# Poster Presentations
## Session 1
1:30 PM - 2:45 PM

<table>
<thead>
<tr>
<th>Poster #</th>
<th>Student Presenters</th>
<th>Project Title</th>
<th>Mentors and/or Co-Authors</th>
</tr>
</thead>
</table>
| A1       | Kelly Elizabeth Holding  
*Animal Science* | Evaluating the Intake and Digestibility of Angus Bull Calves using Alkanes as Markers | Gerald Huntington *Animal Science* |
| A2       | Michelle Theresa-Ann Putman  
*Chemistry* | What keeps the water inside the egg patty on your Egg McMuffin? Describing the mystery of the water holding properties of gel systems | Clinton Stevenson *Food Science* |
| A3       | Deon Dontavius Wilkins  
*Computer Engineering* | Electrically Actuated Micro-Channel Heat-Transfer Device | Thomas Ward *Mechanical & Aerospace Engr* |
| A4       | Michelle D Villeneuve  
*Astrophysics* | Redshift and Angular Effects on the Detected Duration of Gamma-Ray Burst Light Curves | Davide Lazzati *Physics* |
| A5       | Sebastián Guevara Zuluaga  
*Chemistry* | Development of a Novel Synthesis of Biologically Active 4-Oxazolidinones | Joshua Pierce *Chemistry* |
| A6       | Lumumba Harnett *Electrical Engineering*  
Kenji Jamel *Electrical and Computer Engineering*; Lukas Kirchner *Physics* | The Current State of Battery Management Systems | Srdjan Lukic *Elec & Comp Engineering*  
Iqbal Husain *Elec & Comp Engineering*; Iqbal Husain *Elec & Comp Engineering*;  
Iqbal Husain *Elec & Comp Engineering*;  
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Iqbal Husain *Elec & Com
BS

Neel Vinayak Kabadi  Physics
Kelsey Reppert

Catalyzed Ortho Bromination of Arenes

Turbulent and Collective Effects on Supernova Neutrinos

Lyndsay Johnson Barnes  Chemical Engineering

Hydroxamate Linker Results in Fastest Interfacial Electron Transfer Rates in Fe(bpy)2(CN)2 - Sensitized Solar Cell

Elena Jakubikova  Chemistry

Elias Kemuel Pabón-Vázquez  Chemistry

Tyrosyl Radical Formation in Dehaloperoxidase: Sacrificing Substrate Reactivity for Enzyme Stability

Reza Ghiladi  Chemistry
David Barrio  Chemistry

Kathryn Ann Schneberg  Biology with a concentration in botany

CSI Dublin: Hunt for the Potato Killer

Jean Ristaino  Plant Pathology

Ningjia Wu  Electrical Engineering

High frequency high power transformer winding conduction loss optimization using ANSYS

Alex Huang  Electrical & Computer Engineering

Elliott Nelson Locke  Chemical and Biomolecular Engineering

Synthesis and Studies of a Hexacoordinate Bis(2,2?-bipyridine)-2,2?-bipyrolesilicon(IV) Complex

Thomas Schmedake  Chemistry
Derek Peloquin  Department of Chemistry

Benjamin D Brodish  Political Science

Racial Disparity as a Result of the War on Drugs in America

Elisha Savchak  Public & International Affair

Adam Andrew Lee  College Transfer

Application of Fluorescence Spectroscopy to attempt identification of Dissolved Organic Matter in the Rocky River

John Fountain  Marine Earth & Atmospheric Sciences

Elisabeth Wilson Foster  Mechanical Engineering

Magnetic Fluids for Electronic Thermal Management

Subhashish Bhattacharya  Elec & Comp Engineering

Elliot Virgin Cartee  Undeclared

The Effect of Progenitor Rotation on SASI in Core-Collapse Supernovae

John Blondin  Physics

Shaneice Renee Mitchell  Biochemistry

Ion Concentration Effects on Centroptilum triangulifer

David Buchwalter  Toxicology

Meagan Leigh Gentry  Statistics
Austin Martin John

Expected minimum temperatures for NC by methods of spatial statistics to predict dates of spring freezes

Sujit Ghosh  Statistics

Ethan Hunter Smith  AAS

Osteocyte Density from Mesozoic and Cenozoic Fossil Vertebrates

John Fountain  Marine Earth & Atmospheric Sciences

Jorly Chatouphonexay  Mathematics
Breanne Hollie  Zoology;

Assessing Wolbachia Releases in an Age-Structured Population

Alun Lloyd  Mathematics
Michael Robert  Biomathematics;
<table>
<thead>
<tr>
<th>Poster Position</th>
<th>Name</th>
<th>Major</th>
<th>Title</th>
<th>Advisor 1</th>
<th>Advisor 2</th>
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<tbody>
<tr>
<td>B4</td>
<td>Marie Encarnacion</td>
<td>Zoology</td>
<td>Making It With One Parent</td>
<td>Timothy Antonelli</td>
<td>Jason Allaire</td>
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<td></td>
<td>Jessica Rochelle Davis</td>
<td>Psychology</td>
<td>Synthesis of Unnatural Amino Acids with Photochemical and Bioconjugation Properties for the Expression of Proteins with New Function</td>
<td>Alexander Deiters</td>
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<td>B5</td>
<td>Luis Angel Vázquez-Maldonado</td>
<td>Chemistry</td>
<td>Bias in CMAQ Prediction of Ozone Concentration</td>
<td>Brian Reich</td>
<td>Sujit Ghosh</td>
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<td>Ryan Matthew Durden</td>
<td>Statistics</td>
<td>Synthesis of Unnatural Amino Acids with Photochemical and Bioconjugation Properties for the Expression of Proteins with New Function</td>
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<td>B6</td>
<td>Lydia N Raines</td>
<td>Animal Science</td>
<td>Optimization of Jurkat Cell Transfection Using a Liposomal Reagent</td>
<td>Laura Ott</td>
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<td></td>
<td>Elizabeth Bliss Green</td>
<td>Biochemistry</td>
<td>Dengue Virus-mediated Cell Fusion from Within</td>
<td>Dennis Brown</td>
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<td>B7</td>
<td>Nicholas John Panzera B.S.</td>
<td>Geology</td>
<td>Controlling Factors of South Central Crete's Topography</td>
<td>Sean Gallen</td>
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<td></td>
<td>Jonathan Chan</td>
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<td>Elucidating the Light-harvesting Mechanism in Porphyrin-Sensitized Solar Cells</td>
<td>Elena Jakubikova</td>
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<td>B8</td>
<td>Matthew Samuel Wiesner</td>
<td>Electrical Engineering</td>
<td>Data Analysis of a Photovoltaic Installation</td>
<td>Subhashish Bhattacharya</td>
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<td></td>
<td>Nathan R Roberts</td>
<td>Electrical Engineering</td>
<td>Overcurrent Protection Relays: Defenders of the Distribution System</td>
<td>Mesut Baran</td>
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<td>B9</td>
<td>Harper E. Niver</td>
<td>Biology</td>
<td>Silence of the Worms...via RNAi</td>
<td>Rick Davis</td>
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<td>Andrew Mark McLean</td>
<td>Biological Sciences - Human Biology Concentration</td>
<td>Progress Toward the Synthesis of Analogues of Alotamide A</td>
<td>Joshua Pierce</td>
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<td>B10</td>
<td>Currey Allen Nobles</td>
<td>Chemistry</td>
<td>Synthesis, Characterization, and Metatulation of Cycloparaphenylene</td>
<td>Walter Weare</td>
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<td>B11</td>
<td>Ransom Kumar Kochhar</td>
<td>Chemical Engineering</td>
<td>Characterization of the Morphology and the Model Drug Release Profile of Polymer Nanofibers Made by Shear Nanospinning</td>
<td>Orlin Velev</td>
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<td>Erin Jennifer Kuhl</td>
<td>Chemical</td>
<td>Photoelectrodeposition of Platinum on Silicon Photocathodes for</td>
<td>Mark Losego</td>
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<td>B19</td>
<td>Efficient Hydrogen Generation</td>
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<td>Alma Margaret Terpening <em>BIO</em> The influence of early growth on puberty traits in female pigs Mark Knauer <em>Animal Science</em></td>
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<td>B20</td>
<td>Phosphoproteomic Analysis of Human Respiratory Ciliary Axonemal Proteins</td>
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<td>Bruce Garrison Ballenger <em>Biochemistry</em> Michael Goshe <em>Biochemistry</em> Kevin Blackburn <em>Biochemistry</em></td>
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<td>B21</td>
<td>Plant Parasitic (Root-knot) Nematode Infectivity</td>
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<td>Morgan S. Barham <em>Biology</em> David Bird <em>Plant Pathology</em></td>
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<td>B22</td>
<td>Competitive Interactions between River Oats and Japanese Stiltgrass</td>
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<td>Meredith Lynn Wojcik <em>Biological Sciences, EEC and Plant Biology</em> Jon Stucky <em>Plant Biology</em> Consuelo Arellano <em>Statistics</em></td>
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<td>B23</td>
<td>Tailoring the Density of Grafted (Syntactomer) Peptides by Mechanical Deformation of Underlying Substrates</td>
<td></td>
<td>Joseph Anthony Collar <em>mechanical engineering</em> Jan Genzer <em>Chemical and Biomolecular Engineering</em> Julie Albert <em>Chemical &amp; Biomolecular Engineering</em></td>
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<td>C1</td>
<td>Expected minimum temperatures for NC by methods of spatial statistics to predict dates of spring freezes</td>
<td></td>
<td>Austin Martin John <em>Statistics</em> Meagan Leigh Gentry <em>Mathematics</em> Sujit Ghosh <em>Statistics</em></td>
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<td>C4</td>
<td>ATM-Mediated Regulation of Rac1</td>
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<td>Ian Thomas Hill <em>Biochemistry</em> AND Polymer and Color Chemistry Melissa Srougi <em>Plant Biology</em></td>
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<td>C5</td>
<td>Genetic structure of modern U.S. genotypes of Phytophthora infestans</td>
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<td>Meghan Rebecca Wyatt <em>Biology</em> Jean Ristaino <em>Plant Pathology</em></td>
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<td>C6</td>
<td>Selection of Starter Culture(s) for Commercial Cucumber Preservation Using a Screening Design for Fermentation Potential and Antimicrobial Activity</td>
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<td>Rickey Earl Smith <em>Food Science</em> Jeannette Theora <em>Chemistry</em> Erin McMurtrie <em>Food Science</em> Meredith Levi <em>Food Science</em> Sae Iwata <em>Food Science</em> Susan Dieck <em>Food Science</em> Kathyyne Daunhtry <em>Food Science</em> Ilenys Perez-Diaz <em>Food Science</em> Suzanne Johanningsmeier <em>Food Science</em></td>
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<td>C7</td>
<td>Polarized Morphogenetic System</td>
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<td>Daniel S Savelle <em>Mathematics</em> Sharon Lubkin <em>Mathematics</em></td>
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C8
Austin Reese Smith
Biochemistry
Implementing MANS Treatment for Invasive/Noninvasive Cancer Cell Lines (CL1-5/CL1-0)
Kenneth Adler Department Molecular Biomedical Sciences

C9
Liya Tquabo Weldegebriel
Civil Engineering
Regulated Flux Balance Analysis of Lignin Biosynthesis
Cranos Williams Elec & Comp Engineering

C10
Michelle Elizabeth Phillips
Mechanical Engineering
Sarah Butz Industrial Engineering;
Jamie Yannayon Industrial Engineering;
David Lenz Mechanical Engineering
Thrill-Cost Analysis of Roller Coaster Elements
Jerome Lavelle Engineering-Dean's Office

C11
Pollara Antonia B. Cobb
Chemistry
Palladium-Coated Gold Nanorods Drastically Expedite Photo-Reduction of Resazurin to Resorufin
Gufeng Wang Chemistry

C12
Dionicio F Rios Mechanical Engineering
Designing of Photobiological Fuel Cells: Deposition and Characterization of Biocomposite Coatings by Continuous Convective Assembly
Orlin Velev Chemical and Biomolecular Engineering

C13
Anna Susan Carr Physics
Breathing Mode Instability in Hoyle-Lyttleton Accretion
John Blondin Physics

C14
Erika J England Biochemistry
Recombinant expression of Clostridium ljungdahlii OTA1 alcohol dehydrogenase (CLJU_11880) in Escherichia coli
Amy Grunden Microbiology

C15
Joseph Tokeshi Taylor Meteorology and Marine Science
Predicting Observed Soil Moisture Using Statistical Modeling
Ryan Boyles Marine,Earth & Atmospheric Sci

C16
Jonathan Michael Hodiak Animal Science
IMAGINE Safe Drinking Water in South Africa: Student/Community Collaborations to Assess Nitrate Contamination in Ground Water.
Elizabeth Nichols Environmental Technology
Todd Steelman Forestry and Environmental Resources Academic Research

C17
Ramyata Upmaka Materials Science and Engineering, Biomedical Engineering
Investigation of the Inverse Transition Temperature of 16GVG(VPGVG)3 Peptide System
Yaroslava Yingling Material Science Engineering

C18
Kelly Rochelle Perkins Plant Biology
Genetic manipulation of the CYP71AV1 gene expression to understand biosynthesis of artemisinin and increase production of the antimalarial medicine
Fatima Alejos-Gonzalez Plant Biology
Monica Borghi Plant Biology;
Deyu Xie Plant Biology
<table>
<thead>
<tr>
<th>Poster Position</th>
<th>Name and Degree</th>
<th>Title</th>
<th>Advisor(s)</th>
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<tbody>
<tr>
<td>C20</td>
<td>Katie Lynn Shelton Political Science</td>
<td>Undergraduate Social Media Use in Politics</td>
<td>Michael Cobb Public &amp; International Affairs</td>
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<td>C21</td>
<td>Adrianna Renee Cardinal-De Casas Fisheries and Wildlife Conservation</td>
<td>The Secret Lives of Ants: Comparing interactions within nests</td>
<td>Rob Dunn Biology</td>
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<td>C22</td>
<td>Paul M Tyrlilk Chemistry</td>
<td>Controlled Self Assembling of Nanoparticles with super-Resolution Optical Microscopy at Liquid-Liquid Interfaces</td>
<td>Gufeng Wang Chemistry</td>
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<tr>
<td>C23</td>
<td>Joseph Scott Brown Chemistry</td>
<td>Fabrication and Characterization of Environmentally Benign Lignin Nanoparticles</td>
<td>Orlin Velev Chemical and Biomolecular Engineering</td>
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<td>D1</td>
<td>Travis T Lekich Chemistry</td>
<td>Synthesis of Heterobimetallic Compounds for the Purpose of Studying Metal to Metal Charge Transfer</td>
<td>John Franke Mathematics</td>
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<td>D2</td>
<td>Veronica J Bunn Mathematics; Tyler Wales Mathematics; Teresa Shoemaker Mathematics; Christina Davis Mathematics</td>
<td>Chaotic Dynamics of an Epidemic Model with Periodicity</td>
<td>John Franke Mathematics</td>
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<td>D3</td>
<td>Shengkai Alwin Mao Undeclared</td>
<td>A Quest For An Elusive Companion Star</td>
<td>Stephen Reynolds Physics</td>
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<tr>
<td>D4</td>
<td>Kayla Nicole Claassen Biochemistry, Bioprocessing</td>
<td>The Regulation of Ect2 by DNA Damage</td>
<td>Melissa Srougi Plant Biology</td>
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<tr>
<td>D5</td>
<td>Syeda Amina Ikram Shah Political Science</td>
<td>Smart Growth</td>
<td>Richard Kearney Public &amp; International Affair</td>
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<tr>
<td>D6</td>
<td>Matthew Felix Hin Mathematics; Richard Sayanagi</td>
<td>Hole Closing of a Surfactant Layer on a Thin Fluid Film</td>
<td>Karen Daniels Physics</td>
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<td>D7</td>
<td>Glenn Daniel Sidle Mathematics; Jay Xu Applied Mathematics and Statistics; Kayla Coleman Mathematics; Lauren Grana Math and Physics</td>
<td>HIV Patient Health Prediction Using Data Mining Techniques</td>
<td>John David Applied Mathematics</td>
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<tr>
<td>D8</td>
<td>Brandon James Eudy Chemistry</td>
<td>Creation of new functional ingredients by sorption of black</td>
<td>Edward Foegeding Food, Bioprocessing &amp; Nutrition</td>
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<tr>
<td>Poster Position</td>
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<td>Program</td>
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<td>D9</td>
<td>Robert Kyle Bennett</td>
<td>Chemical Engineering</td>
<td>Identification and Characterization of 4-Hydroxybutyrate CoA Ligases: The Missing Link in the CO2 Fixation Cycle in the Extremely Thermoacidophilic Archaean Metallosphaera sedula</td>
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<td>D10</td>
<td>Benjamin Donald Rusche</td>
<td>Biochemistry and Microbiology</td>
<td>Predicting Water Use Efficiency in Pinus radiata using SNP Analysis</td>
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<tr>
<td>D11</td>
<td>Carla Coste-Sánchez</td>
<td>Chemistry</td>
<td>Cp*Ir(III)-Catalyzed C-H Bond Activation/Functionalization of Benzonamides</td>
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<tr>
<td>D12</td>
<td>Erick Josue Andino</td>
<td>Nuclear</td>
<td>Electric Field Effect on the Electron Multiplication Coefficient of Glow Discharge Plasmas with Varying Electrode Geometries</td>
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<td>D13</td>
<td>Natalie Nadia Kandinata</td>
<td>Biochemistry</td>
<td>Dehaloperoxidase D54N Mutant Kinetic Activity</td>
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<td>D14</td>
<td>Anthony Alan Black</td>
<td>Physics</td>
<td>COMPARISON OF TYPE IA SUPERNOVA MODELS WITH YOUNGEST KNOWN SUPERNOVA REMNANT</td>
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<td>D15</td>
<td>Polite Donald Stewart, Jr.</td>
<td>Physics</td>
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<td>Joaquin Omara Green</td>
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<td>Analysis of the Lignin Biosynthesis</td>
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**Mathematical Engineering** Pathway in Populus trichocarpa using a Continuous Boolean Model  

**D23 Kirsten Franzen Chemistry** How much light does it take to kill pathogenic bacteria?  

**D24 Detric Elijah Robinson Biology** Escape responses in wild-derived zebrafish selected for divergent stress-coping styles  

**Environmental Engineering**  

**Reza Ghiladi Chemistry**  

**Brad Carpenter Chemistry**  

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<td>Matthew Koci <em>Poultry Science</em> Tamer helmy <em>Microbiology</em></td>
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<td>Jose Alonso <em>Genetics</em> Anna Stepanova <em>Genetics</em></td>
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<td>Douglas Irving <em>Material Science Engineering</em> Benjamin Gaddy <em>Materials Science and Engineering</em></td>
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<td>Jorge Piedrahita <em>Department Molecular Biomedical Sciences</em></td>
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<td>Linyou Cao <em>Material Science Engineering</em></td>
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<td>Zijian He</td>
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<td>Is link signature dependable for wireless security?</td>
<td>Huaiyu Dai</td>
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<td>Fangkai Yang</td>
<td>Simulation of Five-fold Twins Formation in Nanocrystalline Diamond Films</td>
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<td>Detlef Knappe</td>
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<td>Jaclyn N. Kovach Materials Science and Engineering</td>
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<td>A20</td>
<td>Mollie B Jenkins Professional Biology &amp; Industrial Chemistry</td>
<td>A Novel pH Sensor Produced Via Atomic Layer Deposition on Textiles</td>
<td>Jesse Jur</td>
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Advanced Materials for Environmental Sustainability

Session 2, C18
Analysis of Nanostructured Bismuth Telluride using TEM/STEM
Rylan Alexander Bledsoe Materials Science & Engineering
Mentors and/or Co-Authors: James LeBeau Material Science Engineering

In every mode of energy production and transport, most of the energy is released to the surroundings as heat. The mechanical and insulative design of a system is key in achieving a high efficiency; however, using thermoelectric materials like Bismuth Telluride (Bi$_2$Te$_3$), one can capture waste heat and generate electricity, increasing the overall efficiency of the system. Current thermoelectric materials do not achieve a high enough efficiency to be considered practical in most situations, but recent developments have reignited interest in these systems. Doping and nanostructuring Bismuth Telluride have achieved new promising results, greatly increasing the efficiency factor for waste energy recovery. In our research we use transmission electron microscopy (TEM) and scanning transmission electron microscopy (STEM) to analyze Bi$_2$Te$_3$,doped p-type with Antimony Telluride (Sb$_2$Te$_3$) and n-type with Selenium (Se). The material was nanostructured by hot pressing nanoparticles of diameters less than 30 nm. STEM imaging was used to study the nature of dopants and defects. STEM image simulations were used to predict image intensities, providing a deeper understanding of the experimental data.

Session 2, C3
The Transformational Metallization of Silicon Nitride (Si3N4)
Trent Mitchell Borman Materials Engineering
Mentors and/or Co-Authors: Jon-Paul Maria Material Science Engineering

Under the influence of heat and in contact with a reactive transition metal, silicon nitride can be transformed from an electrical insulator to the conductive metal nitride (TiN). In particular, the transformation from Si$_3$N$_4$ to TiN is thermodynamically favored, and its otherwise sluggish kinetics can be enhanced by the substitution of titanium alloys with low melting points. To explore this concept, metal and silicon nitride powders were homogenized, pressed into disks and annealed at temperatures ranging from 700°C to 900°C before being analyzed with x-ray diffraction (XRD). Compositions, temperature ranges, and phase equilibria were varied systematically to create three unambiguous experiments. The first experiment identified the temperature at which a Ti-Sn alloy with the 6:5 ratio reacts with SiNx, in this case, 750°C. The second experiment explored if eutectic liquids with even lower melting points could further enhance kinetics. To do so, eutectic Bi-Sn powder was added to a set of titanium-tin mixtures spanning 25% to 75% Ti. Bi did not reduce the onset temperature of N-gettering at any composition. The final experiment explored a companion set of reactions between SiNx and hafnium to determine the extent to which thermodynamic driving (i.e., $D_{HfNx} < D_{TiN}$) regulates the practical minimum temperature for reaction. The extreme sensitivity of Hf precludes powder experiments where oxygen contamination cannot be avoided. As such, thin film reactions are being pursued currently and will be presented.

Session 2, B5
Epitaxial Nickel Ferrite Thin Films
Bridget Julianna Calandro Ceramic Engineering
Mentors and/or Co-Authors: Justin Schwartz Material Science Engineering

Epitaxial ferrite thin films (nickel ferrite, cobalt ferrite, etc.) have provided technological promises for many applications such as magnetoelectronics, recording media, and detection probes of magnetic fields. The purpose of this study was to obtain perfect epitaxial thin films of NiFe$_2$O$_4$ (NFO) on a C-plane (0001) sapphire substrate. The NFO thin films were prepared using a chemical solution deposition (CSD) technique. The preparation procedure included deposition (spin coating of the solution) and pyrolysis, followed by a final annealing. Various parameters were changed to produce the desired results. Parameters changed includes varying pyrolysis temperature, varying annealing temperature and time, detailed cleaning method vs. control cleaning method, and change of solution concentration (0.2M and 0.5M). The deposited films were analyzed using X-ray Diffraction (XRD), Transmission Electron Microscopy (TEM), and Helium Ion Microscopy (HIM). The magnetic properties of the prepared films were measured using a superconducting quantum interference device (SQUID) magnetometer. The film deposited using the 0.2M NFO solution, pyrolyzed at 400°C and annealed at 750°C for 10 minutes, using the controlled cleaning method, produced epitaxial orientation.

Session 2, D5
The Improvement of Biosensors using Functionalized Nanoparticles
Melissa Danielle Gaillard Biomedical Engineering
Mentors and/or Co-Authors: Albena Ivanisevic Material Science Engineering

The functionalization of nanoparticles has many applications, specifically in biosensing devices. In this
project, the surfaces of biosensors are coated with amine, alkane, or carboxyl functionalized gold nanoparticles. The surface potential of the functionalizations electrically gate the electrons in the channel of the biosensor, changing the electrical properties of the device. This surface potential is measured using Kelvin Probe Force Microscopy (KPFM). By understanding these electrical properties, nanoparticle coated biosensors can be modified to have quick response, high specificity, inexpensive fabrication, reusability, multiplexing, and label-free detection. The results acquired from Kelvin Probe were statistically significant and the functionalizations had an effect on the surface potential of the nanoparticles compared to the control experiment where functionalizations were stripped with UV light.

