Infrastructure Networks

Samantha Winterrowd Industrial Engineering NC State University

Mentors and/or Co-Authors:
Emily Berglund College of Engineering North Carolina State University

Water distribution systems deliver potable water to customers through complex pressurized pipe networks. Design and management of pipe systems is typically executed in four separate steps. The layout step determines the structure of the network, the design step identifies the pipe types and sizes, the programming step prioritizes the connection of different users, and the planning step determines daily operations. Most optimization algorithms that are presented in recent literature focus on the design step and assume a predetermined network structure. Gains in efficiency may be found through integrated planning that identifies the layout and design simultaneously. The goal of this research is to develop a genetic algorithm (GA)-based approach to identify both the layout and the design for a water distribution system that will minimize infrastructure costs, while maintaining pressure in the network and protecting against failure. Design decisions are the placement and size of pipes to connect demand nodes, and the objective function, which is minimized, represents costs and pressure violations at nodes. The GA is coupled with a hydraulic model, EPANET, to evaluate solutions, and is deployed using high performance computation on a cluster of 192 nodes. The GA framework is applied for the New York Tunnel System case study. Parameter settings for the GA are identified that generate efficient solutions using fewer computations. Solutions are compared with historic solutions identified through other studies, and results show that GA-based solutions have lower costs and lower redundancy. A metric for redundancy is explored to encourage looped networks.
Science of Software in CSC

Poster Number: 47

A Study Of Interventions To Improve Student Experience In Csc216

Adam Abram Computer Engineering Georgia Tech

Mentors and/or Co-Authors:
Sarah Heckman College of Engineering NC State University
Connor Little Life Science First Year NC State University
Hannah Brennan LSFY- Microbiology Intent NC State University

CSC216, a second semester programming course in computer science, historically has a high failure rate. The goal of this research increase student learning, efficacy, engagement, and retention through several interventions in CSC216. Interventions included integrating assignments into a new, overarching lab; implementing a series of process points designed to encourage good coding habits; and adding a guided project dedicated to inheritance. We measured and compared student learning, efficacy, engagement, and retention between a baseline Fall 2015 offering and a modified Fall 2016 offering of CSC216. We hypothesize that the interventions will result in a positive increase across the stated metrics. Supporting our hypothesis, we find that students exhibited a significant increase in grades across several areas, including the final grade, the in-class labs, and the first guided project. We also examined several demographics and found that every racial subset demonstrated improvement, with minorities (African Americans, Native American, Hispanics, and Pacific Islanders) displaying the most improvement.

Poster Number: 31

The Effects Of Challenging Parametrized Metrics In An Ide Usage Smells Study

Brian Hanson, Jr. Computer Engineering University of Maryland Baltimore County
Blake Thrower Computer Engineering Clemson University
Cindi Simmons Computer Science Kennesaw State University

Mentors and/or Co-Authors:
Sarah Heckman College of Engineering NC State University

Developer behavior patterns, or usage smells, are patterns of Integrated Development Environment (IDE) interactions. ABB Inc. completed research using log analysis to reveal patterns of developer behaviors in an IDE. The developer activity logs were input to a data mining algorithm to extract usage smells. We intend to determine how the original study’s usage patterns can be challenged or reinforced by parametrizing the critical assumptions made by the researchers. From our experiment, we aim to explain what specific research assumptions skew data results and illustrate how to verify consistency in log analysis regardless of parameter selection. To accomplish this, we conducted a replication of the analysis detailed in Mining Sequences of Developer Interactions in Visual Studio for Usage Smells. Specifically, ABB found 20 usage smells to characterize and describe potential IDE usage behaviors. The original experiment was handled according to several assumptions, based on the researchers’ acumen. The focal point of our experiment was modifying these parameters and comparing the resulting patterns from each setting. We have prepared multiple data sets for testing but are challenged on running the pattern extraction algorithm due to the size of the dataset.

Poster Number: 27

Smart Data Selection: Less Time And Computing Power

Eric Huynh Computer Science Hendrix College

Mentors and/or Co-Authors:
Timothy Menzies College of Engineering NC State University

Many machine learning techniques today require hours or even days to train on thousands of data points. We would save both time and money if we could significantly reduce the amount of data points needed to train an equivalent learner. This reduction of required data points has many applications such as allowing us to share large data sources without having to share the entire data set or significantly faster and efficient training. In the world of Science of Software, we could apply this methodology to predicting whether or not a new commit of code has bugs and in industry, early prediction of these bugs can help streamline the development process. This summer, I looked to apply the idea of active
learning, smartly selecting data points which will give the most knowledge to our learner, to software engineering data. I used public software engineering data as the data source to show the applications of this methods to industry. In the poster, I present comparisons that show the importance on how to pick the representative subsets of data and explore how many fewer points would be necessary to get comparable results as complete data set among different techniques. In my preliminary results, there have been several instances where less than 10% of the original data can give us the same results as using 50% to 100% of the data.