Session 2, A10
Influence of Substrate Treatment on the Growth of Group IV Chalcogenides by Chemical Vapor Deposition
Cody PK Heitman Materials Science & Engineering
Mentors and/or Co-Authors: Linyou Cao Material Science Engineering

Two-dimensional chalcogenide nanosheets possess a great potential for important fields ranging from solar energy optoelectronics to superconducting. However, efforts on controlled synthesis of the nanosheets have remained very limited. Synthetic control is a necessary foundation for the nanosheet to be a useful material platform for both fundamental and applied interest. We study the effect of substrates on the synthesis of tin selenide (SnSe2) and germanium sulfide (GeS) by chemical vapor deposition. P(100)silicon (Si) and steam oxidized P(100) silicon (SiO2) substrates are treated in piranha solution to cleanse and hydroxylate each substrate’s surface. The Si substrates are further treated with 5.0% HF to actuate hydrogen passivation of the surface. The deposition on the treated Si and SiO2 surfaces were then characterized with scanning electron microscopy and raman scattering. We found substantial differences in the deposition on the silicon and silicon oxide substrates. We believe this is due to the different in surface energy of the substrates.

Session 2, B22
Contact Characterization of GaN and AlGaN
Raymond Thomas Hickey Materials Science and Engineering
Mentors and/or Co-Authors: Ramon Collazo Material Science Engineering

The wide bandgap group III-nitride semiconductors, such as GaN and AlN, are being researched for the development of applications in optoelectronics, high frequency and power devices. The formation of low-resistance Ohmic contacts on these materials is crucially important to improve the performance and reliability of these devices. A figure of merit for characterizing the quality of an ohmic contact is the specific contact resistivity. This is an intensive quantity, as it is independent of contact area and shape. The materials measured in this work were n-type Ga-polar GaN as a control, n-type N-polar GaN with a smooth surface (root mean square roughness ~1nm), and Al0.6Ga0.4N on AlN single crystalline wafers, all grown using metalorganic chemical vapor deposition (MOCVD). The transfer length method (TLM) was used to measure the specific contact resistivity of contacts based on the metal stack composed of 30nm Ti, 100nm Al, 70nm Ni, and 70nm Au, by measuring the resistance between metal contacts across gaps of varying sizes. Patterning and fabrication of the TLM structures was accomplished via photolithography and electron beam evaporation/deposition. The samples were rapid thermally annealed at temperatures between 500°C and 950°C to determine the conditions that produce the least resistive contacts.

Session 1, B18
Photoelectrodeposition of Platinum on Silicon Photocathodes for Efficient Hydrogen Generation
Erin Jennifer Kuhl Chemical
Mentors and/or Co-Authors: Mark Losego Chemical & Biomolecular Eng

As a sustainable source of hydrogen fuel, photoelectrochemical cells (PECs) use solar energy to split water and generate H2 gas. We are attempting to improve the efficiency of PECs by utilizing nanostructured semiconductor electrodes. Platinum (Pt) nanoparticles are efficient catalysts for PEC cathodes, but reliable methods are needed to deposit them inside nanostructured rod electrodes. Our project examines photoelectrodeposition of Pt on p-type silicon (p-Si) photocathodes. Photoelectrodeposition involves shining light on a submerged p-Si wafer while pulsing a potential through the plating solution to produce the electrons necessary for the reduction of Pt. Earlier publications established that photodeposition increases nucleation while electrodeposition increases growth of the nuclei. To obtain small Pt nanoparticles with high density, we adjusted the illumination time and electrical potential. Our experiments used a shuttered 500 W mercury lamp emitting UV light and a three-electrode system: p-Si as the working electrode, Pt as the counter electrode, and Ag/AgCl as the reference electrode. We analyze the deposited Pt nanoparticles using atomic force microscopy (AFM). AFM scans show that 30 seconds of concurrent light and potential generated an ideal array of particles. Using photoelectrochemistry techniques such as cyclical voltammetry, we examine how the Pt particle size and concentration affect the performance of the p-Si photocathodes.
Phase separation, or the segregation of distinct material phases, in thin films is an interesting phenomenon that can lead to a composite microstructure, which could contribute to unique material properties. In this study, the copper-silicon system was investigated at the eutectic point, or the composition with the lowest melting temperature. At this unique composition, the system separates into the copper silicide (Cu₂Si) and silicon phases. Thin films (<1 micron thick) of this eutectic copper/silicon material were deposited via sputter deposition, a physical vapor technique. Two approaches to preparing the sputtering target were used: one method involved fabricating a target of copper and silicon at the eutectic composition, while the other used a silicon target with copper pieces laid on the surface. X-ray diffraction (XRD) was used to determine the existence of the desired copper silicide and silicon phases. Several microscopy techniques were also used to characterize the thin films, including scanning and transmission electron microscopy (SEM and TEM) and atomic force microscopy (AFM).

Vanadium oxides are important catalytic materials used in a variety of applications that rely on partial and selective oxidation reactions. They exhibit interesting physical and chemical properties due to the complex electronic configuration of the transition metal vanadium. These materials have multiple valence states and are known to adopt different crystal structures while showing a reversible metal-to-insulator phase transition at a critical temperature. A problem limiting the use of this material lies in understanding how to stabilize energetically unfavorable polar surfaces. The presence of 3d-orbital electrons in vanadium oxides allow for localized electron states that lead to unique relaxation mechanisms for different surface terminations. However, these localized states also exacerbate problems in using common approximations to the density functional theory exchange-correlation functional. We demonstrate that the generalized gradient approximation (GGA) is an inadequate approximation when applying density functional theory to computationally model vanadium (II) oxide polar and nonpolar surfaces. This deficiency is overcome by implementing a GGA+U approximation. The improved methodology is used to analyze crystal structures of pure vanadium, vanadium (II) oxide, and vanadium (IV) oxide as well as the nonpolar (100) surface and polar (111) surfaces of vanadium (II) oxide. Various surface configurations and terminations are examined using both PBE and PBEsol GGA exchange-correlation functionals with and without their +U counterparts. Surface energies calculated by use of GGA+U methods are extended to finite temperature through ab initio thermodynamic calculations, which allows for direct comparison to experimental trends to demonstrate the effectiveness of the GGA+U framework.

Severe nuclear reactor conditions such as high stress, temperature, and irradiation require materials with high creep resistance in order to perform safely and adequately. This study characterizes the creep deformation of a newly-developed zirconium alloy (HANA4) by correlating the mechanical behavior to the data acquired from a burst test. Creep behavior is then modeled by developing a stress-rupture time curve under a constant temperature of 500°C. The observed anisotropic behavior of the candidate material is due in part by its Hexagonal Close Packed (HCP) crystal structure. Micro-hardness tests of samples annealed at various temperatures are used to correlate to material strength. The mechanical anisotropy parameters, R and P, are derived as a function of annealing temperature with these parameters correlating to a change in material microstructure.
structure of the FeNiCrCoMn High Entropy Alloy. Several different samples were prepared, with the amounts of Nickel and Chromium being varied between 14 and 26 atomic percent in each. The samples were produced by mechanical alloying using high-energy ball milling resulting in an average grain size of less than 10 nm. Each of the samples was then annealed at 400, 600, 800, and 1000°C for one hour in a 98% argon/2% hydrogen atmosphere. Hardness values for the samples were calculated using the Vickers hardness test. Most of the samples exhibited an fcc structure, but some had significant intermetallic phases that were observed only after annealing. The crystal structure was analyzed using x-ray diffraction.

Session 2, A4
Stress determination in GaN thin films grown by UHVPLD and MOCVD on sapphire and Si(111) substrates by Raman spectroscopy.
Jonathan Sami Watson Metallurgical and Materials Engineering
Mentors and/or Co-Authors: Lewis Reynolds Material Science Engineering

GaN devices are promising for use in high temperature, high frequency, and high power devices, as well as blue and green LEDs. Films of GaN grown on nonnative substrates such as silicon and sapphire can introduce a large number of defects and strain which limit the potential of GaN devices. To minimize defects and strain, it is necessary to confine the crystal defects to the interface, so that the rest of the film can grow strain free. In this project Raman spectroscopy was used to characterize the strain in epitaxial GaN films deposited on Sapphire and Silicon substrates. GaN films were deposited by PLD and MOCVD on r-plane sapphire, c-plane sapphire, and Si (111) with an AlN buffer layer. The MOCVD samples were obtained from Veeco. Raman spectroscopy was performed on the GaN films, and on polar and nonpolar bulk GaN samples for comparison. The E2 high and A1 (LO) phonon modes were observed in the Raman spectra from the samples. Shifts in these modes relative to the bulk GaN samples was used to quantify biaxial strain and stress in the films. Using stress coefficients of 2.9GPa-1cm-1 for the E2 high mode and 0.8 GPa-1cm-1 for the A1 (LO) mode, we found stresses in the films ranging from -0.4GPa to -0.8GPa in the MOCVD GaN on Si samples and stresses of 1.0GPa in the PLD GaN on Sapphire and 0.4GPa in the PLD GaN on Si.
Chemistry REU Program

Session 1, D9
Identification and Characterization of 4-Hydroxybutyrate CoA Ligases: The Missing Link in the CO2 Fixation Cycle in the Extremely Thermoacidophilic Archeaeon Metallosphaera sedula
Robert Kyle Bennett Chemical Engineering
Mentors and/or Co-Authors: Robert Kelly Chemical and Biomolecular Engineering

Metallosphaera sedula is an extremely thermoacidophilic aerobic archaea that grows optimally at 75°C and pH 2. M. sedula grows both heterotrophically on peptides or autotrophically on reduced metals or hydrogen gas. During autotrophic growth, carbon fixation within M. sedula occurs via the 3-hydroxypropionate/4-hydroxybutyrate cycle (3HP/4HB), which generates two molecules of acetyl-coenzyme A (CoA) from one molecule of acetyl-CoA and two molecules of bicarbonate. The 3HP/4HB cycle can be separated into three subpathways (SP): SP1 converts acetyl-CoA into 3HP, SP2 converts 3HP into 4HB, and SP3 converts 4HB into two molecules of acetyl-CoA. Although identities of the genes that encode most of the cycle enzymes are known, E10 was until recently unknown. The reaction catalyzed by E10, an acyl-CoA ligase, converts 4HB into 4-hydroxybutyryl-CoA using CoA and ATP as cofactors. The successful identification and recombinant expression of two enzymes from M. sedula that catalyze the E10 reaction is reported here. A spectrophotometric assay using Ellman’s reagent (5,5’-dithiobis-(2-nitrobenzoic acid) - DTNB) was used to measure the amount of unreacted CoA in the reaction mixture to determine E10 activity. A comparison of the two E10 candidates showed that E10B worked better on 4HB than E10A, (kcat/Km = 900 s⁻¹ M⁻¹ vs 160 s⁻¹ M⁻¹, respectively), suggesting that E10B is the physiologically relevant enzyme. Confirmation of this enzyme completes the knowledge of this high-temperature carbon fixation cycle.

Session 1, C11
Palladium-Coated Gold Nanorods Drastically Expedites Photo-Reduction of Resazurin to Resorufin
Pollara Antonia B. Cobb Chemistry
Mentors and/or Co-Authors: Gufeng Wang Chemistry

Palladium nanoparticles have proven to be useful in catalyzing chemical transformations in organic and inorganic synthesis, pollutant treatment, and energy conversion. Recently, there is a growing interest to improve the catalytic property of palladium nanoparticles by introducing a second metal to form a composite nanostructure. Gold has attracted much attention as the potential second metal because of its own catalytic activity and surface plasmon resonance (SPR) in the form of nanometer-sized structures. In this study, we coat Pd onto rod-shaped gold nanoparticles. We demonstrate that trace amount of Pd-coated gold nanorods greatly expedites the photo-reduction of resazurin to resorufin as compared to Pd spheres. The photo-reaction in the presence of hydrazine undergoes two steps: (1) a radical intermediate-generating step caused by the photon-initiated electron transfer, and (2) the deoxygenation of the radical intermediate. The presence of the Pd facilitates both the electron transfer and the deoxygenation steps. The enhanced catalytic activity of Pd-coated gold nanorods as compared to Pd nanospheres comes from gold nanorod cores acting as an antenna to receive photon energy and transfer to the reactants more efficiently due to their SPR at the photo-reaction wavelength. The existence of gold nanorod core SPR is confirmed by observing the scattering spectra of individual palladium-coated gold nanorod particles. This study demonstrated a new way to tune the catalytic property of nanoparticle catalysts.

Session 1, A12
C-H Activation: Cp*Ir(III) Catalyzed Ortho Bromination of Arenes
Jason Tyler Corder Chemistry BS
Mentors and/or Co-Authors: Elon Ison Chemistry

Developing a methodology for selective C-H bond transformation to other functional groups would carry with it expansive implications, particularly in the field of organic synthesis. Transition metal catalysts are a subject of great interest in these developments due to their demonstrated capacity to facilitate highly selective C-H bond activation. In an effort to contribute to this growing field, we have undertaken a series of experiments to develop a catalytic system based on iridium (III) complexes for the ortho halogenation of aromatic compounds. Reactions were inspired by recent reports of ortho halogenation of arenes via Rh(III) catalysts. N,N-dimethyl benzamide, N-methylbenzamide, benzamide, benzoic acid, and acetophenone were chosen as substrates to test the ability of two separate Ir(III) complexes to catalyze this transformation. These catalysts were selected because they have previously shown the ability to activate arene C-H bonds. The substrate scope was selected due to precedent demonstrating that selective activation may be catalytically achieved due to the chelating functionalities of each substrate. Successful bromination of N,N dimethylbenzamide was demonstrated and products were analyzed by GC/MS. N-methylbenzamide was also successfully brominated under these conditions, albeit at much lower
Alphabetical Listing of Lead Student Presenters by Program

Session 1, D11
Cp*Ir(III)-Catalyzed C-H Bond Activation/Functionalization of Benzamides
Carla Coste-Sánchez Chemistry
Mentors and/or Co-Authors: Elon Ison Chemistry

Oxidative transition-metal-catalyzed C-H bond functionalization has turned into a popular research topic recently. However, iridium-catalyzed C-H bond activation and functionalization has not been widely explored. Based on prior studies in our group on the Cp*Ir(III)-catalyzed C-H bond activation of benzoic acid, we aim to explore the application of these catalysts to its nitrogen analog, benzamide. A catalytic system was developed that involved the coupling of benzamide derivatives with alkynes. Typical reactions were performed at 90 ºC with 5 mol% catalyst and 2 equivalents of silver acetate. Initial product formation was first determined by GC-MS analysis of crude reaction mixture. Optimized yields were obtained by 1H NMR spectroscopy. The reaction exhibited a broad scope and [Cp*Ir(NHC)(H2O)2]OTf2 proved to be a competent catalyst, and provided NMR yields up to 95%.

Session 2, B23
Theoretical Studies of Bacteriochlorin-Based Light-Harvesting Molecular Arrays
Jessica Marie González Delgado Chemistry
Mentors and/or Co-Authors: Elena Jakubikova Chemistry
Jonathan Lindsey Chemistry

Porphyrrins and their derivatives—bacteriochlorins—are very attractive as potential components of artificial light-harvesting architectures because of their intense near infrared (NIR) absorption band (700 – 900 nm). They can be utilized to build up artificial photosynthetic architectures with efficient excited-state energy and/or electron transfer, capturing and utilizing light as energy. Even though their potential as light-harvesting arrays is known, theoretical and experimental studies of bacteriochlorin arrays are relatively scarce. We employ density functional theory to investigate electronic structure, calculate UV-VIS absorption spectra, analyze molecular orbital interactions and changes in the HOMO-LUMO energy gaps of various bacteriochlorin systems ranging from monomers through tetramers. We characterize the influence of linker groups and their position (meso vs. beta) on the electronic structure of bacteriochlorin arrays. We find that the identity of the linker (e.g., alkyne, phenyl, m-xylene), its position, as well as the relative orientation of the bacteriochlorin subunits (cis vs. trans), has a profound effect on the electronic coupling of the neighboring bacteriochlorins. Overall, the linkers involving groups such as m-xylene, that introduce steric hindrance and torsional strain into the molecular structure, result in greater decoupling of the bacteriochlorin subunits, larger HOMO-LUMO gaps, and UV-Vis absorption spectra similar to those of the monomers. These results provide an insight into the energy flow and electronic interactions in large pi-electron systems.

Session 1, A5
Development of a Novel Synthesis of Biologically Active 4-Oxazolidinones
Sebastián Guevara Zuluaga Chemistry
Mentors and/or Co-Authors: Joshua Pierce Chemistry

Anthocyanins are a class of polyphenols found in many fruits and vegetables that provide important benefits towards human health. Dietary consumption of anthocyanins and other polyphenols is associated with reduced oxidative stress from aging as well as decreased incidence of cardiovascular disease and diabetes. Data from the Center for Disease Control indicate that 75% of Americans do not consume the recommended daily amounts of fruits and vegetables. Polyphenol rich ingredients have been made by complexing soy proteins and polyphenols. Whey proteins function differently than soy proteins and therefore could be used to provide a new array of functional ingredients. Complexes were formed by adding whey protein isolate to black currant juice. The resulting solution was centrifuged and the precipitate was isolated. Ultraviolet-Visible spectroscopy indicated the presence of both whey protein and anthocyanins in the precipitate. Whey protein-polyphenol complexes were formed and optimal recovery was at pH 4.6. Ongoing experiments will determine ingredient functionality with the ultimate goal of producing a protein ingredient that can be used in a variety of functional foods designed to deliver higher amounts of health boosting phytochemicals and protein into the diet.
Oxazolidiones are naturally occurring compounds containing oxygen and nitrogen in a five-member ring. Many compounds in this class have shown antibacterial, anti-fungal, and anti-cancer properties. The target natural products in this investigation are synoxazolidinones A and B, two compounds that possess a unique and unprecedented 4-oxazolidinone core with an appended guanidine group. The novel approach proposed herein involves an intramolecular cyclization cascade, which occurs via a nucleophilic attack of an enol onto an adjacent acyl iminium ion. This approach not only allows for the synthesis of our target natural products, but also provides a platform for detailed study of a broad family of 4-oxazolidinones that have not been previously evaluated for their antimicrobial properties.

Session 1, D13
Dehaloperoxidase D54N Mutant Kinetic Activity
Natalie Nadia Kandinata Biochemistry
Mentors and/or Co-Authors: Stefan Franzen Chemistry

We were interested in understanding the catalytic site of the dual function protein Dehaloperoxidase-hemoglobin (DHP) found in Amphirite ornata. In order to do so, we conducted a series of experiments involving mutants of altered DHP surface charge. This experiment was on a D54N DHP mutant, which consisted of a mutation of Aspartate-54 to the isoteric amino acid asparagine. We chose this site to make a conservative amino acid mutation on the basis that it is close to Histidine-55, the acid-base catalyst that activates H2O2 when it is bound to the heme-iron catalytic site. Using Visual Molecular Dynamics (VMD) software to model the structure, we visualized the D54N mutant. The surface charge of the protein is less negative by one charge because of this change. Peroxidase activity in presence of enzyme DHP and its substrate 2,4,6-trichlorophenol (TCP) was measured using UV/Vis spectrometry. Kinetic analysis of the wild type and mutant’s catalytic efficiency (kcat/Km), which reflects affinity and catalytic ability of the enzyme, indicated that D54N DHP mutant’s catalytic efficiency (0.00334 ± 0.00053 uM-1s-1) is significantly greater than the wild type’s catalytic efficiency (0.00325 ± 0.00033 uM-1s-1). The result of this experiment supported the hypothesis, based on correlation observations from previous experiments, that more positively charged DHP mutants have increased catalytic efficiency compared to wild type DHP.

Session 1, B15
Synthesis, Characterization, and Metalation of Cyclopaphenylenone
Currey Allen Nobles Chemistry
Mentors and/or Co-Authors: Walter Weare Chemistry

Cyclopaphenylenone (cpp) is a captivating molecule. It possesses a ringed, cyclic shape which lends itself to interesting structural and electronic properties. This research focused on the synthesis, characterization and metalation of variable sizes of cpp. The method employed for this research follows a ground-up synthesis for cpp. In this scheme, an L-shaped, cyclohexyl-based unit is polymerized into a square-shaped macrocycle through a nickel coupling reaction. This macrocycle is then aromatized to yield cpp in ~5% yield. Macrocyclization of the L-unit alone yielded [9], [12], [15], and [18] cpp. Adding p-dihalophenyls to the nickel coupling step yielded variable sized CPP from [8]-[18]. The products of the macrocycle aromatization were difficult to work up and purify, so a different route was tested. Based off previously published findings, a system of selenium dioxide and trimethylsilyl polyphosphate can be used to aromatize compounds. The results of this method were not available at this time, however initial findings were promising.

The final component of the research was metalation of cpp. Metalation of cpp would give the molecule more controlled electronic properties. Chromium, Molybdenum and Tungsten hexacarbonyls were used to metalate cpp. The metalation reactions were carried out in a CEM microwave and the products were identified with IR spectroscopy. Cpp was successfully metalated with Cr(CO)₆.

Session 2, A21
Synthesis of 2-Aminomimidazole Biofilm Inhibitors
Angela Lucy Picciano Chemistry
Mentors and/or Co-Authors: Meghan Blackledge Chemistry
Christian Melander Chemistry

Bacterial biofilms are a significant health threat. Bacteria in the biofilm state are responsible for 85% of infections and can be up to 1,000 times more resistant to antibiotics than their planktonic counterparts. In previous research, our lead compound was found to inhibit biofilm formation in A. baumannii via an interaction with BfmR, a protein involved in quorum sensing. Based on molecular modeling studies with BfmR and the lead compound, we have designed several modifications to improve coordination of the compound to the protein and enhance its antibiofilm activity. Synthetic strategies and progress toward enhanced derivatives will be presented.

Session 1, C22
Controlled Self Assembling of Nanoparticles with super-Resolution Optical Microscopy at Liquid-Liquid Interfaces
Paul M Tyrlik Chemistry
Mentors and/or Co-Authors: Gufeng Wang Chemistry
Self-assembly of nanoparticles has attracted much attention because it offers novel and inexpensive routes to fabricate nanoscopic materials with unique electronic, optical and magnetic properties. In addition, colloidal particles confined to the interface are of particular interest as they serve as a model system to answer questions concerned with fundamental science, such as adsorption, desorption, crystallization and phase transitions. Liquid-liquid interfaces are ideal templates for assembling nanoparticles into two-dimensional structures because the nanoparticles are mobile and defects of the structures can be spontaneously eliminated. Conventional optical microscopy is limited by diffraction thus does not have sufficient resolution to differentiate individual assembled nanoparticles. Electron microscopy, on the other hand, has sufficient resolution but is not appropriate for studying phenomena at liquid-liquid interfaces. In this project, we apply novel super-resolution optical microscopy developed in this lab to observe self-assembling of nanoparticles with different materials. The nanoparticles are self-assembled at the aqueous solution and 1-fluoroheptane interface. Hydrochloric acid, sodium chloride, and ethanol was added to induce the self-assembling of nanoparticles. In order to find the optimum conditions for self-assembling, we varied the salt and ethanol concentration. This procedure can be applied to gold nanoparticle as well as polystyrene nanoparticle solutions. Future work will including observing the dynamic of self-assembling of the nanoparticles in real time.

Synthesis of Unnatural Amino Acids with Photochemical and Bioconjugation Properties for the Expression of Proteins with New Function
Luis Angel Vázquez-Maldonado Chemistry
Mentors and/or Co-Authors: Alexander Deiters Chemistry

Site-specific incorporation of unnatural amino acids (UAAs) into proteins has led to wide-ranging applications for biological studies that have allowed important insights into the structure, function and dynamic behavior of a diverse number of proteins. Thus, the incorporation of UAAs into proteins in bacterial and mammalian cells via an orthogonal tRNA/aminocyl-tRNA synthetase pair to expand the genetic code has created a demand for novel unnatural amino acids. Several analogues of lysine and tyrosine with photochemical or bioconjugation properties have been synthesized. The UAAs with light-removable groups allows the inhibition of the protein’s original function and it is later restored by non-invasive UV irradiation in a spatiotemporal fashion. In addition, UAAs with reactive handles, such as ketone and norbornene, allows for bioconjugation reactions with proteins. The introduction of these otherwise inert functionalities into proteins serves as a strategy to site-specifically label with virtually any probe, allowing for specific tracing and detection of the desired protein. A number of the presented amino acids have been incorporated into proteins, while others are in progress towards biological studies.
Computation for Undergraduates in Statistics Program (NCSU CUSP)

Session 2, B21
Evaluating radar reflectivity measurements as predictors of rainfall
Marisa Kathleen Akers Statistics
Meera Venkataraman
Mentors and/or Co-Authors: Brian Reich Statistics

To improve predictions of weather system models, it is important to have accurate measurements of precipitation at all locations. Actual amounts of rainfall have high variability across space and time, and patterns are generally unpredictable. Gauges measure rainfall, but only at specific locations. Therefore, a reliable prediction method for all locations in a given region is needed. One common method of predicting rainfall is to use measurements of reflectivity from radars. However, radar data is not directly comparable to gauge data because they measure reflectivity and actual precipitation amounts, respectively. The data analyzed contains 406 radar measurements covering about 62,000 square miles in Kansas for August 2004. We match these hourly readings to the 180 gauge stations in this region by the day and hour of measurement. Our main goal is to evaluate how radar reflectivity measurements can be used to predict precipitation. To address this goal, we examine zero-inflated regression models with precipitation as the response variable and radar reflectivity readings as a covariate. Additionally, spatial kriging methods utilizing zero-inflated models are explored.

Session 1, B6
Bias in CMAQ Prediction of Ozone Concentration
Ryan Matthew Durden Statistics
Sarah Y. Cummings
Mentors and/or Co-Authors: Brian Reich Statistics
Sujit Ghosh Statistics

Global scale pollution is among the most controversial topics in society today. The decisions of scientists and policy makers rely heavily on the results of pollution research. Deterministic atmospheric chemistry models help us understand the potential impacts of policy decisions on future air pollution levels. Our goal is to generate a model that allows simulation of future air quality under different conditions and makes improvement on ozone concentration predictions. We accessed and modified a large-scale dataset containing various variables such as the actual measurements of ozone concentrations and CMAQ (Community Multiscale Air Quality) predictions of weather conditions from 82 sites. By selecting the most important variables, we generated a linear model to make predictions for ozone concentration. This would allow the EPA and other CMAQ users to more accurately predict ozone levels throughout the country. In model development, we utilized the statistical procedure of stepwise selection. Exploratory data analysis focused mainly on physical conditions of weather, and we plan to take in chemical predictors to the model.

Session 1, B1
Expected minimum temperatures for NC by methods of spatial statistics to predict dates of spring freezes
Meagan Leigh Gentry Statistics
Austin Martin John
Mentors and/or Co-Authors: Sujit Ghosh Statistics

The goal of this paper is to provide a high-resolution map of daily predicted minimum temperatures over the Southeast US. From these predicted temperatures, we can determine the first date of spring freeze in any location on the map, which is valuable to agricultural industry among other things. First, we introduce a spatial regression model on the daily minimum temperatures recorded by the gauge stations in West Virginia, North Carolina, and Tennessee. The spatial model not only incorporates certain climatic and geographical variables, but also considers the spatial dependency among locations. By the same procedure, we also apply spatial models for longer time periods (weekly, monthly, and seasonal), in order to see the variation in models from time to time. We utilize simple spatial kriging to predict the daily minimum temperature for each point on the high-resolution map. The probability of the minimum temperature lower than 28 Fahrenheit can be estimated for each location over time under assumption of normality. The map of these probabilities is useful in determining the expected first spring freezes date for different locations.
Virginia, North Carolina, and Tennessee. The spatial model not only incorporates certain climatic and geographical variables, but also considers the spatial dependency among locations. By the same procedure, we also apply spatial models for longer time periods (weekly, monthly, and seasonal), in order to see the variation in models from time to time. We utilize simple spatial kriging to predict the daily minimum temperature for each point on the high-resolution map. The probability of the minimum temperature lower than 28 Fahrenheit can be estimated for each location over time under assumption of normality. The map of these probabilities is useful in determining the expected first spring freezes date for different locations.
Initiative for Maximizing Student Diversity (IMSD)

Session 1, C21

The Secret Lives of Ants: Comparing interactions within nests

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Mentors and/or Co-Authors: Rob Dunn Biology

Disease and information spread are regulated through interactions within populations. Within ant colonies (local populations of a special sort), interactions occur both within individual nests and out in those areas where ants forage. We predicted apriori that ant species that differ in their nest structure might have very different social interactions with consequent effects on the potential for information or disease spread more specifically. We hypothesized that in species with multiple nests, networks of interactions would be less well connected. We tested this hypothesis by comparing the social interactions of two ant species, Camponotus chromoaioides and Formica subsericea, one of which has multiple nests and the other of which is typically found in single large nests. These two species were studied comparatively, by separating colonies into small subcolonies, and observing contacts, both inside and outside their initial nest. These observations were made over a nine hour time period with observations made every 15 minutes for several trials. C. chromoaioides being polydomous, inhabit more than one nest, while F. subsericea are not polydomous. Despite this difference, the two species had statistically indistinguishable interaction networks, suggesting networks may generalize across types of populations even when they differ greatly in their spatial organization. These contact data can be used to study how disease and information might flow between small populations.

Session 2, D18

Alcohol Sensitivity in Drosophila melanogaster

Carmen Ellen Cubilla Biological Sciences
Mentors and/or Co-Authors: Trudy MacKay Genetics
Tatiana Morozova Biology

Alcoholism is a disorder determined by interactions between genetic and environmental risk factors. Alcohol sensitivity and development of alcohol tolerance in Drosophila melanogaster has similarities to that of humans. The flies encounter alcohol in their natural environments, and individuals in wild populations have variable sensitivities to ethanol. Alcohol sensitivity can be easily measured in the laboratory by placing flies in an ‘inebriometer’ that is pre-equilibrated with ethanol vapor; the time it takes for each fly to lose postural control and fall through the inebriometer is a measure of sensitivity. Previous research using 40 inbred lines derived from the Raleigh population showed significant variation in sensitivity. As part of a project to map the polymorphisms affecting this variation, we assessed ethanol sensitivity for 480 3rd chromosome isogenic substitution lines that were derived from crossing the 40 inbred lines and substituting homozygous 3rd chromosomes in a common inbred background, the Canton S B strain. We found significant variation among these lines. The Line ×Sex interaction term was highly significant (p<0.0001) indicating that the difference in alcohol sensitivity between males and females also varies among different genotypes. We hypothesize that we will be able to map the loci affecting alcohol sensitivity with much higher resolution than was possible in the previous study and identify novel genes for follow up in human studies.

Session 2, B6

Assessing the Dynamics of Biochemical Pathways Using Continuous Boolean Approximations

Ransford Kenya Damptey Chemical Engineering and Applied Mathematics
Mentors and/or Co-Authors: Cranos Williams Elec & Comp Engineering

The Mass Action Law is a mathematical expression that relates reaction rates and reactant concentrations. Michaelis-Menten kinetics, derived from the mass action law, are frequently used to model biochemical pathways. Michaelis-Menten kinetics require knowledge of kinetic interactions between the substrates (and potential inhibitors) and enzymes. This information however, is often unknown or difficult to determine. Normalized HillCube functions, characterized by continuous Boolean approximations, provide a canonical representation of the reaction rates that is based solely on known interactions, and not on the kinetics of those interactions. Normalized HillCube functions thus, can be an alternative for modeling biochemical pathways that can address the downsides associated with Michaelis-Menten kinetics. The overall goal of this research is to assess whether HillCube functions can provide a good approximation for generalized enzyme kinetics. A simple Glycolysis pathway, for which Michaelis-Menten kinetics are available, is used to test our research objective. Our goal is to determine the parameter values of the HillCube functions that will produce similar dynamics to the Michaelis-Menten model. We present our optimization procedure and the resulting optimized values of the HillCube functions. Our results show that for most reactions, the HillCube representation provides an adequate substitute for Michaelis-Menten kinetics.

Session 2, D21
Developing a Novel Calibration Method for Electrochemical Data Using Charging Current Collected in vivo
Eyob Abebe Eyualem Biomedical Engineering
Mentors and/or Co-Authors: Gregory McCarty Biomedical Engineering

Electrode pre/post-calibration has been one of the biggest problems plaguing electrochemical studies in intact animals when using fast-scan cyclic voltammetry (FSCV) and carbon-fiber microelectrodes. FSCV was used to collect data with a waveform ranging from -0.4 V to+1.3 V at 400 V/s to quantify rapid changes in neurotransmitter concentration with this approach. Traditionally, electrode calibration is done after tissue exposure to determine analyte concentration observed in the brain, but these microelectrodes do not leave a visible track in tissue, so the electrode must be used to lesion the recording area for spacial verification that destroys the electrode, or calibrated. Pre-calibration is problematic as sterilization alters the electrode surface. To overcome these issues we have developed a novel calibration method, which correlates the total charging current recorded in vivo to the sensitivity to a particular analyte using a pre-recorded training set. This method results in a linear relationship between the inherent charging current to the sensitivity of electrode towards changes in dopamine concentration. To further investigate how electrode sensitivity changes in response to treatment, electrodes were calibrated before and after tissue expose, and after a one day isopropyl alcohol cleaning step. Our findings contradict the assumption that electrode sensitivity remains relatively constant throughout experimentation. We determined that pre-calibration gave the highest sensitivity, with after tissue exposure having the lowest value and the one day cleaning step gave intermediate sensitivity. These data will provide unprecedented control over data interpretation for the use of FSCV in biological samples and improve data analysis time.

Session 2, A24
Distance makes a difference: Population divergence in the species Dorymyrmex elegans
Britné Rochele Hackett Animal Science
Mentors and/or Co-Authors: Rob Dunn Biology Daniella Sorger Biology

Dorymyrex elegans is one of the rarest ants in North America. It is known from only two ancient inland ridges in Central Florida, the Lake Wales Ridge and the Brooksville Ridge. This nocturnal species is behaviorally timid, often retreating to the nest at the slightest disturbance. Perhaps, because of its inconspicuousness, this species has not been studied since its description in 1988, such that little is known about the biology of this ant. Even on the ridges, it is not found everywhere, appearing to prefer areas of scrub habitat. Here we explore the biology of this species. More specifically, we test whether the populations on these ridges, which have themselves been separated for about 1 million years, have diverged genetically. Specimens were collected from both ridges to compare the molecular and morphological traits of individuals in the two populations. If the populations have diverged, they should display molecular differences. If the populations have diverged and undergone selection or drift, they should display both molecular divergence and morphological divergence.

Session 2, D17
CNT Deposition in Microfluidic Channels
Chima U Igboko Biomedical Engineering
Mentors and/or Co-Authors: Thomas Ward Mechanical & Aerospace Engr

The goal of this research project is to study the transport and deposition from liquid streams containing dilute concentrations of carbon nano-tubes (CNTs) in micro-channels. This study has applications to particle transport and deposition in human lungs and can be used in the development of a computational model of the human bronchia. Such a model would be instrumental in industries that process nano-particles where worker exposure may lead to acute or chronic health problems. Micro-channel devices were developed using PDMS, a silicon wafer with a 100 μm width, and plasma treatment. A system was set up that pumped a carbon nano-tube (CNT) and deionized water solution through the micro-fluidic device at various pressures (6-10 psig). A minimum clearance pressure was determined by performing experiments at low pressures (< 6 psi) until no clogging of the channels appeared. During the experiments performed at pressure above 6 psig a high-speed camera captured images of the channel every 3 minutes. The images were then analyzed using a MATLAB program. Preliminary data shows that aggregation of the CNT’s were sustained and deposition rates clearly depend on flow rate. Despite these observations the experimental system developed has proved problematic due to several issues that we are working to resolve, including device leakage and loss of pressure.

Session 2, C4
Modeling Biological Systems: Evaluation of Systems Biology Toolbox and Wolfram System Modeler
Morjan Bassam Rahhal Mechanical Engineering
Mentors and/or Co-Authors: Cranos Williams Elec & Comp Engineering

Effective modeling of biological processes can be used to predict the activity of biological systems. Analysis of the utility of tools that biologists and engineers use to develop functional models of biological processes can yield significant advantages in the model
development cycle. Some of these advantages include 1) time spent in the model development phase, 2) resources used to produce experimental data for model evaluation, and 3) efforts expended in developing practical solutions for environmental, medical, and social problems that can be addressed using systems biology. In this work, we explore the functionality of two software packages currently used to model biological processes: Systems Biology Toolbox (SBT), a continually recurrent software package, and Wolfram SystemModeler (WSM), a newly developed one. Our research includes the assessment of the effectiveness of these two tools in addressing issues associated with modeling biological systems where the packages’ approachability, capabilities, functionality and potential limitations are evaluated. The results indicated that both software packages have numerous capabilities due to the open, flexible and ‘user extensible’ environment. Some of these capabilities include their ability to analyze, design, simulate and function at a very similar level. Like SBT, WSM can import/export Systems Biology Markup Language models. SBT however, is not approachable in terms of installation process, documentation and organization. The simulation of both packages is equivalent. The functionality of both SBT and WSM is accurate and usable notwithstanding the lack of approachability in SBT.

Session 1, D24
Escape responses in wild-derived zebrafish selected for divergent stress-coping styles
Detrick Elijah Robinson Biology
Mentors and/or Co-Authors: John Godwin Biology

Many species express correlated suites of behavioral traits termed behavioral syndromes, personality, or stress coping styles. These suites of traits are hypothesized to influence their survival in the wild. For example, fish from high-predation habitats often score higher in measures of boldness than conspecifics from low-predation habitats. However, connections between stress coping style and escape swimming performance are not well understood. We measured performance differences between two populations of zebrafish (Danio rerio): those with a proactive coping style, which exhibit "bold" phenotypes, and those with a reactive coping style, which exhibit "shy" phenotypes. These lines were selectively bred from wild-caught zebrafish based on freezing behavior in a novel environment. We used these lines to compare escape performance in response to a startle stimulus. Average acceleration, average velocity, average maximum acceleration, and average maximum velocity were captured with high speed video. Individual acceleration and average velocity varied widely within both groups. However, the average maximum velocity achieved by zebrafish with a reactive coping style was significantly higher than that of zebrafish from a proactive line (p=.025). A faster escape response in reactive lines of zebrafish may be attributable to the higher levels of anxiety-related behaviors we have found in this group.

Session 1, C8
Implementing MANS Treatment for Invasive/Noninvasive Cancer Cell Lines (CL1-5/CL1-0)
Austin Reese Smith Biochemistry
Mentors and/or Co-Authors: Kenneth Adler
Department Molecular Biomedical Sciences

Myristoylated alanine-rich protein kinase C substrate (MARCKS) protein has been implicated previously in multiple cell processes. Studies from our laboratory have shown that MARCKS is involved integrally in cellular secretion, degranulation, migration and gene expression. These studies were based on the ability of a peptide identical to the myristoylated N-terminal sequence of MARCKS (MANS peptide) to affect processes in disparate cell types when the cells were pre-treated with the peptide prior to stimulation. In all of these cases, a missense control peptide (the RNS peptide) was without effect. Here, we investigated a potential role for MARCKS protein in regulating proliferation of cancer cells. We studied the MANS peptide effects on proliferation of two human lung cancer cell lines; the noninvasive CL1-0 tumor-cell line, and the invasive CL 1-5 tumor-cell line. Proliferation of these cells was assessed via a thymidine incorporation assay. Treatment with 50 uM MANS over 24 hrs caused an increase in proliferation of 9% for invasive cells and 26% for noninvasive cells, while the control RNS appeared to induce proliferation by 25% for invasive cells and 6% for noninvasive cells. While these results represent very preliminary in vitro measurements of proliferation, they indicate that MARCKS protein, which is highly expressed in cancer cells, could be playing a role in proliferation and thus growth of tumors.

Session 2, A7
Miniaturization of commercial swine.
Ashley Marie Sough Chemical Engineering
Mentors and/or Co-Authors: Jorge Piedrahita
Department Molecular Biomedical Sciences

Swine are used throughout the biomedical community as translational research models, due to their physiological similarity to humans. However commercial swine are bred for consumption, therefore bigger is better, which is not always beneficial to the scientific community, in terms of maintenance costs. To generate pigs of reduced size, the current study utilized RNA interference to knockdown the high mobility group AT-hook 2 (HMG2) gene. Three short hairpin RNA sequences (shRNA; SH1, SH2, and SH3) targeting HMG2 were inserted into the pLKO.1 vector, a vector used by the RNAi Consortium to...
produce their shRNA library. A scrambled shRNA was used to control for off-target effects. Expression levels of HMGA2 mRNA in porcine fetal fibroblasts were analyzed by quantitative real-time polymerase chain reaction and the experiment was replicated three times. Results indicate that SH1 and SH3 were able to significantly (P<0.05) reduce the level of HMGA2 mRNA by 71% and 78%, respectively. Future work will focus on whether the knockdown of HMGA2 is proportional to adult pig size, since Zhou et al. produced a pygmy mouse model by deleting the HMGA2 gene.
MEAS-Wake Tech Program

Session 1, A20
Application of Fluorescence Spectroscopy to attempt identifiaction of Dissolved Organic Matter in the Rocky River
Adam Andrew Lee College Transfer
Mentors and/or Co-Authors: John Fountain Marine Earth And Atmospheric Sciences

High levels of nitrogen in surface waters, which can cause algae blooms, fish kills, and health problems, is a worldwide concern. Recent work has suggested degradation of water quality in the Rocky River, Chatham County, NC, is related to elevated levels of nitrogen in the water. The nitrogen is present both as inorganic nitrogen (nitrate and ammonia) and dissolved organic nitrogen (DON). In the Rocky River, DON levels typically exceed inorganic nitrogen. This study focused on identification of the source of the DON. DON is one component of the complex Dissolved Organic Matter (DOM) present in surface waters. We collected samples of DOM from the Rocky River and its tributaries and examined them using fluorescence spectroscopy. Samples were selected based on high concentrations of organic nitrogen. Fluorescence was used to measure the excitation of organic matter in the samples. The results were analyzed using contour color mapping to indentify peaks that can help lead to the possible source of organic nitrogen. If the source of organic nitrogen can be indentified then possible remediation measures can be implemented in order to help conserve the ecosystem of the Rocky River and reduce the increased algae blooms the currently affect it. Preliminary results suggest that the DON is largely from a source of protein that could be possibly washing into the Rocky River and its tributaries during storm events. Future samples are needed to finger print the specific sources of DON in order to indentify what is washing into the river.

Session 2, C5
Absorbance of Particulate Organic Matter Positively Correlates with Total Suspended Solids in Small Tributaries to a Larger River Basin
Jacob Colin Rudolph Geology
Mentors and/or Co-Authors: Christopher Osburn Marine,Earth & Atmospheric Sci

Water quality is a problem that is faced by all human beings. The need for clean water to drink and to provide aquatic habitats for wildlife is significant. Storm events can mobilize dissolved and particulate organic matter (DOM) and (POM) from soils in runoff in urban areas, degrading water quality. The objective of this research was to answer three questions: 1) Is there a positive correlation between particulate absorbance at 350 nm (Ap350) and total suspended solids in mg/L (TSS)? 2) Is there a relationship between TSS and POM quality? 3) Lastly, how does the POM quality change during a storm event in a small tributary? These questions were studied by sampling river water, measuring POM light absorbance with a spectrophotometer, and gravimetric measurement of suspended particle mass. POM quality was determined by calculation of a slope ($S_{R350-400}$) the natural log of absorbance spectra from 350–400 nm. The results of the study were conclusive with my hypothesis. The graph of the relationship between $ap_{350}$ and TSS showed strong positive slope and there was an exponential relationship between the $S_{R350-400}$ and TSS. This study can be continued by further river sampling and analysis on larger bodies of water.

Session 2, C16
African Easterly Waves and Atlantic Hurricanes
Richard Scarborough
Mentors and/or Co-Authors: Anantha Aiyyer Marine Earth And Atmospheric Sciences

This study is a two part effort. Our goals include educating the general public about Easterly Waves, also known as African Easterly Waves (AEWs), and Hurricanes, as they are called in the states. Our focus will be to determine what atmospheric conditions are necessary to transform an AEW into a Hurricane. AEWs are disturbances that originate over northern Africa. They are a product of the interaction between hot dry Saharan desert air and the cooler moist air that travels up from the Gulf of Guinea. We believe that if we can identify the conditions required to convert an AEW to a hurricane, then we will make advancements in forecasting and disaster preparedness.

Session 2, D19
Neuse River Basin’s Water Quality
Oscar Javier Silva College Transfer
Mentors and/or Co-Authors: John Fountain Marine Earth And Atmospheric Sciences

Water samples from eight different sources in the Neuse River Basin were gathered and examined for a measurement of initial absorption of light at 254 nanometers (nm) and Dissolved Oxygen (DO) content. Between 4 and 7 days later, another measurement of the final absorption of light, at the same wavelength,
and dissolved oxygen was performed; last was a measurement of total organic matter concentration in each sample. The purpose of all measurements was to evaluate the lability of dissolved organic matter to bacteria. The biological oxygen demand (BOD) and aromatic organic matter consumption (if any) are desired to be known, as well as any correlation between these two factors. Aromatic compound concentration is determined through its absorption of light at 254 nm using a spectrophotometer. The ratio of aromatic compounds to total organic matter concentration is called Specific Ultraviolet Absorption (SUVA) and is used for determining the aforementioned correlation of aromatic and oxygen consumption. If there is a strong correlation, then, the presence of aromatics in river water also increases the BOD. This effect could lead to increased instances of hypoxia and degrade water quality.

Session 1, B2
Osteocyte Density from Mesozoic and Cenozoic Fossil Vertebrates
Ethan Hunter Smith AAS
Mentors and/or Co-Authors: John Fountain Marine Earth And Atmospheric Sciences

Here, I present the results of the preparation and study of 15 bone thin sections from different Mesozoic and Cenozoic fossil vertebrates, including dinosaurs, mammals, crocodiles, and turtles. The goal of this work is to understand the patterns of preservation of bone cells particularly ancient osteocytes and to interpret their paleophysiological implications, particularly metabolism, body size, and genomics. The methods that I used include: preparing the fossils, embedding the fossils into Silmar, and cutting the embedded fossils. I started by cleaning the fossils with warm water to wash off any unneeded minerals or dirt. Then I began cutting the fossils into a size small enough size to be placed in a Tupperware container. After the fossils were small enough I embedded them into liquid Silmar, which is then cooled and solidified. After the fossils have been solidified into the Silmar I then cut the Silmar into blocks containing the fossils. Once the fossils were in a block size, I placed the fossils on a machine saw which cuts the fossils into 1.5 mm thin sections; finally the section was grinded and mounted in a glass slide to be studied under transmitted and polarized microscopes. After the thin sections were observed under the microscope pictures were taken on 20x to be used for osteocyte counting. The osteocytes were counted and I calculated the osteocyte density based on the volume and area of the thin sections. I came to the conclusion that the osteocytes were in a higher density in the mammal fossil than they were in the turtle and dinosaur fossils.

Session 2, B19

Wind Resources in North Carolina
Ruth Leigh Tull Transfer Student
Mentors and/or Co-Authors: John Fountain Marine Earth And Atmospheric Sciences

The demand for renewable resources is increasing; as explained by 20percentwind.org the current projected goal is to increase wind to 20% of the United States energy production by the year 2030. According to windpoweringamerica.gov, the wind capacity of North Carolina is over 10 gigawatts, however currently there are no large-scale projects in place to take advantage of our abundance of wind resources. The majority of wind farms would be most productive off the shore of North Carolina. However, since the Outer Banks are a huge tourism asset, any proposals to place turbines offshore will most likely meet an uproar of disapproval. As an attempt to research other parts of the state with greater wind resources, the Appalachian Mountains have peaked some interest. WAsP is a numerical wind flow model, in Wind Resource Assessment: a Practical Guide to Developing a Wind Project, Michael Brower explains that the most widely used flow model in the wind industry was created by the Riso National Laboratory of Denmark. Using observed wind--direction and speed--data from the State Climate Office of North Carolina, as well as terrain contour maps and a description of land characteristics, the WAsP program is able to give an estimation of where wind turbines would be successful in producing the most power.
NC Project Seed (High School)

Session 1, B10

Elucidating the Light-harvesting Mechanism in Porphyrin-Sensitized Solar Cells

Jonathan Chan

Mentors and/or Co-Authors: Elena Jakubikova
Chemistry

Dye-sensitized solar cells (DSSCs) are a promising way to convert visible light into electricity without the fragility and costs of silicon solar cells. DSSCs utilize dyes attached to a semiconductor that upon excitation by visible light undergo interfacial electron transfer (IET), thus generating electricity. YD2-o-C8, based on zinc tetraphenylporphyrin (Zn TPP), is the most efficient dye in DSSCs to date, reaching over 12% in power conversion efficiency (Science 2011, 334, 629). In order to understand the link between the structure and light-harvesting properties of Zn TPP dyes, we investigate a series of dyes that include various structural features (4-ethynyl-benzoic acid anchoring group, diarylamine electron donor group, and alkoxy groups) found in YD2-o-C8. We employ time-dependent density functional theory (TDDFT) to obtain the absorption spectra and quantum dynamics simulations to model the IET between dyes and a TiO2 semiconductor surface. We find that diarylamine and 4-ethynyl-benzoate groups both attribute to the redshift of the Q-band and the broadening of the Soret band in the absorption spectrum of functionalized Zn TPP dyes. A new transition, leading to rapid interfacial electron transfer rates (~ 15 fs), also emerges in their absorption spectrum. Overall, various structural components of the YD2-o-C8 dye contribute to its favorable visible light absorption profile as well as faster IET rates, leading to the increased efficiency of YD2-o-C8 sensitized solar cells.
NC State Independent Researchers

Session 1, B20
Phosphoproteomic Analysis of Human Respiratory Ciliary Axonemal Proteins
Bruce Garrison Ballenger Biochemistry
Mentors and/or Co-Authors: Michael Goshe Biochemistry
Kevin Blackburn Biochemistry

Cilia are hair-like macromolecular organelles projecting from epithelial cell surfaces that line the human respiratory tract. Through coordinated beating, cilia clear the airway of mucus and debris. This coordinated beating is controlled and regulated in part through the phosphorylation and dephosphorylation of specific ciliary proteins. Intact cilia were removed from well-differentiated human airway epithelial cells and subjected to trypsin digestion. Samples were then analyzed by LC/MS/MS followed by protein database searching. From the 27 phosphopeptides detected, 10 were found to be reasonably high quality matches. A review of the literature indicated that some of these proteins may be involved in ciliary beat regulation, including radial spoke, beta-tubulin, zinc finger E-box-binding homeobox 1, and phosphatidylinositol 4,5-bisphosphate 5-kinase. Overall, this study reveals the potential for identifying additional regulatory phosphorylation sites in human ciliary axonemes.