Poster Number: 46

**Discrepancies Between Security Breaches And Policy**

Anne-Liz Jeukeng *Computer Science* University of Florida

**Mentors and/or Co-Authors:**

Laurie Williams *College of Computer Science* NC State University

Since 2013, over nine billion data records have been lost or stolen. Only four percent of the breaches were “Secure Breaches” where encryption was used and the stolen data was rendered useless. The number of security breaches has steadily increased over the years. Security breaches are a problem for everyone across any domain whether it is Financial, Healthcare, or Government. Understanding the common patterns underlying the occurrence of breaches as well as their connections to the actual policies and regulations is the first step towards solving the problem of security breaches. Our research goal is to refine security policies and regulations based on identified gaps/holes with respect to security breaches. The most crucial difficulty of refining policies and regulations are the discrepancies between security breaches and policy. We began our investigation of security breaches from different domains such as Financial, Energy, and also Healthcare. Next, we classified breach types and their underlying causes. Then, we identified patterns of common gaps/holes in policies. Finally, we implemented design patterns to help create an automated process for improving security and privacy policies, especially clauses that relate to human errors. After investigating multiple domains, we found that accidental loss makes up the second largest source of data breaches after malicious insiders.

Poster Number: 241

**Evaluating Technical Interviewing Using Eye Tracking**

Alison Lui *Computer Science* University of Notre Dame

**Mentors and/or Co-Authors:**

Christopher Parnin *College of Engineering* NC State University

Programming interviews aim to measure a candidate’s facility with problem solving and coding ability as well as their ability to communicate their technical knowledge. However, techniques used in today’s technical interviews have not been heavily studied and may cause candidates to underperform due to stressful and artificial circumstances such as being repeatedly interrupted and not allowed periods of silent thought. We are ultimately interested in designing alternative interviewing methods that may more effectively measure a candidate’s ability. In order to do this we are first interested in looking at which unique circumstances of technical interviews cause candidates increased stress. Specifically, we are first using eye tracking metrics as measures of stress and cognitive load to compare candidates solving a problem alone on paper versus on a whiteboard while being watched by a silent interviewer. Eye tracking studies have shown these metrics to be linked to stress and cognitive load, and it is a non-intrusive way to gather unconscious and unbiased data from an interviewee. In conjunction with eye tracking technology, we are using ArUco markers with OpenCV in order to track a candidate’s gaze along a whiteboard or sheet of paper in order to detect when the candidate is and is not facing the coding area as well as keep track of backtracking and regressions. The next steps will be to add interviewer interruptions and require explanations from interviewees to examine the effects on stress and cognitive load that these factors contribute.

Poster Number: 240

**How To Make A Magician (optimizing Hyper-parameter Optimization)**

Kayleigh Migdol *Computer Science/Applied Mathematics* Humboldt State University

**Mentors and/or Co-Authors:**

Timothy Menzies *College of Engineering* NC State University

Ryan Walden *Nuclear Engineering* NC State University

Jennifer Baglio *Nuclear Engineering* NC State University
Some people are “magicians” who know how to configure complex devices (e.g. data miners, optimizers, project process options). But these are few in number. Most people view the world around them as controlled by arcane choices which they barely understand. It can be extremely difficult to determine optimal settings for anything we do in life due to the complexity of things we are trying to control and the variability of these devices from problem to problem. Due to this, many users simply use default settings or choose arbitrary numbers that “sound right”. This lack of informed control leads to people struggling-by with sub-optimal decisions. Accordingly, this research explores methods to magically configure the things we use. One of these magic methods is differential evolution (DE) but DE has its own magic parameters that can affect the end results and evaluations required. An analysis of these parameters shows that the ending criteria is very important in terms of gaining the optimal results in the shortest time, as ending too premature leads to suboptimal results but continuing too long is a waste of resources. However, the other parameters of DE appeared to be arbitrary and only had a small effect on the end results. By understanding which of these control parameters is most important, we can learn how to make magic faster. This work explores the above in the context of learning how to configure project processes, software quality control, and data miners.