Session 1, A14
Hydroxamate Linker Results in Fastest Interfacial Electron Transfer Rates in Fe(bpy)2(CN)2 – Sensitized Solar Cell
Lyndsay Johnson Barnes Chemical Engineering
Mentors and/or Co-Authors: Elena Jakubikova Chemistry

Dye-sensitized solar cells (DSSCs) convert solar energy to electricity employing dye molecules attached to a semiconductor surface. Some of the most efficient DSSCs use Ru-based chromophores. Fe-based dyes represent a cheaper and more environmentally friendly alternative to these expensive and toxic dyes. The photoactive state of Fe-based chromophores responsible for charge-separation at the dye-semiconductor interface is, however, deactivated on a sub-picosecond time scale via the intersystem crossing (ISC) into a low-lying photo-inactive quintet state. Therefore, development of Fe-based dyes capable of fast interfacial electron transfer (IET) leading to efficient charge separation on a time scale competitive with the ISC events is important. This research investigates how linker groups anchoring Fe(bpy)2(CN)2, (bpy = 2,2′-bipyridine), a prototypical Fe-based dye, onto the TiO2 semiconductor surface, influence the IET rates in the dye/semiconductor assemblies. Linkers groups investigated include carboxylic acid, phosphonic acid, hydroxamate, and catechol. We employ time-dependent density functional theory (TDDFT) to obtain absorption spectra of Fe(bpy)2(CN)2 with each linker, and quantum dynamics simulations to investigate the IET rates between the dye and the (101) TiO2 anatase surface. For all attachments, TDDFT calculations show similar absorption spectra with two main bands corresponding to the metal-to-ligand charge transfer transitions. Hydroxamate linker couples the dye to the semiconductor most efficiently, leading to the fastest IET rates, the phosphonic acid linker exhibits the slowest IET rates. Utilizing the hydroxamate linker will lead to the most efficient IET and photon-to-current conversion efficiencies of the Fe(bpy)2(CN)2 – sensitized solar cells.

Session 1, A19
Racial Disparity as a Result of the War on Drugs in America
Benjamin D Brodish Political Science
Mentors and/or Co-Authors: Elisha Savchak Public & International Affair

The primary objective of this project is to identify the nature of and issues surrounding racial disparity in America’s “war” on drugs. I review the history and development of the United States’ stance on drug criminalization and trace the link between racial bias and drug crime prosecution to our modern day. Through this examination, I identify the issue as being composed of two parts: First, there is an issue with current statutes regarding drug criminalization that is the result of our government’s entire legislative approach, not merely specific laws. Second, there is an issue with the manner in which our law enforcement bodies are executing this legislation. While this issue is primarily due to our poorly constructed legislation, the devastating results are the ever-apparent racial bias observed in drug arrests. In addition to citing the latest studies and analyses of the problem at hand, I also met with the Federal Policy Coordinator of the Drug Policy Alliance, Grant Smith. Grant Smith provided me with details regarding the origin of America’s disposition regarding drug crime and race, as well as the human rights and health care oriented alternatives to drug criminalization. In conclusion, with the causes of racial disparity apparent, it is certain that a serious reorientation in the approach and goals of America’s drug policy is imperative. This new strategy ought to be not unlike that which is being pursued by the DPA: one which identifies drug users not as criminals in need of severe punitive measures, but as individuals in need of treatment, welfare, and education.

Session 1, C23
Fabrication and Characterization of Environmentally Benign Lignin Nanoparticles
We are developing a new class of environmentally benign nanomaterials based on naturally derived, non-toxic, and biodegradable material matrices. One such material is lignin, derived from wood and pulp processing. A novel set of syntheses have been investigated to fabricate lignin nanoparticles of desired size and stability. A total of three approaches were investigated using Indulin AT Lignin (IAT) and Highly Purified Lignin (HPL). The nanoparticles were characterized by Dynamic Light Scattering. The first synthesis route uses the rapid addition of acid to dissolved IAT in water at high pH to produce nanoparticles which are stable at a low pH range of 2 to 5. The second synthesis approach rapidly adds water to dissolved IAT in ethylene glycol, with size control demonstrated from 50 to 180 nm in diameter. The molecular organization of lignin in these nanoparticles is different, which makes them stable at pH values from 3 to 9 at an ionic strength as high as 0.25M NaCl. The third synthesis method rapidly adds water to dissolved HPL in acetone. Size control from 50 to 225 nm in diameter was achieved by varying the weight percentage of the HPL in stock solution. When starting with 0.1 wt% HPL stock, size control has also been demonstrated from 80 to 200 nm in diameter by varying the water addition rate. These nanoparticles are stable within the pH range of 3.5 to 10.5 and remain dispersed at an ionic strength as high as 0.30 M NaCl. We are presently working on modifying the surface properties and the functionality of these new classes of nanoparticles.

Session 2, C17
The study of Plasma and its use in Material deposition and Growth

Tyesha Shawnta Brown Chemistry

In Materials Science, plasma can be used to grow or manipulate materials to produce different forms or structures. During the past two months, two plasma projects were completed to see the versatility of plasma and learn two common industrial uses for plasma processes. The first project used a plasma process known as sputtering. Sputtering is a process in which atoms are ejected from a solid target due to the barrage of the energetic particles in the plasma. This process was used to create a thin film of Cu on a sample of high purity alumina using a plasma chamber which was first lowered to a pressure of 1.5 E-7 Torr. The second project used a different plasma process called Plasma-Enhanced Vapor Deposition (PE-CVD). This process was used for the growth of Carbon Nano-Walls (CNW) on a (100) Si wafer to show how time and temperature affects density of (CNW) growth. Three (CNW) samples were grown, each at a different temperature and time: (S-1, 790°C, 45min.), (S-2, 845°C, 15min.), (S-3, 876°C, 25min.). All three samples were analyzed using a Scanning Electron Microscope (SEM), to show the difference in density. The two procedures differed in the way a plasma process was used. First, a thin film produced by sputtering (Physical Vapor Deposition (PVD)). Energetic plasma ions and electrons bombarded a target surface, knocking off atoms that collided with a substrate surface, leading to thin film deposition. Second, a related process, Physical-Enhanced Chemical Vapor Deposition (PE-CVD), was used to grow carbon nano-walls.

Session 1, D19
Pay No Attention to the Justices Behind the Curtain

Alexandra Shae Davidson Political Science

In 1996, Supreme Court Justice Souter said, “The day you see a camera come into our courtroom, it’s going to roll over my dead body.” Camera presence in the Supreme Court has been a contentious issue that has been growing over the past decades. Many pieces of legislation have been proposed to solve this issue, but none have had much success in Congress. For my undergraduate research project, I will explore the benefits and downsides of cameras being present in the Supreme Court. By researching the proposed sunshine in the courts legislation, gauging North Carolina State University students’ knowledge of and interest in the Supreme Court, and witnessing Supreme Court oral arguments, I will develop a well-informed perspective on whether cameras should be allowed in this critical, yet inaccessible, government organization.

Session 1, B4
Making It With One Parent

Jessica Rochelle Davis Psychology

Previous research suggests that children in single-parent households do not differ from children of two-parent households. However, less research has examined differences within samples of children from single parent homes. A sample of 34 college students (17 males and 17 females) between the ages of 18-23 completed a survey. Of those were taken of those in single parent households. Participants completed a survey asking how college aged students from a single parent household are affected with respect to self-esteem. In addition, they were asked how gender plays as a factor to these effects. Independent samples t-tests were used to determine if there was a statistical difference in gender among the sample. The difference between males (M =3.19, S.D. = 1.03) and
females (M = 3.43, S.D. = .99) was not significant t(32) = -.70, p = .49. Discussion will focus on the significance college students self-efficacy and self-esteem from single parent households, thereby using gender as a factor.

Session 1, C14
Recombinant expression of Clostridium ljungdahlii OTA1 alcohol dehydrogenase (CLJU_11880) in Escherichia coli
Erika J England Biochemistry
Mentors and/or Co-Authors: Amy Grunden Microbiology

Biofuels research is a continuously growing field as the push towards renewable energy sources increases. The use of biological catalysts for the production of ethanol from biomass is one of these areas of research. Clostridium sp. are ideal catalysts for their ability to convert carbohydrates or C1 gases like carbon monoxide and carbon dioxide into ethanol. Clostridium ljungdahlii OTA1 is a mutant strain that produces more ethanol and has been shown to have higher alcohol dehydrogenase activity compared to the wild-type strain. Recently, two bifunctional acetaldehyde/ethanol dehydrogenases and an ethanol dehydrogenase gene from OTA1 strain have been identified in the C. ljungdahlii genome. We are interested in assessing whether mutations in the enzyme coding regions or operator regions may play a role in the improved ethanol production of C. ljungdahlii. To do this, the three dehydrogenase genes were isolated from the wild-type and OTA1 strains and cloned into Escherichia coli expression vector pET28a for sequencing and expression. Promoter regions were also sequenced and compared separately. We have found that there is no difference in either the enzyme coding regions or operator regions for the mutant strain. Here we are presenting the cloning and expression data for one of the C. ljungdahlii OTA1 alcohol dehydrogenases, CLJU_11880.

Session 1, D20
Assessing Hardwood Biomass Production for North Carolina
Amanda Leigh Freeman Environmental Tech
Mentors and/or Co-Authors: Elizabeth Nichols Environmental Technology
Dennis Hazel Extension-forestry General

There is growing interest to generate biofuels from energy grasses and trees, in particularly, hardwood trees, in North Carolina. An important question to assess is biomass production by non-native hardwoods such as hybrid poplars based on plantation spacing and harvest rotations. We determined the biomass production of two hybrid poplar clones at a phytoremediation site in Aberdeen, NC. These trees were planted in 2002 and 2008 in stands of different spacings. We measured tree diameter and height for biomass calculations and verified the clone and age of each hybrid poplar stand. We report biomass production for these particular hybrid poplar clones per spacings planted.

Session 1, A10
Novel Enzymatic Conversion of Acetyl-CoA to n-Butanol using Recombinantly Expressed Proteins from Thermophilic Archaea
Glenn Dale Garrison Chemical and Biomolecular Engineering
Mentors and/or Co-Authors: Robert Kelly Chemical and Biomolecular Engineering

Electrofuels are an emerging technology being developed to fulfill the need for a renewable energy source that utilizes the existing liquid fuel infrastructure. Electrofuel projects aim to use microorganisms to produce liquid fuels from inorganic feedstocks such as carbon dioxide and hydrogen, bypassing many of the shortcomings of current biofuel production methods that rely on photosynthesis. Using a hyperthermophilic archaean, specifically Pyrococcus furiosus, as the host organism, a synthetic metabolic pathway will be developed where two acetyl-CoA molecules are produced from a single acetyl-CoA. The second acetyl-CoA will then be converted into n-butanol. Currently, each enzyme in the pathway is being recombinantly expressed and studied. The project has been divided into five subpathways. Sub-pathway 5 (SP5), the focus of my research, converts the surplus acetyl-CoA molecule into n-butanol using a
series of enzyme-catalyzed reactions with 5 intermediate products. Such a pathway has never been developed in a thermophilic organism. Currently, the conversion mechanism is being developed using 4 enzymes from selected thermophilic organisms. Like the other sub-pathways, the enzymes composing SP5 have been recombinantly expressed in E. coli and purified. Various enzyme characteristics, such as kinetics, thermostability, and specificity, are being compared between different enzyme candidates to optimize the process. This project, and in particular SP5, have far-reaching effects. Since acetyl-CoA is a common metabolic intermediate, this enzymatic process can be used to produce n-butanol from many living organisms.

Session 1, B8
Dengue Virus-mediated Cell Fusion from Within
Elizabeth Bliss Green Biochemistry
Mentors and/or Co-Authors: Dennis Brown Biochemistry

The dengue virus (DENV), a member of the genus flavivirus, is the arthropod-borne human pathogen responsible for the increasingly common dengue fever. Scientists strive to master the flavivirus’ mechanism of infection, focusing on viral membrane fusion events as a potential antiviral target. The process by which DENV1-4 induces the fusion of Vero cells in monolayer cultures was examined in the following research. The pH conditions required for DENV 1-4-infected Vero cells to fuse optimally were determined. Maximal fusion for all four serotypes was observed when infected monolayers were subjected to a low pH 5.0-6.0 for 20 minutes and then returned to a more neutral pH 6.5-7.5 for one hour. This low-pH induced fusion insists on a conformational change triggered by acidic conditions, similar to alphaviruses like Sindbis. This information allows us to better characterize a step in the complex DENV1-4 infection cycle, putting us another step closer to blocking flavivirus infection.

Session 1, D22
Analysis of the Lignin Biosynthesis Pathway in Populustrichocarpa using a Continuous Boolean Model
Joaquin Omara Green Mathematical Engineering
Mentors and/or Co-Authors: Joel Ducoste Civil, Construction and Environmental Engineering

Lignin, the major phenolic polymer made by plants, is the main barrier to the utilization of biomass for energy, papermaking, and forage digestibility. Understanding the fundamental nature of lignin biosynthesis will lead to improved crop yields and could also aid in their resistance to drought, pests, and pathogens. Several models, based on mass action kinetics, have been developed to describe how the lignin pathway in plants is regulated and potentially revealed new control mechanisms leading to lignin polymers. Although these models can be accurate, they require significant experimental data to determine the activation and inhibition kinetics, which may be challenging to collect. An alternative approach to these mass action based models is a Boolean derived model. An advantage of this model is that a fairly accurate numerical representation of the biological pathway can be developed from knowledge of substrate/ enzyme interaction of various metabolites within the biosynthesis pathway. In this research, a Boolean model was developed to simulate the lignin biosynthesis pathway. This model incorporated a continuous Boolean equation to explain the rate change of the metabolite concentration. Parameters for the continuous Boolean model were obtained by minimizing the Sum Squared Errors (SSE) between the data obtained from the Boolean model and a model based on the Michaelis Menten (M-M) approach using an optimization algorithm. The results from the optimized Boolean model will help explain the preferred flux pattern and also identify the important metabolites necessary for the production of lignin in Populustrichocarpa.

Session 1, A1
Evaluating the Intake and Digestibility of Angus Bull Calves using Alkanes as Markers
Kelly Elizabeth Holding Animal Science
Mentors Elizabeth Holding Animal Science
Mentors and/or Co-Authors: Gerald Huntington Animal Science

The objective of this research was to predict and evaluate the intake and digestibility of Angus bull calves using alkanes as markers. For this research twelve bull calves were used. There were three phases to this study. The bulls (phase 1, 21 days) were fed independently in one pen, and were offered the same diet. This main diet, fed ad libitum, was a corn silage; supplement total mixed ration consisted of 180g of soyhulls and corn mixture along with 160g of C32 and C36 alkanes. The bulls were fed the supplement by itself for a few weeks before giving them the total mixed ration. They were given 2lbs of feed for the total 61 days. The bulls had specific keys around their necks to open the Calan gates to each of their feed bins. In phase 2 the bulls were fed the same mixture but were group fed (21 days). Then they were brought down to teh Calan gates and fed like ther were in phase 1 (this is now phase 3, the last 21 days of the study). The bulls were weighed at the beginning and end of each phase (average weight at the end was around 641 pounds). Also during the last five days of each phase fecal grabs were collected on each bull. After the 63 days were up, their fecal samples and left over feed samples were taken to labs where a saponification and other analyses were ran to provide us with our results.
SNP discovery through Genotyping by Sequencing in Conifers
William Henry Kohlway IV Microbiology
Mentors and/or Co-Authors: Ross Whetten Forestry & Environmental Resource

Conifers, such as the North Carolina natives Loblolly Pine and Fraser Fir, are important sources of income and construction materials around the world. Single nucleotide polymorphisms, or SNPs, are a common form of genetic variation useful both for understanding diversity in native populations of these conifer species, and for applied breeding programs aimed at developing better planting stock. Due to the size of conifer genomes [16.8 to 21.6 Gb], complete sequencing of the genomes of an entire population to find SNPs is not feasible. One alternative approach for SNP discovery is Genotyping by Sequencing (GBS), a method that employs methylation sensitive restriction enzymes. Highly-methylated areas of the genome include repetitive sequences, and other “junk” DNA that does not encode genes, while gene-encoding regions are typically less-methylated. Synthetic DNA adaptors, which include a unique “barcode” sequence, can be added onto the ends of the genome fragments to allow pooling and amplification of DNA samples from many different individuals in a population into a single sequencing run for the discovery of many SNPs in many individuals. An initial trial of GBS using a single restriction enzyme and 93 samples was sequenced, yielding 144 million reads of which 94.8% contained barcodes. Two different software packages were used to analyze the sequences; the TASSEL GBS pipeline yielded sequence-tagged sites that mapped with much higher frequency to a draft loblolly pine reference genome sequence than did the STACKs package. A second GBS trial using two enzymes instead of one is currently being sequenced.

Session 1, A18
Synthesis and Studies of a Hexacoordinate Bis(2,2′-bipyridine)-2,2′-bipyrolesilicon(IV) Complex
Elliott Nelson Locke Chemical and Biomolecular Engineering
Mentors and/or Co-Authors: Thomas Schmedake Chemistry
Derek Peloquin Department of Chemistry

The chemistry of hypercoordinate silicon compounds is significant due to their role as intermediates in organic reactions. Recent studies of stable hexacoordinate poly(pyridyl)silicon complexes have shown promising electrochemical properties with multiple accessible oxidation states. Incorporation of a poly(pyridyl)silicon center into a conductive polymer chain could provide tailorable conducting properties. A heteroleptic complex was targeted in which one of the bipyridine ligands was replaced with a bipyrole ligand capable of polymerizing to form a conductive poly(pyrrrole). The bis(2,2′-bipyridine)-2,2′-bipyrolesilicon(IV) complex was synthesized in a multistep process, starting with bis(2,2′-bipyridine)-diiodosilicon diiodide and lithiated 2, 2′-bipyrole. Characterization and studies of the resulting product are underway.

Session 1, A7
The Role of p38 MAPK in LPS-Induced MARCKS Expression
Kendall J Lough Biology
Mentors and/or Co-Authors: Laura Ott Plant Biology

The myristoylated alanine-rich C-kinase substrate (MARCKS) protein is a substrate of protein kinase C that regulates actin dynamics and is upregulated upon LPS stimulation. LPS is a component of gram-negative cell walls and is responsible for the robust inflammatory response observed in septic patients. The p38 mitogen activated protein kinase (MAPK) pathway mediates pro-inflammatory gene expression regulated by LPS stimulation and it has been suggested that targeting the p38 MAPK pathway may be a suitable therapeutic option for the treatment of gram-negative sepsis. Recent evidence demonstrates that MARCKS is a negative regulator of LPS signaling and thus understanding the role of p38 MAPK in LPS-mediated MARCKS expression is critical to evaluate the effectiveness of targeting p38 MAPK for the treatment of sepsis. Herein, we hypothesized that the p38 MAPK pathway regulates LPS-mediated...
MARCKS expression. To address this hypothesis, THP-1 monocytes were stimulated with various concentrations of LPS with or without SB203580, a selective p38 MAPK inhibitor, and expression of MARCKS and beta-actin was determined by Western blot analysis. Our results demonstrate that LPS upregulates MARCKS expression in a dose dependent manner. Further, treatment of LPS-stimulated THP-1 monocytes with SB203580 results in decreased MARCKS expression compared to vehicle control (VC). Taken together, our hypothesis that the p38 MAPK pathway regulates LPS-induced MARCKS expression was confirmed.

Session 2, A6
Efficacy of Salmonella Detection in Poultry: Evaluating Different Sampling Methods to Minimize Number of Animal Use
Yan Ting Mak Biochemistry
Mentors and/or Co-Authors: Hosni Hassan Microbiology

Under normal experimental protocols, researchers need to repeatedly euthanize an overwhelming amount of animals to frequently obtain caecal samples to test for the persistence of Salmonella Typhimurium. To be humane and cost efficient, it would be beneficial to determine an alternative method for collecting cecum samples that did not require the euthanization of the chicks. In the first trial, we explored the correlation between cecum samples and cloacal swabbing samples, where samples of the cecum and cloacal swabs were plated on XLT4 media containing the appropriate antibiotics to phenotypically select for Salmonella colonies. All viable counts were later confirmed by API diagnostic strip tests to be indeed Salmonella Typhimurium. There was a weak correlation found for trial 1 (R^2 value=0.098), however, cloacal swabs tend to be able to detect presence of Salmonella only when there were high concentrations of Salmonella in cecum samples. To further track the presence of Salmonella in the chick’s digestive tract and search for other correlative factors, trial 2 of the research included sampling from the colon as well. Trial 2 has shown greater R^2 values in “colon versus cecum” samples (overall R^2 value=0.5326) than “colon versus cloacal swab” samples (overall R^2 value=0.1702) and “cecum versus cloacal swab” samples (overall R^2 value=0.2095) as expected. This elucidates the ineffectiveness of cloacal swabbing for detecting the presence of Salmonella Typhimurium in chickens.

Session 1, A15
Tyrosyl Radical Formation in Dehaloperoxidase: Sacrificing Substrate Reactivity for Enzyme Stability
Elias Kemuel Pabón-Vázquez Chemistry
Mentors and/or Co-Authors: Reza Ghiladi Chemistry David Barrio Chemistry

Dehaloperoxidase (DHP) from the terebellid polychaete, Amphitrite ornata, is the first oxygen-binding globin that possesses a biologically relevant peroxidase activity. Two known isoforms of DHP, A and B, have been shown to oxidize trihalophenols to dihaloquinones in a dehalogenation reaction that utilizes hydrogen peroxide as the oxidant. The catalytically competent species in dehaloperoxidase appears to be Compound ES, a reactive intermediate that contains both a ferryl heme and a tyrosyl radical. For DHP B, EPR studies suggested that two different radicals are present, a primary tyrosyl radical consistent with being located on either Tyr28 or Tyr38. Previously, our lab has shown that recombinant substitution of both of these tyrosines with the redox inactive residue, phenylalanine, prevented the formation of Compound ES in DHP B at pH7. However, subsequent experiments at lower pH values indicated that the formation of Compound ES is restored. Beyond the aforementioned tyrosyl residues, DHP B also contains two other tyrosines, Tyr16 and Tyr107, as well as a tryptophan, Trp120, as possible
Alphabetical Listing of Lead Student Presenters by Program

(Monica Borghi - Plant Biology; Deyu Xie - Plant Biology)

Session 1, B9
Controlling Factors of South Central Crete's Topography
Nicholas John Panzera B.S. Geology
Mentors and/or Co-Authors: Sean Gallen, Marine, Earth & Atmospheric Sci

In south central Crete an area of known mountain uplift has been occurring for over 30 million years in an area composed predominately of marine limestone. This area is also where the known subduction of the African plate underneath the Eurasian plate occurs, creating 3 known extensional faults. Determining whether uplift in the region is caused by faulting or weathering of the predominate rock type would give us an understanding of how the mountainous topography was formed. Determining the controlling factor of the area's topography aids the interpretation of the fault's activity. A digital map was created in ArchGIS of the region by overlaying geologic unit maps, watershed areas, and known faults. After comparing the data created by the digital maps with the known topography of the uplifting area, it was determined that the weathering of the rock units was not the first order of control. The uplift in southern Crete is mainly due to the three faults in the region extending, indicating a sizable seismic hazard for the region.