Poster Number: 114

Peer Parity On Stack Overflow
Savannah Morgan Computer Science and Economics Centre College
Mentors and/or Co-Authors:
Christopher Parnin College of Engineering NC State University

Stack Overflow is a useful Q&A online community for programmers. On Stack Overflow, programmers are able to ask questions, comment on questions, and answer questions. However, studies have shown low participation of females programmers on Stack Overflow, and also that presence of peers improves activity. Peer Parity is the concept that multiple individuals of the same group are present in a community where they are considered the minority. To investigate peer parity, we extracted 32209817 posts from the most recent Stack Overflow data dump including tags, badges, and Display Names. We then modified a popular gender computing tool to use first names of online users and identified the gender of 2502438 users from the 5987284 list of current users. We randomly selected 10 peer parity posts and 10 non parity posts among women and compared statistically significant differences in participation. We identify factors affecting female participation on StackOverflow to determine how to make the community more welcoming. Of our sample of 32209817 Stack Overflow posts, we identified 265752 posts that had more than one distinct woman on the post. We find that female answers are more likely to be accepted by posts with peer parity than posts without peer parity. Our results also demonstrate that women become more active after they have taken part in a peer parity post. We discuss implications for these findings and suggest improvements to encourage inclusion in the Stack Overflow community.

Poster Number: 69

Finding The Shapes Of Beginner Programs
Hannah Morrison Computer Science NC State University
Mentors and/or Co-Authors:
Kathryn Stolee College of Engineering North Carolina State University
Peter Ciaccio Nuclear Engineering NC State University
Amber Robinson Nuclear Engineering NC State University
Andrew Ballard Nuclear Engineering NC State University
Patrick O’Brien Nuclear Engineering NC State University
Jonathan Garrett Nuclear Engineering NC State University
Jaquan Rivers Nuclear Engineering NC State University

Kodu is a block-based introductory programming language used to make games. Games made with Kodu take on many forms: some pit the user against an AI-controlled enemy, and others take no user input at all. We analyzed a subset of over 300 Kodu programs created by users and mapped their structures. Preliminary results suggest that despite their differences, most programs have similarities in their underlying structure—and that common programming pitfalls, called “code smells,” occur in them regardless of form.
Visualizing Attack Surface Approximations

Dalisha Rivera-Rodriguez  Mathematics and Computer Science  Hanover College

Mentors and/or Co-Authors:

Laurie Williams  College of Computer Science  NC State University

Identifying, testing, and reviewing security vulnerabilities within software systems remains to be a challenge for developers. The attack surface is the sum of all paths for untrusted data into and out of a system. Therefore, code that appears on its stack trace is vulnerable code that is accessible and exploitable to malicious users. Determining what codes in the stack trace is the source of the vulnerability remains to be a difficulty; therefore, the codes that are vulnerable are approximated through the attack surface’s stack traces. The goal of this research is to assist developers in determining where vulnerabilities are in their code through an eclipse plugin that data mines stack traces and creates a graph visualization to better identify where vulnerable code is. To accomplish this goal, we created Python scripts with Selenium to parse information from an online database into CSV files to gain more information on the crashed fedora programs. We are currently in the process of creating an eclipse plugin that will parse through the CSV files to create an interactive graph of the binaries and crashed functions to assist developers identify vulnerable code within their program, and prevent malicious users from gaining access to sensitive information.
Socially Relevant Computing and Analytics in CSC

Will This Comic Creator Be Your Sidekick? Developing Intelligent Authoring Interfaces For Visual Storytelling
Hiru Nelakkutti Acharig Computer Science NC State University
Carolyn Thompson Computer Science NC State University

Mentors and/or Co-Authors:
Arnav Jhala College of Engineering NC State University

Many comic artists face challenges when creating comics such as the proper lighting, placement of characters or speech bubbles, color schemes etc. The project that I have been working on, the comic interpretation project, creates a comic creation tool that would allow comic artists see immediate visual results of their artwork and narrative ideas. In addition, the creation tool would further assist them with creativity by displaying suggested comic panels based on their previously created comics. Our goal is to analyze the interpretations and/or intentions of comic artists. In return, we are hoping to build the suggestion comic panel generator feature. Our approach is to make the comic creation tool web-based therefore it would be easily accessible for all comic artists and easy for data collection (i.e. data from published comics). As we are still working on the creation tool, we currently do not have any results/findings.