Session 1, C18
Genetic manipulation of the CYP71AV1 gene expression to understand biosynthesis of artemisinin and increase production of the antimalarial medicine
Kelly Rochelle Perkins Plant Biology
Mentors and/or Co-Authors: Fatima Alejos-Gonzalez, Plant Biology; Monica Borghi, Plant Biology; Deyu Xie, Plant Biology

Based on the reports from World Health Organization, the malaria disease threatens people's lives in 106 endemic countries and territories, particularly those countries in Africa. In 2010, approximately 3.3 billion people were at risk of malaria and 655,000 deaths (particularly children under five years old and pregnant women) were estimated. Plasmodium falciparum that is a resistant parasite to most antimalarial drug causes nearly 80% of casualties. Currently, the most effective treatment of falciparum-caused malaria is the use of artemisinin and the artemisinin-based combination therapies (ACT). Although several genes (e.g. ADS and CYP71AV1) have been cloned from A. annua and biochemically shown the involvement into the biosynthesis of artemisinin precursors, to date, whether these genes are genetically involved in the biosynthesis of artemisinin has not been investigated. This is because genetic evidence of these gene functions in Planta is lacking. Our goal underlying this specific proposal is to use transgene to demonstrate the functions of CYP71AV1 gene and to increase the production of artemisinin plants. We have cloned CYP71AV1 gene from A. annua and constructed binary vectors for genetic transformation. The experimental procedures of transformation include activation of Agrobacterium, pre-culture of leaf explants, infection of explants by activated Agrobacterium, cultivation of infected explants, regeneration and selection of transgenic plants, identification of transgenic plants, RT-PCR, southern blotting analysis and metabolic analysis of artemisinin and its precursors. We are expecting to obtain multiple transgenic plants with high levels of artemisinic acids and likely artemisinin.

Session 1, B7
Optimization of Jurkat Cell Transfection Using a Liposomal Reagent
Lydia N Raines Animal Science
Mentors and/or Co-Authors: Laura Ott - Plant Biology

Jurkats are a human T lymphocyte cell line that is used to study T cell biology and is commonly transfected using electroporation or nucleofection approaches, requiring specialized equipment. For labs interested in T cell biology that do not have access to this equipment, transfecting Jurkats by liposomal transfection would be preferred. GenCarrier-2 is a liposomal transfection reagent that has been reported to successfully transfect Jurkats, although a published protocol does not exist. The aim of this study was to optimize a protocol to transfect Jurkats using GenCarrier-2. Jurkat cells were transfected with pEGFP-N1, an enhanced green fluorescent protein expressing plasmid. To optimize the protocol, various volumes of GenCarrier-2 (0.5-6 μL) along with 1 μg pEGFP-N1 were incubated with Jurkats in serum free conditions for 5 or 18 hours. Flow cytometric evaluation of cell viability and transfection efficiency was analyzed 24 hours after the addition of complete media. We observed similar levels of cell viability and less than 5% transfection efficiency in GenCarrier-2 transfected Jurkats, regardless of the conditions. To confirm that our batch of GenCarrier-2 was capable of transfection, human embryonic kidney (HEK) cells were transfected with pEGFP-N1 and GenCarrier-2 and successful transfection was achieved.

...
Additionally, to confirm that our strain of Jurkats could be successfully transfected, we electroporated cells with 5 μg pEGFP-N1 using an established protocol and observed approximately 79.1% viability and 18% transfection efficiency. Taken together, while claims that GenCarrier-2 successfully transfects Jurkats, to date we observed very little transfection efficiency, with further optimization required.

Session 1, D10
Predicting Water Use Efficiency in Pinus radiata using SNP Analysis
Benjamin Donald Rusche Biochemistry and Microbiology
Mentors and/or Co-Authors: Ross Whetten Forestry & Environmental Resource

The proliferation of next generation DNA sequencing technologies in recent years has made the identification of single nucleotide polymorphisms (SNPs) a rapidly expanding scientific field. Previous research has indicated that SNPs in several different genes of the Pinus taeda genome are associated with carbon isotope discrimination (δ13C), an indirect measure of plant water use efficiency. It is unknown however if SNPs in similar genes are associated with carbon isotope discrimination in other tree species. The identification of genetic markers for water use efficiency could be useful for the selection of faster growing and more drought resistant pine trees. In this current phase of research, 1,400 foliage samples were collected from Pinus radiata trees in Chile and their carbon isotope ratios measured. The samples that were on the extreme ends of the dataset were selected and their genetic material extracted utilizing a modified Qiagen DNeasy protocol. Five target genes were amplified from the purified DNA samples and analyzed using Picogreen assay and gel electrophoresis. In the next phase of this research, the amplified genes will be sequenced utilizing a genotyping by sequencing (GBS) method. The identified SNPs will be compared to the known carbon isotope ratios to test if an association exists.

Session 1, B17
Effect of Hydrodynamic Shear on the Disruption of Cellulose-CaCO3 Agglomerates for Paper Manufacturing Applications
Miguel Antonio Sanchez Paper Science & Engineering
Mentors and/or Co-Authors: Martin Hubbe Wood And Paper Science

Prior to the headbox, a papermaking furnish undergoes multiple levels and types of physical stresses, or shear regimes. First of all, a high level of shear in the refining operation results in cellulose fibers being partly deliminated, resulting in greater conformability, some fibrillation of the surfaces, and a large amount of fines being produced. It is essential for papermakers to gather and flocculate these fines in order to get them out of the way, therefore reducing drainage time, and improving the economy of the papermaking operation as a whole. Our research project sought to emulate the types of shear that fines and filler particles might experience during the papermaking process. We employed various polymer bridging techniques, in order to increase flocculation, and tested various types of shear against several levels of polymer dosages. The resulting state of agglomeration of the fine materials was evaluated by means of laser diffraction particle size analysis. It was found that DADMAC, a highly charged cationic polymer commonly used in wastewater treatment plants, was very effective in reversing the negative charges of the fines, and filler particles as well. When followed by an anionic polymer, such as anionic polyacrylamide (aPAM), flocculation was found to increase greatly, and still retain up to 74% of its original mean agglomerate size, depending on the shear. Furthermore, through several zeta potential tests, it was found that DADMAC had a logarithmic effect on the charge of a fines or PCC particles.

Session 1, D5
Smart Growth
Syeda Amina Ikram Shah Political Science
Mentors and/or Co-Authors: Richard Kearney Public & International Affair

This research project is a case study of Cary, North Carolina and its purpose is to determine whether the town’s development models the principles of Smart Growth. Smart Growth is an urban planning concept, which focuses on fostering compact, efficient, and environmentally friendly development. My hypothesis for this case study is that the Town of Cary does not fully meet the criteria for a Smart Growth municipality. The methods used to conduct the research was to first study the scholarly literature on Smart Growth and then interview relevant staff members in the Town of Cary Planning Department. The next step was to thoroughly study the Town’s Comprehensive Plan, an official policy document composed of separate constituent plans that describe present and future developments of Cary. The findings indicate that the Town of Cary represents Smart Growth development. Therefore, the hypothesis that Cary does not fully meet the criteria for a Smart Growth municipality is rejected.

Session 1, C6
Selection of Starter Culture(s) for Commercial Cucumber Preservation Using a Screening Design for Fermentation Potential and Antimicrobial Activity
Rickey Earl Smith Food Science
Jeannette Theora Chemistry;
Erin McMurtrie Food Science;
Meredith Levi Food Science;
Sae Iwata Food Science;
Susan Dieck Food Science;
Kathryne Daughtry Food Science

Mentors and/or Co-Authors: Ilenys Perez-Diaz Food Science
Suzanne Johanningsmeier Food Science

Without the use of a starter culture, the cucumber pickling industry currently relies on 6% sodium chloride (NaCl) brine solutions to aid in selection of lactic acid bacteria to carry out the fermentations. Cucumbers can be fermented without NaCl if a starter culture is added and natural preservatives are supplemented after the primary fermentation is completed, eliminating the cost of treating high salt cover brines post-processing. A commercially viable starter culture must be effective in a variety of conditions. Potential starter cultures were tested under varied initial pH, salt concentration, and temperature. In this experiment, 233 bacterial isolates from commercial cucumber fermentations (70:30 Lactobacillus plantarum: Lactobacillus brevis) were evaluated for the ability to rapidly decrease pH. Each isolate was tested in duplicate for the ability to ferment cucumber juice under 0% and 6% NaCl, pH 4.0 and 5.4, and at incubation temperatures of 15°C and 30°C using a fractional factorial screening design. Based on the magnitude of the pH drops in each treatment combination, 143 isolates were eliminated. Remaining isolates were screened for antimicrobial activity against two fermented cucumber spoilage yeasts, Pichia manshurica and Issatchenka occidentalis, two Lactobacillus buchneri strains associated with fermented cucumber spoilage, and Lactobacillus plantarum and Lactobacillus brevis. The selected Lactobacillus plantarum and Lactobacillus brevis strains will be further evaluated in commercial fermentations to determine their potential as starter cultures. Identification of suitable starter cultures for commercial scale cucumber fermentations will allow processors to reduce high salt waste, implement a more sustainable operation, and reduce processing costs.

Session 1, C15
Predicting Observed Soil Moisture Using Statistical Modeling
Joseph Tokeshi Taylor Meteorology and Marine Science
Mentors and/or Co-Authors: Ryan Boyles

Marine, Earth & Atmospheric Sci

Soil moisture (SM) is the amount of water contained in a volume of soil. SM is important to agriculture, coastal ecosystems, and environmental engineering e.g. the amount of water holding capacity for a particular soil type is essential for irrigation, drought and flooding potential in coastal ecosystems. However, SM is measured by few stations in the U.S. including the North Carolina Environment and Climate Observing Network (ECONet) and U.S. Climate Reference Network (USCRN). The purpose of this study is to evaluate the accuracy of a SM estimation technique utilizing these observations. This estimate will assist with quality control of ECONet data and prediction of missing data. Observed hourly SM from each station and observed minute data from every ECONet station are used to create statistical models to predict SM. This model has a time series component to account for change in SM with time. The model predicts up to 24 hours in advance for hourly data and up to an hour in advance for minute data. With every new observed SM value, the model will adjust itself to account for new information. The model captures the observed SM with an error of less than ±0.07 m3m-3 at every ECONet and USCRN station. Also at USCRN stations, SM values at different depths are used to test sensitivity of the model to soil depth. One model limitation is the station of interest must measure SM for at least a year to have minimal error.

Session 1, B19
The influence of early growth on puberty traits in female pigs
Alma Margaret Terpening BIO
Mentors and/or Co-Authors: Mark Knauer Animal Science

The objective of the current study was to correlate early growth with subsequent puberty traits in female pigs. Gilts (n = 400) were housed at the Tidewater Research Station near Plymouth, NC. Daily estrous detection began at 130 days of age using mature boars. Females were housed indoors in pens of 15 on slatted flooring and had ad libitum access to feed and water. Traits measured included birth weight, weaning weight (at 21 days of age), age at puberty, weight at puberty, length of estrus and vulva width. Data were entered and analyzed in Microsoft Excel using the correlation function. Results are shown below in Table 1. Birth weight and weaning weight had moderate, positive correlations with puberty weight (r = 0.46 and 0.39, respectively). This means a larger birth weight and weaning weight were associated with a greater weight at puberty. Birth weight and weaning weight had low, positive correlations with age at puberty, length of estrus and vulva width (r = 0.02 - 0.12). The results of this study suggest a larger piglet birth weight is associated with a greater mature size.

<p>| Table 1. Correlations between early growth and puberty traits in female |
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<th>Weaning weight</th>
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environments in Wake Co., the riverside levee and a floodplain flat farther from the river. We first studied the survival of river oat transplants in experimental plots, some of which were cleared of stiltgrass and others which were left uncleared. Transplant survival was determined to be independent of treatment, environment, and block. We speculated that drought and extreme temperatures caused transplant mortality which occurred uniformly across all experimental transplants. Secondly, we studied the amount of river oat invasion into plots which had been cleared of above ground stiltgrass cover and the amount of stiltgrass invasion into plots which had been cleared of above ground river oats cover. We hypothesized that the relative amount of invasion would depend largely on the number of seedlings produced by each species. Therefore, we preliminarily determined that the stiltgrass seedbank in each floodplain environment produced an average of 228 seedlings/25m² and the river oats seedbank produced an average of 19 seedlings/25m². In the case of both species, neither was able to successfully invade the plots of the other species. To explain these results we speculate that (1) the number of river oats seedlings was too low to promote invasion and (2) the large number of stiltgrass seedlings were prevented from invading by the vigorous river oats re-growth from underground perenniating structures.

### Session 1, D17

**Incorporating Cell Growth into Mixture Models for Articular Cartilage Regeneration**

Timothy Steven Wessler Mathematics

Mentors and/or Co-Authors: Mansoor Haider Mathematics

Chondrocytes are specialized cells in cartilage that are responsible for the maintenance of the extracellular matrix (ECM) that give cartilage its structure. The insertion of chondrocytes that have been seeded in a biopolymer or hydrogel scaffold has been shown to regenerate cartilage. A better understanding of this treatment would benefit patients with osteoarthritis, a degradation of the cartilage that can often necessitate total joint replacement. In Haider et al (2011), a phenomenological mixture model was presented for biosynthesis and linking of ECM constituents in scaffolds seeded with chondrocytes. However, the average volume fraction of the cells in the mixture was idealized to be constant. The aim of our current research is to extend the model to account for cell growth. In the prior study, the system was modeled by using three ordinary differential equations for average apparent densities of unlinked ECM, linked ECM, and scaffold. In current research, we extended the model by adding a fourth ordinary differential equation for the average apparent density of chondrocytes. The model provides a quantitative framework for assessing and optimizing the design of engineered cell-scaffold systems and guiding strategies for articular cartilage tissue engineering.

### Session 1, B22

**Competitive Interactions between River Oats and Japanese Stiltgrass**

Meredith Lynn Wojcik Biological Sciences, EEC and Plant Biology

Mentors and/or Co-Authors: Jon Stucky Plant Biology Consuelo Arellano Statistics

The purpose of this research was to estimate the strength of competitive interactions between Chasmanthium latifolium (river oats), and an exotic invasive species, Microstegium vimineum (Japanese stiltgrass) in two different Neuse River floodplain environments in Wake Co., the riverside levee and a floodplain flat farther from the river. We first studied the survival of river oat transplants in experimental plots, some of which were cleared of stiltgrass and others which were left uncleared. Transplant survival was determined to be independent of treatment, environment, and block. We speculated that drought and extreme temperatures caused transplant mortality which occurred uniformly across all experimental transplants. Secondly, we studied the amount of river oat invasion into plots which had been cleared of above ground stiltgrass cover and the amount of stiltgrass invasion into plots which had been cleared of above ground river oats cover. We hypothesized that the relative amount of invasion would depend largely on the number of seedlings produced by each species. Therefore, we preliminarily determined that the stiltgrass seedbank in each floodplain environment produced an average of 228 seedlings/25m² and the river oats seedbank produced an average of 19 seedlings/25m². In the case of both species, neither was able to successfully invade the plots of the other species. To explain these results we speculate that (1) the number of river oats seedlings was too low to promote invasion and (2) the large number of stiltgrass seedlings were prevented from invading by the vigorous river oats re-growth from underground perenniating structures.

### Session 2, C20

**Effect of Zinc Supplementation on Rumen Fermentation**

Vanessa Lorene Wolf Animal Science

Mentors and/or Co-Authors: Vivek Fellner Animal Science

Zinc is an important feed additive in dairy cattle-it can enhance reproductive performance and hoof integrity, while reducing incidence of mastitis. The objective is to determine the effects of zinc supplementation on rumen fermentation when utilizing different sources (HiZin, ZnSO4, and ZnO) and varying levels (30mg/kg and 120mg/kg) of zinc compounds. Seven continuous culture fermenters inoculated with rumen fluid were designated with each of the dietary treatments including a no zinc control; 30mg/kg DM HiZin, ZnSO4, or ZnO; or 120mg/kg DM HiZin, ZnSO4, or ZnO. After five days of stabilization, methane concentration, pH, VFAs, and zinc concentrations were measured for each fermenter for three days. HiZin was found to increase the molar percentage of acetate and decrease propionate when compared with inorganic zinc. Pre- and post-feeding methane increased when fed HiZin in comparison with inorganic zinc. Both inorganic zinc and HiZin led to greater pre- and post-feeding pH levels when compared with the control. HiZin fed at the 30 and 120mg/kg levels resulted in similar pH values for pre- and post-feeding. Rumen soluble zinc concentrations increased with an increase in dietary zinc concentration irrespective of zinc.
source. Feeding either HiZin or inorganic zinc resulted in greater levels of rumen soluble zinc than the control. Feeding 120 mg/kg HiZin produced greater rumen soluble zinc when compared with similar levels of inorganic zinc. The information from this study can be used to re-evaluate NRC recommendations for zinc supplementation and to help consumers choose the most effective zinc source.
NC State Undergraduate Research Awardees

Session 1, D4
The Regulation of Ect2 by DNA Damage
Kayla Nicole Claassen Biochemistry, Bioprocessing
Mentors and/or Co-Authors: Melissa Srougi Plant Biology

In normal cells, irreparable DNA damage leads to cell cycle arrest and cell death, however, many cancer cells have evolved to avoid this prototypical response. Clinical resistance is therefore a common problem as many current cancer chemotherapeutic agents work by damaging the DNA of rapidly dividing cells. Previous studies have shown that the small GTPase RhoB is necessary for cell death as a result of DNA damage and that the nuclear guanine nucleotide exchange factor (GEF) Ect2 mediates the activation of RhoB in response to damaged DNA. This study aims to continue previous research in the field by characterizing the regulation of Ect2 by etoposide (VP-16)-induced DNA damage in the human breast cancer cell line MCF-7. The LD_{50} values were calculated for etoposide exposure times of 30, 45, 60 and 90 minutes; 13.0, 11.7, 10.8, and 4.3 µM, respectively. Additionally, LD_{50} values were extrapolated to be 48.0, 35.2, 41.9, and 27.3 µM, respectively. Furthermore, preliminary western blot analyses suggest that Ect2, which is normally nuclear at steady-state, is translocated to the cytoplasm after VP-16 treatment. The findings from this study will be useful in determining how oncogenic cells regulate the cellular survival response after DNA damage, and shed light upon the process by which cancer cells develop resistance to DNA damaging agents such as VP-16.

Session 1, C4
ATM-Mediated Regulation of Rac1
Ian Thomas Hill Biochemistry AND Polymer and Color Chemistry
Mentors and/or Co-Authors: Melissa Srougi Plant Biology

Rac1 is a member of the Rho family of small GTPases, which are important for cell cycle regulation, cell polarity, and cell motility through the formation of actin-based structures. Rho GTPases are tightly regulated by three main classes of proteins. Guanine nucleotide exchange factors (GEFs) activate GTPases by exchanging GDP for GTP, while GTPase-activating proteins (GAPs) inactivate GTPases by promoting the hydrolysis of GTP to GDP. Finally, guanosine nucleotide dissociation inhibitors (GDI) sequester GDP-bound Rho GTPases to the cytosol rendering them inactive. Interestingly, data have also suggested that Rho GTPases can be directly activated via oxidation of a novel redox sensitive motif, which promotes guanine nucleotide dissociation in the absence of GEFs. In this work, we examined the novel mechanism(s) by which loss of ATM, a protein normally involved in the DNA damage response, alters cellular redox leading to an increase in Rac1 activity via its redox sensitive motif. To study this pathway, two in vitro model systems were utilized: a HeLa cell line where we inhibited ATM and a fibroblast cell line proficient and deficient in functional ATM protein. Using both ATM proficient and deficient cell model systems, intracellular ROS as well as activated Rac1 were measured. Our preliminary results suggest that loss of functional ATM leads to an increase in activated Rac1. This work will help elucidate why patients with Ataxia–telangiectasia, a genetic disorder characterized by lack of functional ATM, have a hypersensitivity to oxidative stress and a predisposition to cancer.

Session 1, A23
Ion Concentration Effects on Centroptilum triangulifer
Shaneice Renee Mitchell Biochemistry
Mentors and/or Co-Authors: David Buchwalter Toxicology

Human activities such as coal mining, oil-drilling and surface mining can frequently lead to contamination of surface water in surrounding areas. Mountaintop removal-valley fill coal mining, a type of surface mining, has been shown to adversely affect the chemical composition of freshwater streams and, more importantly, populations of aquatic insects that dwell in these streams. Residential aquatic insects are used as biomonitor of water quality because they are the dominant invertebrate faunal groups in streams. These streams that are impacted by valley-filling display elevated levels of selenium, total dissolved solids (TDS) and pH. Several studies have examined the effects of selenium in a representative aquatic insect, reporting reduced survivorship, body mass, and fecundity after dietary exposure. Recently, studies have shown that increased concentrations of TDS with mountaintop mining ionic signatures were toxic to the mayfly Centroptilum triangulifer suggesting that high TDS water can contribute to population declines in aquatic insects. In our lab, we are focused on understanding the toxicity of individual ion components of high TDS water (specifically [SO_4^{2-}] and [HCO_3^-]) to see if any one ion is the primary driver of toxic effects. We have conducted 48- and 96-hour acute toxicity test with newly hatched C. triangulifer larvae, exposed to a range of [SO_4^{2-}] and [HCO_3^-] while holding all other ion concentrations constant, in order to obtain LC_{50} values for the organism. We also investigated the hemolymph osmolarity of an aquatic insect after exposure to high TDS water. Toxicity testing on SO_4^{2-} and HCO_3^- is ongoing.
Session 2, A18
Thrill-Cost Analysis of Roller Coaster Elements
Michelle Elizabeth Phillips Mechanical Engineering
Sarah Butz Industrial Engineering;
Jamie Yannayon Industrial Engineering;
David Lenz Mechanical Engineering
Mentors and/or Co-Authors: Jerome Lavelle
Engineering-Dean's Office

The field of roller coaster production—including design, manufacturing, and marketing—is a niche with high entry costs in terms of capital and specific knowledge. The goal of a roller coaster is to produce a heightened state of thrill for the rider. Ideal coasters maximize rider thrill while minimizing production cost. Few previous academic studies on this subject exist, as industry data is largely proprietary. This study seeks to open the field to academia, while specifically focusing on determining the ideal basic coaster element among loops, downhill drops, corkscrews, and in-line twists. Quantitative thrill in this study is defined as the reciprocal difference between force experienced by the user and allowable force as per ASTM International standards. To collect force data, rider acceleration was recorded on multiple coasters of varying elements using accelerometers. Cost data was determined through volumetric analysis of the corresponding track and supports for each element. To validate assumptions necessary for calculation of quantitative thrill, survey data was collected from amusement park patrons. While loops were the most purely thrilling elements based on quantitative data alone, downhill drops were significantly less costly. Therefore, the thrill per cost ratio from experimental data suggests that downhill drops are the most efficient of the basic elements. Survey data suggests that thrill may not be a function of force alone, as most respondents found downhill drops the most purely thrilling. However, the survey data does correlate with the overall thrill per cost ratios.

Session 1, A2
What keeps the water inside the egg patty on your Egg McMuffin? Describing the mystery of the water holding properties of gel systems
Michelle Theresa-Ann Putman Chemistry
Mentors and/or Co-Authors: Clinton Stevenson Food Science

Water is the main ingredient in many foods, however the mechanism by which water is held within food matrices is not clearly understood. Capillarity is the main theory for describing such water holding, yet, of its three governing factors, only pore size has been studied. This study sought to relate both the hydrophilic nature of gel matrix surfaces and the surface tension of the solutions inside gels with water holding properties in an egg protein gel system. Egg white protein gel systems (10% w/v, pH 7.0) with different water holding properties were created by varying heating rates (0.1oC/min, 1oC/min, 20oC/min). The captive bubble method was adopted to evaluate contact angle measurements obtained by using a goniometer to quantify the hydrophilic natures of different gel matrix surfaces. Protein content of the water expressed from the gels during centrifugation was measured using a bicinchoninic acid assay as an indicator of surface tension of gel water solutions. Held water was measured by microcentrifugation at 153 x g for 10 min. Contact angle was a useful predictor of hydrophilicity of surfaces and water holding capacity, as gels that held more water had smaller contact angles. Gels with more held water had more protein in solution, suggesting that surface tension is an indicator of water holding. The study showed that water holding capacity is not based on pore size alone, and that contact angles of gel matrices, protein contents of gel water solutions, and surface tension deserve recognition as factors affecting water holding in gels.