Snag’ Em: Perceived Effects Of Website Interface
Camille Anderson Computational and Cognitive Interface Whitman College

Mentors and/or Co-Authors:
Tiffany Barnes College of Engineering NC State University

Snag’ Em is a social networking game designed specifically to facilitate interactions within academic communities. Often, uneven social dynamics influence activity in settings such as conferences and community colleges, catering more toward extraverted and outgoing individuals. Language and culture barriers also interfere with fluid networking'. Snag’ Em aims to provide a way of initiating social and professional connections that does not rely on extraversion, language fluency, or culture familiarity; rather, it encourages participants to interact by providing missions that require finding certain players. However, Snag’ Em’s current website interface has navigational and aesthetic drawbacks. This project aims to redesign the interface in accordance with previous research that has shown positive reactions to designs that employ high unity, symmetry, and multiple methods of navigation. Collected data will address subtleties of design and their corresponding effects on users.

Implementation Of Subdue Into The Agg Library
Connor Leyers Computer Science Winthrop University
Emily Hupalo Computer Science and Communications DePauw University

Mentors and/or Co-Authors:
Collin Lynch College of Engineering NC State University
Grecia Morales Biochemistry NC State University

The goal for this research project is to implement the SUBDUE algorithm into the pre-existing Augmented Graph Grammar (AGG) Library and to apply augmented graph grammars to analyze financial and news data. SUBDUE is a beam search algorithm that sifts through textually represented graphs and sorts and compresses them based on the substructure patterns. AGG is a graph analysis library, written in Python, that has been applied to extract pedagogically-relevant information from student-produced argument diagrams. Our first task was to implement SUBDUE, and to test it on a simple data set. Next, we worked on locating larger datasets which can be used to test customized rules. This allowed for a better understanding of how the rules operate in conjunction with one-another. We analyzed two different data sets. One set was a collection of “fake news” websites funded by advertisements before November 2016 and during March 2017. The other set utilized the AGG library to the Neo4j Graph database, and applied augmented graph grammars to analyze financial data. The first hypothesis is that websites with a satire disclaimer will gain funding and websites with domain names that mimic popular names like “CNN” will lose funding. The Second hypothesis is that officers and intermediaries operating within the US have more 3rd party connections with entities outside of the
country. The data suggests that these individuals mask their financial actions more so than that of other countries or individuals outside of the US.

Poster Number: 126

**Authoring Ai For Interactive Storytelling**

Emma McCamey *Electrical Engineering* Virginia Commonwealth University  
Johanna Timmer *Information Technology* Georgia Gwinnett College  

*Mentors and/or Co-Authors:*  
Chris Martens College of Engineering NC State University

Currently, writing interactive fiction games requires an extensive amount of hand-authoring. Dialogue planning typically uses dialogue trees, which calls for a lengthy authoring process involving hand-scripting entire conversations. Similarly, NPC behavior must be explicitly written for every action a character takes. With a more generative game engine, we've sought to reduce the amount of hand-authoring needed to create compelling game stories. The system uses information about the state of the world to determine how NPCs will act and react in the game. This tool will potentially allow for more complex stories in interactive fiction games while minimizing the required work for game authors.

Poster Number: 121

**Crate Training Shelter Dogs Using A Computer Assisted Training System**

Tony Pappas *Computer Science* NC State University  
Denzel Ketter *Computer Science* University of Maryland  

*Mentors and/or Co-Authors:*  
David Roberts College of Engineering North Carolina State University

According to Jennifer Kwan and Melissa Bain (2013), owners report behavior problems as the reason behind 48% to 65% of the returns of adopted dogs to shelters. As a part of our research, we have created a computer-assisted training system to autonomously train sheltered dogs. The goal of our project is to reduce the rate at which dogs are returned to shelters after being adopted and demonstrate the ability of a computer to successfully train a dog. In our project, we rely on the Microsoft Kinect's camera and microphone, along with a Pet Tutor automatic treat dispenser, to pace dogs through a set of training protocols. By reducing the amount of effort required by owners, shelter employees, and volunteers needed to train dogs, we expect to reduce the rate at which dogs are returned to shelters after being adopted. Preliminary evaluation of the effectiveness of our system suggests it has the capability to shape the behavior of sheltered dogs with automated training.