Session 2, A1
DEVELOPMENT OF A SALMONELLA SPECIFIC ELISA TO TEST THE EFFICACY OF A NOVEL SALMONELLA VACCINE
Alesandra Giamario Seal Biological Sciences
Mentors and/or Co-Authors: Matthew Koci Poultry Science
Tamer helmy Microbiology

Salmonella is a major cause of foodborne disease resulting in 1.4 million cases in the US in 2010, of which 400 cases were fatal. In spite of numerous food safety education efforts to reduce the impact of this pathogen, cases continue to increase. This has led many to explore methods for preventing Salmonella colonization of food animals, namely chickens, as a means of preventing disease in consumers. Our research group has recently developed a novel attenuated Salmonella strain and begun to test its ability to prevent Salmonella colonization in chickens. To begin to understand how the chicken immune systems responded to this vaccine, we needed to develop an ELISA specific to the vaccine strain. Therefore; the goal of this project was to produce vaccine specific positive control reagents and develop an ELISA that would allow for the analysis of anti-Salmonella antibody responses in experimentally vaccinated chickens. To achieve this, chickens were first injected subcutaneously with inactivated Salmonella antigen (325ug/bird) or diluent control a total of 3 times over the course of 6 weeks. Serum and crop washes were collected from the hyperimmunized systems responded to this vaccine, we needed to use an ELISA that would allow for the analysis of anti-Salmonella antibody responses in experimentally vaccinated chickens. To achieve this, chickens were first injected subcutaneously with inactivated Salmonella antigen (325ug/bird) or diluent control a total of 3 times over the course of 6 weeks. Serum and crop washes were collected from the hyperimmunized chickens to serve as assay positive and negative controls respectively. These reagents were then used to determine the optimal concentrations of antigen, primary and secondary antibody to be used in our new ELISA. Based on these results, serum and crop washes
from experimentally vaccinated chickens were assayed. The development of this assay will allow us to determine the most effective vaccination program for inducing anti-Salmonella immunity in chickens.

Session 1, C20
Undergraduate Social Media Use in Politics
Katie Lynn Shelton Political Science
Mentors and/or Co-Authors: Michael Cobb Public & International Affairs

Social media has become an important part of today’s society, especially for college aged students. Politicians have begun trying to exploit the growing trend of social media networking as well. The 2008 elections, for example, showed just how imperative social media was in motivating young people to vote. Researchers found that social networking improved campaign outreach by increasing the public’s interest in politics and politicians. It allows voters to feel more connected to politicians, and permits their voice to be heard in real time via comments on Facebook and tweets on Twitter. This study examines how undergraduates at North Carolina State University use and engage social networking sites politically. I also examine how using social networking sites affects their behavior and the way they interact with political content on the internet. My data come from a random sample (N = 896) of undergraduate NCSU students from the Spring 2012 semester.
**NSF Engineering the Grid Program**

**Session 2, A22**  
Image-Based Finite Element Analysis for the Microstructure Optimization  
**Kamalaksa Broomes Computer Engineering**  
**Mentors and/or Co-Authors: Hsiao-Ying Shadow Huang Mechanical & Aerospace Engr**

The objective of this project is to develop an image-based finite element analysis for virtual experiments. The virtual experiments employ real microstructures of images and finite element methods to study physical or thermal problems. The interactive content is made possible through the use of an open source finite element software--OOF2, developed by National Institute of Standards and Technology. The core functionality of OOF is not suited to solve all problems. Therefore it is desirable to improve the functionality of this program through extensions. I worked with primarily one extension called the Pixel Selection Extension via C++ and Python coding. This extension is designed to improve the problem solving with OOF by making sure all pixels are selected so they may be assigned materials. This extension will allow for more accurate results when conducting virtual experiments with OOF.

**Session 2, D23**  
Nonpolar and Semipolar Nitride-based LED Devices  
**N. Cammardella, D. Van Den Broeck, A. Hosalli, T. Paskova** Department of Electrical and Computer Engineering, North Carolina State University, Raleigh, NC 27695  
**Neil James Cammardella Electrical Engineering**  
**Mentors and/or Co-Authors: Tania Paskova Elec & Comp Engineering**

Nitride-based materials have made possible highly efficient 450 nm (blue) light-emitting diode (LED) devices. However, developing LED devices that efficiently emit in the 530 nm (green) region has proved more challenging. Some of these challenges include increasing the incorporation of indium in the InGaN/GaN quantum wells, high dislocation densities due to growth on lattice-mismatched foreign substrates, the presence of a spontaneous polarization field along the conventional (0001) (c-axis) growth direction, and the presence of a lattice-mismatch-related piezoelectric polarization field.

There are two main approaches to address these challenges: growing on bulk GaN substrates to ensure smaller dislocation densities and altering the growth direction to form nonpolar and semipolar oriented LED devices. Nonpolar devices lack a spontaneous polarization field but increasing their indium incorporation is difficult. Semipolar devices have a reduced spontaneous polarization field and are expected to ensure greater indium incorporation.

In our work we employed both approaches. First, all devices were grown on bulk GaN substrates by metal organic chemical vapor deposition. Second, we chose to evaluate nonpolar m-plane, semipolar (20-21), and semipolar (20-21) oriented devices and compare them with conventional polar c-plane oriented devices. All of the studied devices exhibited photoluminescence and electroluminescence peaks in the range of 500-530 nm. The longest wavelength was achieved by the device with (20-21) plane alignment and its output wavelength was more stable at higher currents. With further optimizations of the quantum well growth process, (20-21) oriented GaN LED devices may become an efficient source of green light.

**Session 2, A23**  
Current conduction mechanisms in lead zirconate titanate (PZT) thin films  
**Eliezer Fernández Electrical Engineering**  
**Mentors and/or Co-Authors: Leda Lunardi Electrical & Computer Engineering**  
**Kanu Sharma Electrical Engineering**

Lead zirconate titanate (PZT) is a ferroelectric material commonly used in dynamic random access memories, non-volatile random access memories and decoupling applications. To achieve optimum device performance, it is important to understand the variation of leakage current as function of temperature and voltage. The primary goal of this study is to identify the conduction mechanisms in PZT films. For this purpose, metal-insulator-metal (MIM) structures with gold and platinum as the top and bottom electrodes respectively were fabricated. 1-V characteristics were measured at temperatures ranging from 300 to 450K. Analysis indicated Schottky thermionic emission, with potential barrier of 0.12 eV much lower than earlier reported value of 0.87 eV. This value reduction can be attributed to reduction in built-in potential due to ferroelectric polarization. The lower value of 1.589A/cm²K² for the Richardson constant suggests other on-going conduction mechanisms along with Schottky thermionic emission. At room temperature the I-V curves asymmetry eliminated conduction through Frenkel Poole mechanism.

**Session 2, C21**  
Studies for MOSFET Performance Improvement  
**Harold Anderson Haldren, III Electrical Engineering/Mathematics**  
**Mentors and/or Co-Authors: Leda Lunardi Electrical & Computer Engineering**  
**Jaladhi Mehta Elec & Comp Engineering**
Metal-oxide-semiconductor field effect transistor (MOSFET) is the device of choice and elementary building block of modern computers. Acting as tiny switches within computers, smartphones, and many other electronic devices, MOSFETs enable society in the twenty-first century to function quickly and efficiently. As progressing technology has demanded faster switching and power efficiency, MOSFET devices have rapidly scaled down in size. Scaling down in size offers many benefits, such as faster switching, lower power consumption, and higher chip density. However, this size reduction presents some design challenges, as very small devices have different characteristics, problems, and considerations than their larger counterparts. Here the Synopsys Sentaurus Process and Device software was used to simulate the design and fabrication of modern short channel MOSFET devices. MOSFETs are 4 terminal devices which are fabricated on silicon wafer using different materials, process masks, and doping. I created three different devices throughout my project: an n-channel MOSFET (NMOS), a p-channel MOSFET (PMOS), and a PMOS with SiGe heterojunctions. The simulations for the electrical performance of these devices included characteristic graphs to obtain parameters such as threshold voltage, leakage current, channel length modulation parameter, and subthreshold swing. Results will be presented.

Session 2, A20
A Novel pH Sensor Produced Via Atomic Layer Deposition on Textiles
Mollie B Jenkins Professional Biology & Industrial Chemistry
Mentors and/or Co-Authors: Jesse Jur Textiles

Inherently conductive textiles offer new avenues for the development of various flexible, conformal sensing platforms. This research examines the ability to develop conductive textile platform that can sense the pH of an Arrhenius acid or base, which is of interest to the medical field for personal health monitoring. The application of conductive materials to the textile was achieved by atomic layer deposition (ALD). ALD is a self-limiting surface reaction that creates a nano-scale coating as an organo-metallic precursor and a co-reactant are sequentially exposed to a substrate. An inorganic coating on an organic material, such as a textile, changes the characteristic properties of the material creating a new hybrid material. The experiments conducted in this work optimized the conductivity of an aluminum-doped zinc oxide (AZO) ALD on a textile. Processing parameters optimized include deposition temperature, number of cycles, and doping (Al/Zn) ratio. The textile platform was examined as a pH sensor based on the theory that current flows through a liquid by means of positively charged ions in solution. The conductive coating on the textile measures the conductivity and/or relative ion concentration based on the change in resistance of the material once exposed to the acidic or basic solution. This platform is a cost efficient solution to developing sensors that have enhanced flexibility in comparison to its planar inorganic counterparts.

Session 2, B20
Optimizing the Conductivity of Textiles via Atomic Layer Deposition for Pressure Sensitivity
Jeremy C Jones Chemical Engineering
Mentors and/or Co-Authors: Jesse Jur Textiles

The ability to create a conductive coating on a textile platform allows for new designs of electronic sensors that use the construction of the textile to show variation of electrical properties with external stimuli. Atomic Layer Deposition (ALD) is useful in depositing conformal nano-scale coatings using a self-limiting sequential reaction between the ALD precursors and specific substrate. ALD of aluminum-doped zinc oxide (AZO) onto different fabrics produces conformal conductive coatings allowing the substrate to be utilized in the electronic sensor applications. A range of electrical resistivity values were determined for ALD AZO by varying the number of ALD cycles, reaction temperature, and the aluminum to zinc oxide composition. These coatings were applied to cotton (plain weave and knit geometry), woven polyester, and cotton paper. The electrical resistivity of these coated fabrics was measured using the novel four point probe method. The changes in electrical behavior of the fabrics were then evaluated by compressing the porous textiles, which in effect determines the efficacy for these modified fabrics to be used as a pressure sensor. Designs are presented in which the responsive nature of textiles can be used to detect impact regions on personal wearables and for personal security.

Session 2, A19
Printed semitransparent silver nanowire electrodes for flexible organic solar cells.
Jaclyn N. Kovach Materials Science and Engineering
Mentors and/or Co-Authors: Brendan O'Connor Mechanical & Aerospace Engr

In organic solar cells, indium tin oxide (ITO) is typically used as the electrode layer due to its high transparency and conductivity. However, ITO is brittle, expensive and difficult to fabricate onto certain substrates. Therefore, researchers are now looking to replace ITO with silver nanowires (Ag NWs). Ag NWs are inherently flexible and less expensive than ITO, which is essential to the commercial potential of organic solar cells. For this project, we have focused on optimizing a Ag NW printing process using a polydimethylsiloxane (PDMS) stamp for printing onto polyethylene terephthalate (PET) substrates. The printing process consists of spin casting Ag NW
solution onto a UV-ozone treated PDMS substrate. The Ag NW-PDMS stack is then laminated onto a pre-treated poly-l-lysine PET substrate by applying pressure. Then, the stamp is removed leaving the Ag NWs on the PET substrate. Ag NW solution concentration, spin speed, annealing conditions, UV-ozone treatment time, and print pressure were optimized based on transparency and conductivity of the final Ag NW film. A similar printing process was also completed with poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS) in order to properly prepare the Ag NWs as the high work function electrode. With this fabrication method, roll-to-roll manufacturing onto low-cost plastic substrates at ambient conditions is possible. Future research includes using this technique to print the Ag NWs onto a corrugated PET substrate that effectively traps light, leading to an increase in the efficiency of the solar cell.

Session 1, C19
Three-Dimensional Atomic Force Nanomachining with X-Y Ultrasonic Vibrations
Matthew Philip Weinstein Electrical and Computer Engineering
Mentors and/or Co-Authors: Jingyan Dong E.P. Fitts-Industrl. & Sys Engr
Li Zhang E.P. Fitts-Industrl. & Sys Engr

Atomic Force Microscopy (AFM) is a method used to capture topographical images of a desired area within the micro or nanoscale range by using a probe tip on a cantilever that is only a few nanometers thick. This cantilever will travel across the sample, and the changes in its height as it encounters different structures will be recorded and displayed accordingly. While the miniscule tips make AFM useful for accurately imaging designs and structures as small as the nanoscale, for the same reason it has disadvantages when used to fabricate nanostructures. The probe is so miniscule, using it as an etching tool leaves barely noticeable marks on the surface, where the width of the etchings is dependent on the size of the tip, and causes the probe to wear down quickly because of the amount of force applied between it and the sample. A new method of using AFM as a nanofabrication method involves rotating the sample in a circular motion using piezoelectric vibrations in both the X and Y direction. The circular motion of the sample allows the tip to carve out circular areas of the sample, allowing control over the width of the etchings based on the magnitude of the piezoelectric vibrations. This study focuses on the creation of 3-dimensional images using this nanofabrication method based on the use of varying shades of black and white within the base image inputted to the AFM’s program.

Session 1, D15
Template-Directed Self-Assembly for Anti-Glare Self-Cleaning Surfaces
Polite Donald Stewart, Jr. Physics
Mentors and/or Co-Authors: Chih-Hao Chang Mechanical & Aerospace Engr

The purpose of this research is to develop anti-Rglare self-cleaning surfaces through the use of template-directed colloidal self-assembly. The origins of this research come from nature. For example, the lotus leaf is a self-cleaning plant whose leaves exhibit superhydrophobicity. This keeps water and dust particles from sticking, maintaining the cleanliness of the leaf surface for photosynthesis. Likewise, the antireflection design is also biomimetic, and can be found in the moth’s eye. Moth eyes do not reflect light because of nano-sized bumps on the surface of their eyes. Hierarchical design, where nanoscale, microscale, and macroscale structures work together to form improved functionalities, is also extremely useful. For instance, a gecko’s feet have natural hierarchical structures, allowing enhanced adhesion to combat gravity. These bio-inspired effects will be replicated using the proposed method of nano-sphere assembly on the surface of silicon wafers. These wafers will then be used to create a working template containing the arrangement of spheres and photoresist necessary to do 2D and 3D nanolithography. This will result in a hierarchical structure consisting of distinct microscale and nanoscale patterns. The goal of this process is to create a microstructure with elevated and non-elevated sections decorated with nanostructures. The elevated sections will be made superhydrophobic and the non-elevated sections will be made superhydrophilic. Light retention will also be improved because it will increase the angles at which light can be captured.

Session 1, A3
Electrically Actuated Micro-Channel Heat-Transfer Device
Deon Dontavius Wilkins Computer Engineering
Mentors and/or Co-Authors: Thomas Ward Mechanical & Aerospace Engr

Research is being conducted on an experimental device whose purpose is to dissipate heat from a smaller area, to a larger one. This device is an “Electrically Actuated Micro-Channel Heat-Transfer Device”. In the experiment, two glass plates coated with conductive metal on one side are separated by a small distance “d” 300µm < d < 750µm partially submerged in a beaker filled with an oil of known physical and thermal properties. The oils are chosen based on their ability to absorb heat. The beaker sits on a hot plate that passively heats up the glass plates through the oil and acts as the heat source in the experiment. The method chosen to achieve the heat-transfer process is to pass oil through the glass plates. The oil is being actuated by applying electricity to one of the electrodes while
the other is grounded. The oil motion is controlled by a high voltage amplifier in series with a function generator that is attached to the two conductive glass plates. By periodically actuating the oil heat is transferred from the oil to the glass. Temperature data is collected from probes attached to the plates and or placed in the beaker of oil. The data is then interpreted in MATLAB to plot the temperature and record the movement of the oil.
**Session 1, A21**

**Magnetic Fluids for Electronic Thermal Management**

Elisabeth Wilson Foster *Mechanical Engineering*

Mentors and/or Co-Authors: Subhashish Bhattacharya *Elec & Comp Engineering*

This poster is a representation of weeks of work on a liquid cooling (thermal management) system to cool electronic devices. The system is a mechanical cooling pump that has no moving parts. It uses a fluid called ferrofluids as a working fluid. Ferrofluids are a fluid that has magnetic nano-particles synthesized into them. The fluid then in a magnetic field has magnet properties but when the field is removed the fluid keeps only its fluid properties. Basic ferrofluids are easy to make, but for our experiment we need temperature sensitive nano-particles which are much more difficult to synthesize. How the pump works is that it uses the properties of the ferrofluid to control the flow of the fluid using a permanent magnet. The magnet causes the flow to move with the magnetic field then uses the heat flow to cause the fluid to reach the Curie point and become de-magnetized and continue to flow. The pump is a passive cooling system which means it needs no external energy besides the heat that it is cooling, to run. This project is important because density of electronics packaging is constantly increasing. This project is set to replace the cooling systems for the solid state transformer that FREEDM is developing. It will cause much improvement because it will decrease the amount of energy consumed.

**Session 1, A6**

**The Current State of Battery Management Systems**

Lumumba Harnett *Electrical Engineering*

Kenji Jamel *Electrical and Computer Engineering; Lukas Kirchner Physics*

Mentors and/or Co-Authors: Srdjan Lukic *Elec & Comp Engineering*

Iqbal Husain *Elec & Comp Engineering;*

Currently, the best mass produced battery in terms of energy density are Li-ion batteries. However, the problem with Li-ion batteries is that they have a very low tolerance to the amount of current each cell receives making them vulnerable to overcharging and over discharging. If either of these things happens, the cells will be damaged leading to decreased lifetime and efficiency of the battery pack. Due to battery manufacturing and environmental variables the current charging design does a poor job of evenly charging all cells in the battery pack. The goal is to design a passive battery management system which bypasses the current from cells that are charging faster than others in order to get an evenly charging system. This is made possible by hooking each cell to a microcontroller that will detect the state of charge for each cell and determine when to bypass the current. In order to do this, it was necessary to become familiar with programming the microcontroller in the system and the various functions required including interrupts, initializations, and analog to digital conversion. The result of this is a battery management system that regulates voltage, protects from overcharging, and fully and evenly charges each cell in the battery pack. The positive benefits of a consistent charge cycle leads to faster recharge time, longer lifetime, and increased efficiency of the battery pack.

**Session 1, B12**

**Overcurrent Protection Relays: Defenders of the Distribution System**

Nathan R Roberts *Electrical Engineering*

Mentors and/or Co-Authors: Mesut Baran *Electrical & Computer Engineering*

Protection is a very critical topic in the field of Power Systems. Defending our system from faults requires various dedicated devices, which are called protection relays. Faults are the reasons we are left in the dark or without power; this can be a huge inconvenience to us. Unprotected fault occurrences within the system can be a danger to life, property and can cost a great deal of money when left unattended. In recent years the development of Solid State Transformers has given us an alternative to the modern Grid, a grid we can potentially make Smart. I have been given the task to develop the schemes necessary to protect a Radial conventional distribution system and a Solid State Transformer based loop Distribution system that is currently in development at the FREEDM System Center. Protection Relays require their own settings and coordination to provide sufficient protection for the system. Based on my research and simulations, I have come to the conclusion that conventional overcurrent relays used to protect radial distribution systems are not suitable for the protection of the new Smart Grid and must be updated to function for this needed change.

**Session 2, D9**

**Lithium-Ion Batteries: Amorphous Carbon Coating of Silicon-Carbon Nanofibers as Anode Materials**

Stephen Patrick Vicchio *Chemical Engineering*

Mentors and/or Co-Authors: Xiangwu Zhang *Textiles*

A promising material replacing the current commercialized graphite anodes (specific capacity = 372 mAh g⁻¹) in lithium ion batteries (LIBs) is
silicon/carbon (Si/C) nanofibers (specific capacity > 1000 mAh g\(^{-1}\)). These materials combine the strengths of the carbon nanofiber’s electrical conductivity and the silicon’s high specific capacity (specific capacity = 4200 mAh g\(^{-1}\)) to improve battery performance. However, clusters of Si nanoparticles agglomerate on the surface of the nanofiber resulting in the unstable formation of the solid electrolyte interface (SEI) during cycling and a decrease of structural integrity. To solve these problems, chemical vapor deposition (CVD) has been used to coat amorphous carbon on the surface of the Si/C nanofiber. The layer protects the Si nanoparticle during lithium intercalation and de-intercalation, thereby increasing the electrochemical performance of the anode. The specific capacity showed an increase of 200 mAh g\(^{-1}\) after the amorphous carbon layer was coated. The results indicated that the amorphous carbon layer improved the electrochemical properties and the cycle performance of Si/C nanofibers as the anode material in LIBs.

Session 1, B11
Data Analysis of a Photovoltaic Installation
Matthew Samuel Wiesner Electrical Engineering
Mentors and/or Co-Authors: Subhashish Bhattacharya Elec & Comp Engineering

This paper proposes a method used to process and group raw data from a solar installation in order to form a lookup table of maximum power points (MPPs). This lookup table returns the current and voltage values of the MPP for inputs of temperature, and solar irradiance. A main challenge addressed in this paper is how to identify data points collected under uniform solar irradiance. Two approaches are tested: The first compares the power output of separate solar arrays to deduce if there may be partial shading. The second approach uses a Gaussian Mixture Model to form 3 density based groups of data sharing similar characteristics. Although slightly less accurate, the second approach requires fewer data, and less sensing equipment. The group corresponding to uniform irradiance is then divided into pixels of temperature and irradiance. One voltage and one current corresponding to each pixel are determined by a maximum likelihood estimate (MLE). The lookup table outperforms a simple linear regression in reproducing the electrical characteristics of a solar array, especially at irradiance levels lower than 400 W/m\(^2\). To test the functionality of the lookup tables and linear regression, simulations using an emulator are performed in Simulink. The emulator, implemented in software, is otherwise as described in Di Piazza, and Vitale’s paper “Photovoltaic field emulation including dynamic and partial shadow conditions.”
Session 2, B1

Expression of Lipid Biosynthetic Pathway Genes of 
*Dunaliella viridis*

Patrick Noah Backman **Microbiology**

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With increasing global energy demands, alternative energy sources are needed to reduce foreign dependence on unsustainable petroleum fuel sources. Biofuel is a renewable fuel source for the high energy demands of transportation. Algae are a promising biofuel feedstock because their culturing does not compete with land for food crops and their biomass production rate is hundred-fold faster than land plants. *Dunaliella viridis* has great potential as a biofuel feedstock because it grows in salt or brackish water. Genetically engineering the lipid biosynthetic pathway in *Dunaliella viridis* to increase its lipid content would greatly increase potential biofuel production. However, the lipid biosynthetic pathway has not been characterized in *Dunaliella viridis*. Triacylglycerides accumulate in *Dunaliella viridis* in response to increased temperature. This study characterizes the expression of key genes in the lipid biosynthesis pathway in response to changes in temperature. Quantitative PCR was used to determine the changes in mRNA levels of the subunits of acetyl-CoA carboxylase, 3-ketoacyl-CoA-synthase, and acyl carrier protein thioesterase. Acetyl-CoA carboxylase converts acetyl-CoA to malonyl-CoA, 3-ketoacyl-CoA synthase is involved in fatty acid elongation, and acyl carrier protein thioesterase is involved in fatty acid chain termination. Genes of interest were determined from transcriptome assemblies of *Dunaliella* subjected to continuous light and 25°C or 35°C temperature growth conditions.

Session 2, A3

Characterizing Auxin Biosynthetic Mutants in 
Arabidopsis thaliana

Nicole Marie Colon **Biology**

*Mentors and/or Co-Authors: Jose Alonso Genetics Anna Stepanova Genetics*

The phytohormone auxin regulates numerous aspects of plant growth and development. Although auxin was one of the first plant hormone to be discovered, our understanding of how plants produce this hormone in a spatially and temporally regulated manner is still limited. Two main routes for auxin production have been proposed, the tryptophan dependent and tryptophan-independent pathways. This study aims to shed light on the tryptophan-dependent auxin biosynthetic pathway using a novel mutant screen in Arabidopsis thaliana. Because ethylene response induces this auxin biosynthetic pathway, the ethylene response is utilized as a tool in the screen. Specifically, loss of the auxin biosynthetic enzyme tryptophan aminotransferase, weiz, results in a partial loss of ethylene response in the root. weiz was mutagenized to find novel mutants which enhance its auxin deficient phenotype. In particular, I have focused on the characterization of the mutant 2-93 that shows dramatic reduction in the ethylene response and reduced root meristematic activity. A mapping population from a cross between 2-93 and the Ler accession was obtained. F2 seedlings with the 2-93 mutant phenotype were selected and the genetic nature of the mutation determined to be recessive based on the segregation analysis. Plants with strong auxin deficiency phenotype marked by the loss of root meristem integrity were selected for mapping. Polymorphic markers across the whole Arabidopsis genome are being used to determine the chromosomal location of causal mutation in the 2-93 line. The characterization of this mutant will advance our understanding of how this essential plant hormone is produced.