Poster Number: 217

**Combining Multiple Kernels With Dynamic Time Warping For Effective Sequential Trajectories Clustering**

Thomas Petrovich *Computer Science* NC State University  
Gabriel Santiago *Computer Engineering* University of Puerto Rico – Mayaguez  

*Mentors and/or Co-Authors:*  
Min Chi College of Engineering NC State University

One of the most challenging tasks in the field of Educational Data Mining (EDM) is to cluster students directly based on system-student sequential moment-to-moment interactive trajectories. The objective of this study is to build a general temporal clustering framework that captures the distinct characteristics of students’ sequential behavior patterns, that tracks whether a student’s learning experience is unprofitable, and can identify such an individual as early as possible so personalized learning can be offered. The central idea of our framework is based on Dynamic Time Warping (DTW), which calculates distance between any two temporal sequences even with different lengths. Previously, Shen et al (2017) combined Principal Component Analysis (PCA) and DTW and showed that significant interesting patterns can be found by exploring student’s moment-to-moment interactive trajectories. In this proposed work, we will further explore combining multiple kernels and DTW. Discriminative kernel transformation including Linear, Polynomial, Gaussian, Exponential/Laplacian, and Sigmoid have been shown to be quite effective in improving the effectiveness of machine learning methods such as SVMs. We hypothesize that by combining multiple Kernels with DTW, our proposed temporal sequential framework can find more robust and effective clusters compared with Shen et al’s prior work.
Effectiveness Of Teaching Conditionals To K-12 Students Through An Educational Game

Megan Petruso Computer Science Appalachian State University

Mentors and/or Co-Authors:
Nick Lytle College of Engineering NC State University
Michael Rosenberg Industrial Engineering NC State University

The educational video game, BOTS, teaches novice programmers computational thinking. Players maneuver a bot and blocks around a set of levels using loops, functions, and conditionals. However, previous versions of BOTS did not have puzzles that taught the player how to use conditionals. New gameplay features added to BOTS now require players to use conditionals by hiding the block’s color until the bot picks up the block. Therefore, players cannot complete certain levels unless they adjust their code to fit all possible cases the block color can be. We will test the improved BOTS game on two computer science camps for middle and high schoolers at NCSU. We will use pre and post test data and gameplay log data to evaluate learning gains and understanding of concepts. Our hope is to demonstrate that the altered version of BOTS increased students’ understanding of the principles of conditionals in programming.

Ease Of Analysis In Text And Skill Development Through Gameplay

Joseph Reinhart Sustainable Materials and Technology NC State University
Hiru Nelakutti Computer Science NC State University

Mentors and/or Co-Authors:
Arnav Jhala College of Engineering NC State University

The visual narrative games lab as a whole is centered on studying how people interact with stories and games. My projects involve experimenting with the design of interfaces that incorporate advances in display and interaction technologies, and natural language processing tools to improve user interaction. My first project involves using computational tools to find and visualize features of written texts such as nouns (character names, locations, etc.). This will allow us to study relationships between characters and events, and open further opportunities for better narrative comprehension. We are currently developing a system that uses an ensemble of language processing tools to identify important information about stories and visualize it on the iPearl immersion theatre screen at the Hunt library. The program is written in HTML, CSS and Javascript. My second project is based on creating a game that will dynamically adjust gameplay parameters to improve player skills across different dimensions of play. It is an effort to create a system to improve learning of game mechanics and game skills. We are using Unity to program the game, and the game itself uses dynamic difficulty to help skill development. The game is called ProcDefense and we are currently implementing difficulty adjusting AI. This project should allow us to gain insight into computational coaching for improving gameplay skills.

The Implementation Of “previous Work” In The Deep Thought Logic Tutor

Ila Wallace Computer Science NC State University

Mentors and/or Co-Authors:
Tiffany Barnes College of Engineering NC State University
Kevin Kronk Materials Science and Engineering NC State University

Deep Thought is a data-driven tutoring system that teaches students logic proofs. Deep Thought provides automatic verification of proofs and immediate feedback on logical errors. Automatically generated feedback tailored to the users’ needs improves retention and completion rates. I hypothesize that students can also benefit from viewing their previously-solved work. In the current version, viewing previously worked examples and problems is impossible until full completion of the tutor, making many students unable to complete the tutorial in its entirety if stuck on a problem. I hypothesize that adding the ability to view their own solved problems will help the users: complete the tutor faster, retain the information after completion, and have higher completion rates of the tutor. I will implement the previously worked problems in a new section of the Deep Thought tutor through the addition of a button that makes a pop-up window displaying the previous solved problems. I will test my hypothesis by gathering data from three different tests: time how
fast users complete the tutor, a post-test given after the completion of the tutor, and gather data from the Deep Thought database concerning how many users completed the tutor versus how many did not. With this gathered data, I will then compare the new data to previous data collected on the Deep Thought tutor. Through this new addition to the Deep Thought tutor, I expect that completion rates of the tutor itself will rise dramatically as well as an increase in both retention and speed of completion.