Session 2, D2

Photo-Activated Toxins in Black Sigatoka

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Black Sigatoka is a very costly disease of bananas and plantains, important food crops especially in developing countries. The fungus *Mycosphaerella fijiensis* causes the disease and appears to kill host tissue with a photo-activated toxin. This approach is similar to related plant diseases caused by well characterized *Cercospora* fungi. Through bioinformatic comparisons between the *Cercospora* and the *M. fijiensis* genome sequences, several gene clusters have been identified that may be important in toxin production. These clusters are hallmarked by genes encoding for polyketide synthases (PKS). To begin identifying the toxin, knock-out mutants of *M. fijiensis* for the PKS genes were created and screened for changes in toxicity towards bananas. *Agrobacterium tumefaciens*-mediated transformation was used to transform *M. fijiensis* with interrupted versions of several PKS genes. Inserted DNA can add to the host genome by either recombining at the homologous gene site to create a knock-out mutant, or by inserting randomly. Due to the potential for false positives by random insertion, a high throughput screening method for detecting homologous
recombination was established. Through this approach it was discovered that homologous recombination occurs infrequently in *M. fijisiensis*. *M. fijisiensis* was also observed to produce a pink pigment under certain growth conditions. Photo-activated compounds are often pigmented, and it is hypothesized this pigment may be a toxin. The pigment was successfully extracted from mycelium using methanol, and methods were developed for infiltrating diluted extracts into banana leaves. Preliminary experiments have not confirmed toxicity of the extract.

Session 2, D1
Can ?Satellite Like? Molecules associated with cassava mosaic disease break transgenic geminivirus resistance?
Catherine DeLarn Doyle Biology
Mentors and/or Co-Authors: Linda Hanley-Bowdoin Biochemistry
Mary Dallas Biochemistry

In Africa, Cassava mosaic disease is a leading constraint on the production of cassava (*Manihot esculenta*), a tuberous root crop plant originally from the Americas. The resilience of cassava to withstand droughts and grow in diverse ecological locations has resulted in cassava being the main source of income for many developing countries and the basic diet for about 500 million people worldwide. Cassava is infected by a complex of geminiviruses that are characterized by small, single-stranded DNA genomes composed of A and B components. The A component controls replication using the host machinery and the B component controls movement. Recently, “Satellite Like” molecules (SAT) were shown to break endogenous resistance to geminiviruses in cassava. We wanted to test whether the SAT molecules also break engineered resistance against geminiviruses using transgenic *Nicotiana benthamiana* plants that are resistant to Tomato golden mosaic virus (TGMV). To analyze the SATs’ abilities to break TGMV resistance we inoculated transgenic plants with *Agrobacterium* vectors containing TGMV and the SATs. In addition, to see if the SATs effect replication of TGMV we used *Agrobacterium* vectors containing the SATs and the A component in leaf disc replication assays. Due to low efficiency of viral infection in nontransgenic, control plants, our data did not allow us to conclude whether the SATs can break TGMV-resistance. The infection and replication studies are being repeated to determine the effect the SATs have on TGMV infection.

Session 2, C1
Do putative satellite DNAs from cassava replicate and/or enhance geminivirus replication?
Darryl Devon Lewis Pharmaceutical Sciences
Mentors and/or Co-Authors: Linda Hanley-Bowdoin Biochemistry

Cassava is an important tuber crop in Africa and Asia, where it is produced primarily by women farmers. Its loss leads to reduced food security and potentially starvation for millions of people. Cassava is threatened by a group of geminiviruses that cause Cassava Mosaic Disease (CMD). Cassava geminiviruses have DNA genomes with two components called A and B. The A component is involved in virus movement. CMD-infected plants contain two putative satellite DNAs (Sats) associated with severe symptoms and resistance breaking. A better understanding of Sat DNA function(s) is important to develop a solution to combat their effects on CMD. The purpose of this research is to investigate if the Sats replicate during geminivirus infection and/or increase geminivirus replication. We addressed these questions using available infectious clones for Tomato golden mosaic virus (TGMV), Tomato mottle geminivirus (ToMoV), Tomato yellow leaf curl virus (TYLCV), and Cabbage leaf curl virus (CbLCuV). Experiments are in progress.

Session 2, C2
Metabolic Engineering and Biosynthesis of Limonene in Camelina sativa
Cynthia Kay Holland Biology

*Mentors and/or Co-Authors: Monica Borghi Plant Biology
Deyu Xie Plant Biology*

*Camelina sativa (Camelina) is a plant species in Brassicaceae known for its oily seeds that can be utilized as a renewable resource for the production of jet biofuel. Limonene is a natural aromatic monoterpenepathway, where geranylpyrophosphate (GPP) is converted to limonene using limonene synthase (LS). The aim of this project is to increase the limonene content in the oil of Camelina. However, since limonene may have detrimental effects on seed development, Camelina valve tissue has been targeted for the production of limonene. To reach this goal, the LS gene is being expressed under the control of the promoter of the gene FRUITFUL (pFUL) that is only functional in fruit valves. To date, the gene cassette with pFUL:LS has been cloned in the binary vector pBGWFS7, which has been further used to transform Camelina via Agrobacterium mediated infiltration. The T1 and T2 generations will be selected using the herbicide phosphinotricin (Basta) to identify putative transgenic plants that will be further analyzed for limonene production. In addition, Gfp and GUS reporters will be used to localize LS expression in valves.*
using the recently available East African cassava mosaic virus (EACMV-CM). *Nicotiana benthamiana* leaf punches were co-inoculated with *Agrobacterium* cultures carrying viral A component or Sat DNA. The A component was used because our goal is to see the affect of the Sats on viral replication and not viral movement. After 3 days in culture, total DNA was prepared from the leaf punches. We are currently characterizing viral and Sat DNA accumulation in the DNA samples using PCR and DNA hybridization.

**Session 2, B2**

**Roles of Iron Deficiency Response Proteins PYE, ILR3 and BTS in Arabidopsis Roots**

*Lynnicia Naomi Massenburg* Plant Biotechnology

*Mentors and/or Co-Authors: Terri Long Plant Biology  
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Understanding iron deficiency responses in plants is important to improve nutritional content in food crops. The iron deficiency response proteins POPEYE (PYE), IAA–leucine resistance 3 (ILR3) and BRUTUS (BTS) play vital roles in controlling iron homeostasis within plant roots. While PYE and ILR3 are transcriptional regulators of the iron deficiency response, BTS is thought to be an iron binding protein that interacts with PYE and ILR3. Protein specific antibodies (anti-BTS, anti-ILR3 and anti-PYE) were used as probes to detect changes in extracted protein content in *Arabidopsis thaliana* wild type, *bts*, *ilr3* and *pye* root in response to iron deficiency. In addition, recombinant BTS:GST and GST:BTS proteins were generated to purify BTS protein for further structural and functional characterization. Antibody probes against BTS, ILR3 and PYE did not produce detectible signals for low protein concentrations extracted from *A. thaliana* wild type, *bts*, *ilr3* and *pye* root samples. However, Anti-BTS effectively detected high protein concentrations found in induced *E. coli* cells containing the pDEST15 vector, in which BTS was fused in frame to GST. This cell line will be used to generate sufficient recombinant protein for purification and detection of iron binding capacity.

**Expression of a codon-optimized thermophilic lipase for application in biofuel production**

*Gretchen Elizabeth Walljasper* Biology

*Mentors and/or Co-Authors: Amy Grunden Microbiology*

With the limited supply of fossil fuels there is a push for renewable energy sources, including biofuels. Algae are a promising source of biofuel since they can produce more oil than other feedstocks (e.g. soybean) and their production does not require valuable agricultural land. However, more efficient production methods are needed for algal biofuels to be a viable energy source. One method to increase algal oil production involves the use of lipases, which increase oil production efficiency by cleaving algal lipids into free fatty acids, which can be used directly in existing fuel conversion processes. This study focused on the recombinant expression of the codon-optimized synthetic *Solfolobus solfataricus* gene LipP-2, which encodes for a thermostable lipase in an effort to biochemically characterize the lipase for its application in algal biofuel production. The codon-optimized lipase was cloned into pQE-1, containing an upstream T7 promoter and N-terminal histidine-tag, for recombinant expression in *Escherichia coli* M15(pREP4) cells. To optimize soluble expression of the thermostable lipase, the protein was over-expressed under various conditions including different *E. coli* strains (M15, JM105, and Arctic Express), different culturing media (LB and auto-induction), and varying induction temperatures (18°C, 30°C, and 37°C) and IPTG concentrations (0.05 mM, 0.2 mM, 0.5 mM, and 1 mM IPTG). It was determined that recombinant LipP-2 was expressed in *E. coli* M15(pREP4) cells at 37°C with the addition of 0.2 mM IPTG to induce expression, using LB media to culture the cells; however, soluble expression was not observed under any condition tested.

**Session 1, C9**

**Regulated Flux Balance Analysis of Lignin Biosynthesis**

*Liya Tquabo Weldegebriel* Civil Engineering

*Mentors and/or Co-Authors: Cranos Williams Elec & Comp Engineering*

The overall research focuses on regulation and modeling of lignin biosynthesis. Lignin, the major phenolic polymer made by plants, is the main barrier to the utilization of biomass for energy, for papermaking, and for forage digestibility. Understanding the fundamental nature of lignin biosynthesis will lead to improved crops and could also aid in resistance to drought, pests, and pathogens. We work with a research team that seeks to build models to describe the lignin biosynthesis pathway and to create new lignin polymers. Lignin biosynthesis is regulated by various factors such as enzymatic effects. It is important to describe how the lignin pathway in plants is regulated and to reveal new control mechanisms, leading to lignin polymers. Our main focus was on steady state analysis and the use of visualization tools for pathway analysis. We performed steady state simulation of the lignin biosynthesis pathway while considering regulatory and metabolic constraints. Steady state model was used to characterize the lignin biosynthesis pathway and assess changes that result from various enzymatic regulatory effects. The base line steady state model was described using the Flux Balance Analysis (FBA) approach. The model was implemented using CellNetAnalyzer, which is a computational toolbox extension for MATLAB. The FBA approach allows us to manipulate constraints on enzyme concentrations to mimic changes in a regulatory enzymatic activity. We
show results that indicate how enzymatic regulatory effects impact metabolic steady states in the lignin biosynthesis pathways and compare this to steady states achieved without regulatory control.

Session 2, B3
Exploring the genetic basis of inflorescence architecture evolution in the dogwood genus (Cornus L.)
Chanel DiShon Wilson Pharmaceutical Science
Mentors and/or Co-Authors: Qiuyun (Jenny) Xiang Plant Biology
Xiang Liu Plant Biology

The dogwood flowers (Cornus L.) are displayed in various inflorescence forms among species, ranging from elongated, branched compound cymes, to condensed patterns, such as umbels and heads that are associated with bracts in different morphology. The remarkable differences in inflorescence architectures make Cornus an excellent system for studying the evolution of plant flowering display. Although the importance of inflorescence in angiosperm evolution is well recognized, genetic mechanisms of inflorescence development have been studied in only a few model plants. Few studies have investigated the molecular changes during speciation that may have led to divergence of inflorescences. We use a phylogeny-based method to test a few candidate genes in Cornus for their roles in controlling inflorescence divergence by comparing their expressions and functions among species. This summer research project focuses on testing the functions of APETALA (AP1) and Terminal Flower 1 (TFL1) via genetic transformation in Arabidopsis thaliana and comparing the expression patterns of SEPALLATA 3 (SEP3) gene among Cornus species using RT-PCR. Analysis of gene segregation following transformation of dogwood genes in Arabidopsis was conducted to understand the potential functions of AP1 and TFL1 genes. Preliminary results showed that SEP3 expressed at different levels between species and phenotypic variation was observed among genotypes of transgenic Arabidopsis. The potential roles of these genes in flower and inflorescence development will be discussed.
NSF Physics REU

Session 1, D14
Comparison of Type IA Supernova Models with Youngest Known Supernova Remnant
Anthony Alan Black Physics
Mentors and/or Co-Authors: Carla Frohlich Physics
Stephen Reynolds Physics;
John Blondin Physics;

Type Ia supernovae (SNe Ia) are produced by the thermonuclear explosion of a white dwarf star. These supernovae(SNe) are the source of most iron in the universe. Additionally, the uniform peak brightness of SNe Ia allows them to be used as accurate distance indicators, giving the scale of the universe. There have not been any recent observations of SNe Ia in our galaxy, but supernova remnants (SNRs) hold valuable information about the SNe themselves. There is, however, a gap in what we know about SNe and what we know through observing their remnants; the exact mechanism of the explosion is still not understood. By using data from a SN Ia model simulation 100 seconds after the explosion as the initial conditions for a hydrodynamic simulation, we can predict the appearance of the remnant hundreds of years later. Specifically, we compare these results to the youngest known SNR (approximately 100 years old) in our galaxy, G1.9+0.3. In previous simulations, shock waves had not reached iron in the center, contrary to X-ray spectral observations. With our model, we can predict the location of light elements expelled by the blast (carbon and oxygen) as well as the formed intermediate (sulfur and silicon) and heavy elements (iron). We report the distribution of elements at the age of G1.9+0.3, and compare with observations.

Session 1, D14
Principles and Operation of Pulsed Laser Deposition
Robert Andrew Bratton Applied Physics
Mentors and/or Co-Authors: Jack Rowe Physics

Pulsed Laser Deposition (PLD) is an important technique used for depositing nanoscale thickness films of solid materials onto a substrate. The process works by focusing a high-energy laser onto a sample or “target” of the material to be deposited. The target material is then vaporized into a plasma plume and deposited as a thin film on a substrate opposite the target. This technique must occur in high vacuum and can sometimes include the addition of a reactive gas into the deposition chamber. In our experiments, Magnesium Oxide was deposited onto a graphite flake by using a Mg target and a background gas of O₂. Kawakami et. al. demonstrated that nanoscale thick MgO could be grown on graphene using molecular beam epitaxy if a partial monolayer of titanium atoms were introduced as a nucleation layer in order to obtain atomic-scale film smoothness. The NC State PLD technique achieves this low roughness without the titanium layer by depositing the MgO much more rapidly and at lower substrate temperatures.

Session 1, C13
Breathing Mode Instability in Hoyle-Lyttleton Accretion
Anna Susan Carr Physics
Mentors and/or Co-Authors: John Blondin Physics

Gravitational accretion serves as a ubiquitous source of power for many celestial objects, yet its fundamental properties remain poorly understood. Proposed in 1939, the Hoyle-Lyttleton model of accretion describes mathematically the behavior of a uniform gas cloud collecting onto a compact star. While this model has been found to predict generally accurate data, it is limited to steady, axisymmetric flow and fails to address the temporal variability seen in many accreting X-ray sources. Recent studies of high-resolution simulations of HL accretion demonstrated instability in the mass accretion rate creating breathing mode oscillations of unclear origin. We conducted an in-depth investigation of accretion breathing modes using 2D simulations to characterize their nature as a function of varying conditions and were able to confirm their existence. The instabilities were only observed when the accretor radius was less than Rₚ = 0.02Rₛ. Additionally, We found that when the adiabatic index deviated from γ = 5/3, the properties of the instabilities changed. As the adiabatic index became smaller, the period of the oscillations decreased while their regularity increased.

Session 1, A22
The Effect of Progenitor Rotation on SASI in Core-Collapse Supernovae
Elliot Virgin Carlee Undeclared
Mentors and/or Co-Authors: John Blondin Physics

Current simulations of core-collapse supernovae (CCSNe) suggest that the post-bounce shockwave stalls at a radius of approximately 100km. This stalled shockwave has been found to be unstable, in what is known as the Spherical Accretion Shock Instability (SASI). Previous numerical simulations involving SASI, suggest that it plays an important role in reviving the explosion and powering CCSNe but are limited in their study of how rotation of the progenitor star affects the SASI. We systematically investigated progenitor star rotation in our simulations of CCSNe,
using the VH-1 hydrodynamics code in two dimensions following the methods described by Blondin and Shaw. Our simulations quantified the effect of progenitor rotation on the SASI by measuring growth rates of the SASI as a function of progenitor rotation, finding that growth rates generally decreases with progenitor rotation.

Session 1, D21
Turbulence in Core-Collapse Supernovae
Mithi Alexa de los Reyes Physics
Mentors and/or Co-Authors: John Blondin Physics

The Spherical Accretion Shock Instability (SASI), in which a supernova shock wave stalls and produces a turbulent post-shock flow, has generally been accepted as an important phenomenon in core-collapse supernovae. However, the effects of the turbulence caused by the SASI have not yet been thoroughly investigated; indeed, recent literature presents contradictory results about the evolution of this turbulence on different length scales. We therefore use high-resolution two-dimensional hydrodynamic simulations of core-collapse supernovae to study the growth of the SASI-driven turbulence. We produce and analyze Fourier transform power spectra in order to quantify energy conversion (i.e. gravitational potential energy to the kinetic energy of turbulent flow) on different length scales, as well as to determine which scaling laws best describe this turbulence. Finally, we present observations on the effects of resolution on the two-dimensional SASI.

Session 1, D6
Hole Closing of a Surfactant Layer on a Thin Fluid Film
Matthew Felix Hin Math
Richard Sayanagi
Mentors and/or Co-Authors: Karen Daniels Physics

The dynamics of surfactant spreading on an underlying fluid layer play an important role in medical treatments and industrial processes. A surfactant is a compound that reduces the surface tension of a fluid. Where there is a gradient in surface tension, spreading will occur to reduce that gradient. We perform experiments on the inward spreading of surfactant into a region without it. Instead of uniformly closing the hole, the surfactant creates a distention in which the underlying fluid is lifted up. We quantify the persistence of the distention and its dependence on the depth of the underlying fluid layer.

Session 1, A13
Turbulent and Collective Effects on Supernova Neutrinos
Neel Vinayak Kabadi Physics
Kelsey Reppert

Mentors and/or Co-Authors: Jim Kneller Physics

During core-collapse supernovae explosions, large fluxes of neutrinos are emitted from the proto-neutron star formed at its center. The flavor oscillations of these neutrinos as they pass through the supernova is an area of active study. Previous simulations of neutrino collective effects have found distinct spectral features known as spectral splits but these features may be disrupted by turbulence in the region between the proto-neutron star and the standing accretion shock where the collective effects dominate. We consider this possibility and examine the effect of adding turbulence into several different supernova models under different neutrino mixing schemes and find that turbulence has little effect except for low-mass iron core progenitors and large amplitude turbulence.

Session 1, D3
A Quest For An Elusive Companion Star
Shengkai Alwin Mao Undeclared
Mentors and/or Co-Authors: Stephen Reynolds Physics
John Blondin Physics

The mechanism behind Thermonuclear (Type Ia) Supernovae is believed to involve a white dwarf and a companion star, which could be a normal star (single-degenerate model) or a white dwarf (double-degenerate model). Finding the companion star would show that the companion star was not destroyed in the collision, implying a single-degenerate progenitor. Due to the sheer size of the supernovae and the number of candidate stars contained therein, it is necessary to determine the star's rough location before making an exhaustive search. It is thought that the companion star can be found at the explosion center, but assumptions that the explosion center would be at the remnant's geometric center have proved fruitless. However, these searches did not factor in the possibility that a nonuniform interstellar medium (ISM) density could cause an asymmetric expansion, which would cause the apparent geometric center to shift from the true explosion site. By running numerical hydrodynamics simulations modeling the effects of ISM density gradients with differing steepness and shape, a collection of remnants can be formed, and a more reliable search location can be determined. To that end, it has been found that Type Ia supernovae simulated by exponential density models are significantly offset by jump discontinuity and hyperbolic tangent ambient density profiles. However, young supernovae simulated with an exponential density model in linear ambient density profiles are not significantly offset until they reach the Sedov expansion phase.
Redshift and Angular Effects on the Detected Duration of Gamma-Ray Burst Light Curves
Michelle D Villeneuve Astrophysics
Mentors and/or Co-Authors: Davide Lazzati Physics

As some massive stars evolve, it is thought that long-duration (>2 sec) gamma-ray bursts (GRBs) are produced from relativistic jets at the poles of the star just after the star starts to collapse, eventually forming a black hole. The length of time these jets emit these gamma-rays ($T_{\text{engine}}$) was always thought to be the same length of time that the bursts were detected ($T_{90}$). GRBs are classified by their $T_{90}$ times assuming that the same type of progenitor always has the same detected duration classification. By creating long duration GRB simulations at different redshifts, accounting for random noise and observing angle, the light curve and therefore detection of the burst changes. These simulations can show that bursts produced by the same stellar explosion could have different $T_{90}$ times, depending on the distance and observing angle.
Nuclear Engineering UG Research Program

Session 1, D12
Electric Field Effect on the Electron Multiplication Coefficient of Glow Discharge Plasmas with Varying Electrode Geometries
Erick Josue Andino Nuclear
Mentors and/or Co-Authors: Mohamed Bourham Nuclear Engineering

The electron multiplication coefficient (EMC) in a DC glow discharge plasma in parallel disc electrode configuration is usually assumed to be a constant value that depends on the electrodes material and the working gas. The electric field is assumed uniform and is simply taken as the voltage divided by the distance between the two electrodes, however, under different electrode geometries the solution of the “equation of the breakdown voltage” does not holds true due to the fact that electric field is a function of space and no longer a constant uniform field. Using charge particle simulation software (SIMION) electrons were flew; recreating the conditions of the experimental cases. From such simulations equations of the average E-field as a function of distance were obtained at different voltages, and the equations were consolidated to obtain the E-field as a function of distance and applied voltage. The consolidated equations were integrated along the distance between the electrodes to give an equation of the effective voltage. Using experimental data and the voltage transformation equations the EMC was obtained. It was observed that the EMC was a function of the effective E-field and pressure. Equations describing the behavior of the EMC were obtained.
**OIA-SRE, Office of International Affairs - Summer Research Experience**

**Session 2, B14**

**Growth of TiO2 Epitaxial Film**

*Motao Cao Material Science and Engineering*

*Mentors and/or Co-Authors: Jay Narayan Material Science Engineering*

The growth of TiO2 epitaxial film is important for both the development of epitaxy theory and the application in semiconductor devices, because epitaxy is the only affordable method of high quality crystal growth for many semiconductor materials. In my project, pulsed laser deposition technique is employed to grow rutile TiO2 epitaxial thin films on r-, c- and m- sapphire substrates. The formation of the rutile TiO2 epitaxial thin films, growth characteristics, and defect content as a function of laser and substrate variables are studied. 20scan XRD revealed formation of highly textured rutile films with out-of-plane orientations of [100] and [001] on c- and m- sapphire substrates, respectively. The epitaxial relationships across the film/substrate interface is determined using Φ-scan XRD. The results are further confirmed by TEM diffraction and imaging. The atomic arrangement at the interfaces is explained based on the domain matching paradigm, where integral multiples of planes match across the film-substrate interface.

**Session 2, B7**

**To be dumped or to be recycled - How does Taiwan dispose food waste?**

*Chih-yi Chang Business Administration*

*Mentors and/or Co-Authors: Al Chen Accounting*

How to collect and deal with everyday food waste is a tough issue for many countries. Every country has its own unique way to dispose food waste. According to figures from Taiwan Environmental Information Center, everyday food waste recycling rate in Taiwan is 35% to 50%, and more than 70% of the recycled food waste will be transferred to piggyery as feed. Other recycled food waste will become farmyard manure or be dumped. This is an outstanding performance compared to other countries. According to the U.S. EPA, the food waste recycling rate in the U.S. is only 2.4%, and 97% of the recycled food waste will end up being dumped. This research is about Taiwan experiences dealing with food waste, and about problems that Taiwan is currently facing. This research hopes that with Taiwan experiences, it can help other countries raise their food waste recycling rate and also offer other countries different ways to dispose food waste. If people can exploit food waste, people might be able to create a positive effect in the cycle of food, and might be able to strengthen the sustainability of the environment. For example, if people made food waste become animal feed or farmyard manure, people not only could save a lot of earth resources, but also could protect the environment. The environment would be protected because people can save a lot of animal feed from grain, and food waste will not be dumped somewhere anymore.

**Session 2, A8**

**Assessment of Visual Aiding in Virtual Reality-based Motor Task Performance Using a Haptic Interface**

*Shih-Ching Chen Industrial Management*

*Mentors and/or Co-Authors: David Kaber Fitts Dept of Industrial and Systems Engineering*

Within the recent past, virtual reality has become a popular tool for simulating motor task performance and facilitating skill training. Many research systems and programs have been developed incorporating 3-D displays and haptic devices. Considering the potential growth of application of these systems, the importance of familiarizing novice users with visual and haptic interfaces is critical. This study involved a group of students from North Carolina State University in a pilot experiment to test the hypothesis that visual cues, such as color changes in virtual objects in a VR simulation of a simple motor task, could reduce user cognitive processing load and accelerate learning of displays and control interfaces. The task was a virtual dice manipulation application requiring positioning and orientation of a die at a target location. Participants were divided into two groups at random, one performing the original version of the training task and the other performing the augmented version with visual cues available. The visual cues included two colors applied to the original color of the die: a red color highlighting the surface of the corresponding target face of the die, and a green colored surface when the die was oriented to the correct position by a participant. Performance data was automatically collected through the VR simulation and subjective ratings of system usability were gathered using the System Usability Scale. Results demonstrated that the augmented version of the simulation, including visual cues, helped participants to learn the VR system faster and to understand system functions better.

**Session 2, C13**

**Massively Parallel Computing for Protein Isoform Discovery, Estimation and Testing**

*Xi Chen Mathematics*

*Mentors and/or Co-Authors:*

Protein isoforms play an important role in gene expression regulation and form the basis of many complex phenotypes, including human diseases. The recently introduced RNA-Seq technology has propelled
the discovery of many new genes and splice isoforms. The counts of millions of short reads generated by RNA-Seq often show over-dispersion and thus can be modeled by a negative binomial distribution, an improvement of previously used Poisson distribution. Thus isoform discovery corresponds to the variable selection and isoform abundance estimation translates to the parameter estimation under a negative binomial regression model. Unfortunately the involved optimization problem is extremely high dimensional and current algorithm does not scale well with the magnitude of RNA-Seq data. To deal with it, in this project, we develop and implement a massively parallel algorithm for isoform discovery, abundance estimation and testing using graphics processing units (GPU). A single GPU card with hundreds of arithmetic cores can be inserted in a personal computer and dramatically accelerates many statistical algorithms. Our algorithm utilizes the powerful minorization-maximization (MM) principle to separate variables, making it ideal for the fine-scale parallel structure of GPUs. Experiments on simulated and real data show significantly improvement in the efficiency compared to the current central processing unit (CPU) algorithm and implementation. Our implementation is based on the CUDA library for the widely used NVIDIA GPU cards and will be incorporated into the comprehensive RNA-Seq data analysis software package IsoDOT.

Session 2, B10
Switching Loss Analysis of Different Power Semiconductors
Binjie Cheng EE
Mentors and/or Co-Authors: Alex Huang Electrical & Computer Engineering
FREEDM (Future Renewable Electric Energy Delivery and Management) is a brand-new smart micro-grid system. The key networking equipments of FREEDM are SSFID and SST which include different kinds of power semiconductors. Thus, the switching loss of power semiconductors should be taken into consideration in order to advance the efficiency of SST and SSFID. In this project, the switching loss of different power semiconductors in Boost converter circuit was analyzed and compared through simulations of Pspice. Switching loss was also calculated based on datasheets of different semiconductors. Meanwhile the data of switching loss was measured through oscilloscope in real Boost converter circuit. Combining all of the results of simulations of Pspice, calculations based on datasheets and experiments of real circuits, it proves that different power semiconductors have different switching losses and they should be chosen according to the actual situation. The results are meaningful because low switching loss helps save energy and update efficiency.

Session 2, B16

Development of Classification Scheme for Trucks Suitable for Incorporating into the Highway Capacity Manual
Han Cheng Civil Engineering
Mentors and/or Co-Authors: George List Civil, Construction and Environmental Engineering

The research is one of the fundamental components of the entire NCFRP project aiming at incorporating truck analysis into the Highway Capacity Manual (HCM). HCM is an important reference book for analyzing the performance and operation of streets and highways mainly based on passenger cars. As the truck percentage of the whole traffic rises up nowadays, it’s necessary to bring a better methodological system for analyzing traffic and designing roads and vehicles based on needs from trucks. Meanwhile a better evaluation of effects of trucks on other modes of transportation and vice versa is also significant. As one of the primary foundations of these objectives, a modified truck classification scheme is required, which is the main purpose of conducting this research. We derived the truck classification schemes from Federal Highway Administration (FHWA) as a prototype and modifying the form by enriching the performance-related characteristics values (e.g., weight, length, power) varied by different class of trucks, where the reference mainly comes from literature research. We’ve also computed the distribution of weight, weight per axle and weight per tire among the gross statistic sample from weigh-in-motion (WIM) station data throughout the country, grouped by different number of axles or types. The distributions of truck weight, weight per axle and weight per tire are presented as plots, which show us the status of current relationships between truck performance parameters (e.g., weight per tire) and truck types (and axles) and the necessity of developing a new one. The conclusion is that there indeed requires a classification put into practical use and thus the development work of truck classification is meaningful.

Session 2, D7
Electrospun graphene-composite nanofibers for lithium-ion battery applications
Huai-ping Cho Chemical Engineering
Mentors and/or Co-Authors: Peter Fedkiw Chemical and Biomolecular Engineering

Graphene-composite nanofibers (GCN) were prepared using the electrospinning method and investigated for potential uses anodes in lithium-ion batteries. The effects of precursor compositions, graphene-oxide concentrations, and electrode pyrolysis temperature were examined systematically with an attempt to improve the reversible charge capacity and cycling life of the carbon based anodes. The structure and morphology of the GCN and graphene oxide was characterized by scanning electron microscopy,
transmission electron microscopy and Raman spectroscopy, while the electrochemical properties were analyzed by chronopotentiometry. Microscopy shows fiber diameters on the order of 1 µm extruded, which reduced during carbonization. Raman data showed an increase in crystalline structure defects as carbonization temperature increased. The composite nanofibers will be tested to determine potential for lithium-ion batteries.

Session 2, C7
Graphene-supported Platinum Catalysts for Oxygen Reduction Reaction
Chin-yu Chung Chemical Engineering
Mentors and/or Co-Authors: Peter Fedkiw Chemical and Biomolecular Engineering

Graphene is a promising support owing to its high electronic conductivity, good chemical stability and large surface to volume ratio. However, without surface modification, most graphenes are short of adequate binding sites to anchor metal precursor or nanoparticles, which will result in poor dispersion and aggregation of nanocrystals. Therefore, a new composite support, polyoxometalate-modified graphene nanoplatelet (GNP), is investigated in this study through the chemisorption between phosphomolybdic acid (PMo) and GNP. A wet reduction method is chosen to prepare supported platinum catalyst by using sodium formate as reducing reagent. The particle sizes of Pt are calculated to be 5.9 and 2.7 nm for Pt/GNP and Pt/PMo/GNP, respectively. The TEM images show that Pt nanoparticles are homogeneously dispersed on the surface of GNP with the assist of PMo. Furthermore, Pt/PMo/GNP catalyst shows 1.7 times higher Pt electrochemical surface area (ECSA) when compares to the Pt/GNP catalyst. Koutecky-Levich plots further indicate that the oxygen reduction reaction (ORR) mechanism is via a four-electron pathway on the prepared Pt catalysts. Moreover, the Pt/PMo/GNP catalyst show higher ORR activity (0.93 mA cm⁻²) when compared to the Pt/GNP catalyst (0.82 mA cm⁻²). These results show that polyoxometalate-modified GNP as a new catalyst support has good potential application in polymer electrolyte membrane fuel cells.

Session 1, D16
A simulation model and strategy for voltage source inverters in FREEDM system based on proportional-resonant control
Hua Feng Electrical
Mentors and/or Co-Authors: Alex Huang Electrical & Computer Engineering

With the development of semiconductor devices, the idea of an energy Internet is being realized in FREEDM system center. The use of Solid State Transformer (SST) which makes flexible energy exchange between AC and DC possible is an essential part of this grand plan. However, semiconductor devices like SST will bring distorted current into grid for their non-linear characters. To solve this problem, people have designed various methods to reach unit power factor and keep the grid current in a sinusoidal form. Both conventional synchronous frame PI controller and a relatively new stationary frame proportional-resonant (PR) controller have been simulated in this research project and proved effective to reach the goal if used on the rectifier part of SST. Both method reach unit power factor in approximately one line-frequency period (0.02s) and steady DC voltage state in less than 0.06s, which is three line-frequency periods. The quasi direct power control method used in PR controller also has its potential in var generator control. Additionally, for other non-linear loads in the system, a hybrid controller with harmonics suppressing as an active power filter is also simulated. This largely reduces the 5th and 7th harmonic current on the AC side thus improve power quality and system stability.

Session 2, C14
Monte Carlo Simulation of Light in Ocean Water
Cheng Fu Optical
Mentors and/or Co-Authors: John Muth Electrical & Computer Engineering

Underwater free space optical communication systems are of interest for underwater vehicles since radio frequency electromagnetic waves do not penetrate seawater. Understanding how light propagates underwater is important in designing such systems. This work uses Monte Carlo numerical simulation to model the impulse response and attenuation of the light signal due to scattering and absorption. The programming was done in Python. Python is a cross platform language that is increasingly used for scientific computing. The result shows the relation between the received photons and the influencing factors, including water type, the receiver apertures and the field of view. The histograms of photons received in temporal domain for different seawaters are also presented and are connected to the bandwidth of the communication signals. The simulations are validated by comparing them with simulation results found in the literature.

Session 2, A11
Development of LabView-Based Baterry and Electric Vehicle Data Acquisition System
Zijian He Control
Mentors and/or Co-Authors: Mo-Yuen Chow Electrical & Computer Engineering

Nowadays, the Hybrid Electric Vehicle (HEV) is getting more and more popular for the rising demand to use sustainable energy resources instead of fossil fuels. However, accurate estimation of the battery parameters
and states (State of Charge (SOC) and State of Health (SOH)) is still a serious existing problem in the purpose of optimizing the functionality of Electric Vehicles and avoiding the drivers? anxiety of relying on the battery power for long distance drives. In order to build a comprehensive battery testbed for demonstrating battery operation in Electric Vehicles, we have developed a LabVIEW-based Battery and Electric Vehicle Data Acquisition System. With our software connected to the hardware built by the other group, user is able not only to read all the data of the battery and the driven AC motor that needed for estimating the battery parameters and states, but also to control the dynamic emulation system by choosing different operating profiles for the motor and sending commands to switch the power between battery and grid through a graphical user interface (GUI) based in LabVIEW. Moreover, a data transmission interface is set up between LabVIEW and MATLAB/SIMULINK based on SIMULINK Interface Toolkit (SIT), which allows researchers to run their own battery estimation algorithm in MATLAB and simultaneously display the estimated parameters and states of battery on the GUI.

Session 1, C16

IMAGINE Safe Drinking Water in South Africa: Student/Community Collaborations to Assess Nitrate Contamination in Ground Water.

Jonathan Michael Hodiak Animal Science

Mentors and/or Co-Authors: Elizabeth Nichols Environmental Technology

Toddie Steelman Forestry and Environmental Resources Academic Research

IMAGINE is an undergraduate/graduate research program funded by the University of Pretoria (PI, Liesel Ebersohn) and North Carolina State University (PI, Melissa McHale). Faculty and students from the United States and South Africa work together with rural communities to conduct research on resource use and health and well being. Nitrate/nitrite (NO3-N) is a widespread contaminant in groundwater in the USA and South Africa, and a public health concern when concentrations exceed 2 to 4 mg/L. In the USA, studies have shown that the incidence of specific cancers and lymphomas increased when nitrate exposure exceeded 2 to 4 mg/L. Infants are particularly susceptible to methemoglobinemia or “blue baby” syndrome if exposed to nitrates in drinking water. In South Africa, this particular health issue is a concern as mothers with AIDS are encouraged to use infant formula with water rather than breast-feed their babies. Both South Africa and the U.S. EPA have established a maximum contaminant level (MCL) of nitrate/nitrite at 10 mg/L. We collected samples and determined NO3-N concentrations and general water quality parameters at ground water wells used for drinking water sources in northern South Africa in June 2012. Results show some drinking water wells with NO3-N greater than USEPA and South Africa allowable maximum contaminant levels.

Session 2, B8

Testing of Second Use Traction Batteries in Grid Application

Yu-chien Hsu Power Electronics and Power Systems

Yu-Shan Cheng

Mentors and/or Co-Authors: Srdjan Lukic Elec & Comp Engineering

In recent years, the increasing demands for plug in and electric vehicles has led to a large increase in the use of Li-ion batteries. At the end of the vehicle life, there may still be a substantial amount of available energy that can be extracted from the battery. In this research we explore the capability of such batteries to support the electric grid. Therefore, in our research, we focused on developing a cascaded inverter control system that would allow the reclaimed battery modules to be integrated with the electric grid. Our goal is to test the efficiency of the four batteries to make sure the batteries are stable while charging and discharging. To capture the battery charge and discharge information, we have built a current sensor board, and we designed a low pass filter that allowed us to capture the average charge and discharge current information. We used Agilent data logging system to collect the voltage and current values of a four-cascaded H-bridge system.

Session 2, D8

The sharing world—Collaborative Consumption

Ming-chiang Huang Business Administration

Mentors and/or Co-Authors: Al Chen Accounting

The subject matter in this summer research program is sustainability, including the following dimensions: Economy, Society and environment. The focus of this research is the Economy dimension about the concept called “Collaborative Consumption.” In fact, some of the companies like Zipcar taking this concept into action are gradually become a groundswell in major cities around the world. More importantly, it was discussed in the academic world and evolved into the study called “Sharing Economy.” The objective to research this concept is, by realizing how this idea influence our human society and finding the key points of practicing it into our daily life, in order to make our worlds more environmentally friendly and sustainable.

The framework is as follows. In the beginning, introduce the background of the emergence of Collaborative Consumption and the drivers pushing ahead this concept into our real life. Second, interpret the content about Collaborative Consumption, and some systems included that we have already applied in our daily life. Third, discuss the pros and cons this concept brings to the consumer, producer and the economy. Fourth, by searching some statistics on the
The Food and Drug administration (FDA) has different criteria for regulating the fermented and acidified foods. However, very little is known about brined pepper sauces, which have 15% high salt (NaCl). The aim of this study was to determine what type of microbiota may be present in pepper sauces. Roughly filtered pepper sauce was spread on Trypticase Soy Agar (TSA) and marine agar (MA) and the plates were incubated at 30 °C in aerobic and anaerobic environments to isolate single colonies of organisms. MA was used because it had 2% NaCl which can select for salt resistant bacteria. The colony counts on TSA from aerobic and anaerobic incubation were 8.50 x10^5 cfu/ml and 7.17 x10^5 cfu/ml, respectively. On MA, the colony counts under aerobic and anaerobic incubation were 8.10 x10^5 cfu/ml and 7.17 x10^5 cfu/ml. Different morphologies of pure colonies are chosen for streak plates, which will be used for 16S rRNA gene sequence analysis to identify the species, using the NCBI database on the website. This project is the first step in research to characterize the microbiota of high salt pepper sauce. No one has examined this kind of microbial ecology may aid FDA in determining how to regulate this product.

Session 2, C8
Simulation of a Drive-through Vaccination Clinic for Disease Outbreak Response
Yi-Dun Lai Production Management
Mentors and/or Co-Authors: Julie Ivy E.P.Fitts-Industrl. & Sys Engr

Health care is an important issue nowadays. The potential for disease outbreak and the need to control disease spread as efficiently as possible is particularly of interest given the recent H1N1 outbreak. There are many ways to control disease spread including quarantine and self-isolation, and one of the most efficient is vaccination. However, the resources of clinics, e.g., the number of doctors and nurses or clinic space, are limited. As a result, the problem of optimizing the mass vaccination process, i.e., the delivery of vaccination to large portions of the population within a short period of time, becomes a very significant and complicated problem. Our research is to develop simulation models of one or two mass vaccination clinics using the simulation software, Simio, with the goal of identifying optimal staffing levels for responding to a disease outbreak in a population of approximately 21,000 people. We use the 3-D technology to simulate the real clinic, input related data such as the average service time and patient arrival rate, and then run a variety of vaccination scenarios. With help of simulation, we can identify how to make the process more efficient. The information provided by such a model can be used to help public health departments prepare for disease outbreaks and insure that they have sufficient resources available for responding to an outbreak in a timely manner.

Session 2, C9
What you eat is not just a pepper - Isolation and Identification of Microorganisms in a High Salt Fermented Pepper Sauce
Hsin-yu Huang Plant Pathology and Microbiology
Mentors and/or Co-Authors: Fred Breidt Food Science

The Food and Drug administration (FDA) has different criteria for regulating the fermented and acidified foods. However, very little is known about brined pepper sauces, which have 15% high salt (NaCl). The aim of this study was to determine what type of microbiota may be present in pepper sauces. Roughly filtered pepper sauce was spread on Trypticase Soy Agar (TSA) and marine agar (MA) and the plates were incubated at 30 °C in aerobic and anaerobic environments to isolate single colonies of organisms. MA was used because it had 2% NaCl which can select for salt resistant bacteria. The colony counts on TSA from aerobic and anaerobic incubation were 8.50 x10^5 cfu/ml and 7.17 x10^5 cfu/ml, respectively. On MA, the colony counts under aerobic and anaerobic incubation were 8.10 x10^5 cfu/ml and 7.17 x10^5 cfu/ml. Different morphologies of pure colonies are chosen for streak plates, which will be used for 16S rRNA gene sequence analysis to identify the species, using the NCBI database on the website. This project is the first step in research to characterize the microbiota of high salt pepper sauce. No one has examined this kind of microbial ecology may aid FDA in determining how to regulate this product.

Session 2, A12
Fuel systems for gasoline direct injection (GDI) applications
Wenbang Li Energy
Hui Sun
Mentors and/or Co-Authors: Tiegang Fang Mechanical & Aerospace Engr

Gasoline Direct Injection (GDI) engines are the late-model engines whose fuel efficiency is higher than conventional spark-ignition gasoline engines. With the application a piezoelectric injector, the injection events and the fuel delivery can be precisely controlled during each engine cycle which can significantly affect the combustion process with reduced emissions and improved fuel efficiency. The fuel system will be set up and experiments will be conducted under different injection pressures from 50 bar to 200 bar. The fuel system consists of a fuel rail, a high pressure pump, and a low pressure supply pump. The fuel pressure will be controlled by a customized LabView program. Fuel will be injected by a piezoelectric injector, which is controlled by a trigger pulse given by a signal generator. The injection process will be synchronized with a high speed camera used to take spray images. Finally, the results will be analyzed in terms of spray angle and penetration. We aim to find the effects of injection parameters on the spray pattern, penetration, and spray angles, all of which are important to control the combustion process.

Session 2, C10
Robustness of 1200V SiC MOSFET in Short-Circuit Modes
Yingshuang Li EE
Mentors and/or Co-Authors: Alex Huang Electrical & Computer Engineering
SiC is one of the most promising alternatives to silicon (Si) for power semiconductor devices due to its superior material characteristics. The state-of-art 1200V SiC power MOSFET has low Rds, on and low output capacitance when compared to Si IGBTs. In the research, we evaluated the short-circuit ruggedness of SiC MOSFETs by measuring the amount of time it withstood in short-circuit operations. The short-circuit time should be long enough for controllers to detect and interrupt the fault. An electric test bench was developed and destructive tests of two samples of a commercially available 1200V SiC MOSFET were carried out under an identical supply voltage of 400V. The destructive breakdown occurred after short-circuit operations of 50µs and 80µs with on-state gate bias voltage of 10V and 15V respectively. The fast increase in temperature of the chip during the short-circuit modes led to the failures. To analyze the waveforms during the short-circuit modes, measurements of the temperature characteristics of the SiC MOSFET were carried out. The results show the exceptional robustness of SiC MOSFETs in short-circuit operations when compared to Si devices. Analysis indicates that SiC-MOSFETs have great potential as power devices for high power applications.

Session 2, D12
The Fabrication of Ultra-Stretchable Metal Wires
Yiliang Lin, Polymer Science and Engineering
Mentors and/or Co-Authors: Michael Dickey, Chemical & Biomolecular Eng

This talk will describe efforts to fabricate microfluidic channels using a ultra-stretchable material. The channels may be useful for creating stretchable wires by injecting them with liquid metal. Conventional wires, which are often made of copper, fatigue when bent repeatedly and therefore are not suitable for making flexible, stretchable, or soft electronic devices. We propose here to replace the solid metal component with a liquid metal and encase it in a stretchable elastomer. The stretchable material we use is an elastomeric polymer gel (styrene ethylene butylene styrene with oil) and the liquid metal is eutectic Ga–In (EGaIn). The challenge of this project is to seal a molded piece of polymer (featuring molded microchannels) to a flat piece of polymer without collapsing the channel or without changing the mechanical properties of the polymer gel. This summer we used heat and plasticizer oil to seal the micro channels and explored suitable condition to enable sealing. If successful, this approach will surely provide a new sealing technology and enable researchers to fabricate soft electronics more easily; also I can rapid prototype devices of ultra-stretchable wires under suitable conditions, which may lead to the mass production of stretchable wires and other soft electronic devices.

Session 2, A15
Path Planning for Object Recognition
Wanxi Liu, Optical
Mentors and/or Co-Authors: Edgar Lobaton, Elec & Comp Engineering

The object recognition problem in computer vision has several applications in security and environmental sciences to name a few. For example, one may be interested in identifying objects that can be associated with a potential threat in an airport. In this context, we aim to minimize the traveled distance of a mobile robot looking to recognize multiple targets. Our objective is optimal path planning of a mobile robot's motion for the recognition of multiple targets under the assumptions that (1) objects have circle shape and can be recognized from a certain orientation, and (2) all objects and the robot can be localized. We proceed by building a mathematical model for the problem, finding the best strategy by geometrical derivation, analyzing the result via numerical simulations in MATLAB, and testing the result in a clear path–chameleon robot. We use an Optitrack Motion Tracking System to localize the robot and the objects. The implementation is done using the Robot Operating System. For single object, both the simulation and the derivation show that the optimal strategy is to let the robot go directly towards the object to enter the possible recognition area and circle around the object until it is recognized. The tangential point also turns out to be a good choice when the robot is close enough to the object and the angle of recognizing the object is relatively large. The result will be extended to multiple objects by inserting intermediate target points set as end or starting points in single object situation.

Session 1, C24
A Reconstructed Discontinuous Galerkin Method for Elliptical Problems
Jialin Lou, Mechanics
Wentao Zhang
Mentors and/or Co-Authors: Hong Luo, Mechanical & Aerospace Eng

An accurate and efficient method for solving the elliptical problems in the context of the discontinuous Galerkin methods (DGM) is still at large. In this study, a reconstruction-based discontinuous Galerkin (RDG) method is presented for the solution of the 1D Poisson’s equation. The RDG method, originally developed for the hyperbolic type of partial differential equations, is extended to discretize the elliptic equations using a so-called inter-cell reconstruction, where a smooth solution is locally reconstructed using the least-squares method from the underlying discontinuous Galerkin (DG) solution. The main effort presented in this study is focused on the effect of different least-squares reconstructions on the accuracy of the RDG method for the discretization of the 1D...
Poisson's equations. A numerical analysis has been performed to assess the formal order of accuracy for this RDG method. The numerical results obtained indicate that this RDG method is able to deliver the same accuracy as the well-known BR2 scheme, at a half of its computing cost, demonstrating that the RDG method provides an attractive alternative for solving the elliptic problems.

Session 2, A17
Recent Trend of China's Housing Prices
Chenlu Ma Geographic Science (Land Resource Management)

Mentors and/or Co-Authors: Huixia Wang Statistics

Chinese real estate has caught numerous attentions from the government to the public in recent years. House prices showed an upward trend before the government imposed leverage limits on it recently. Superficially, house prices and sales plunge after China's government intentionally slams on the brakes. Whether China's real estate bubble will burst or not is still a question. In this research, we study housing prices of eleven districts in Nanjing, China from 2009 to 2012 for total 30 months. The time trend, the effects of household average income and districts on housing prices are assessed through least squares and quantile regression analyses. In addition, we compare different choices of models using various model selection criteria. Results show that the housing prices of Nanjing tend to increase from July, 2009 to the first half of 2011 and then become stable with a downward trend. Secondly, there appears a positive correlation between income and low-end-house prices, whereas such positive correlation is not significant for high-end houses. Quantile regression also suggests that the prices of low-end houses rise relatively faster than those of the high-end. The research results are potentially useful for government to take targeted regulatory measures for different levels of houses.

Session 2, A16
Effectiveness of silver-impregnated carbons and ion exchange resins for the removal of bromide
Yao Nie Environmental

Mentors and/or Co-Authors: Detlef Knappe Civil, Construction and Environmental Engineering

Bromide serves as a precursor for regulated disinfection byproducts in drinking water. For example, ozone reacts with bromide to form bromate, and chlorine reacts with bromide and natural organic matter (NOM) to form trihalomethanes and haloacetic acids. Therefore, finding effective methods for the removal of bromide (and NOM) from drinking water is of great importance. Activated carbon and ion exchange resin are two kinds of common drinking water treatment additives. The objectives of the research were to assess the effectiveness of (1) silver-impregnated activated carbons (SIACs) and (2) ion exchange (IX) resins for bromide removal. Three commercial SIACs with different silver concentrations and three anion IX resins, including a magnetic ion exchange (MIX) resin, were investigated. Batch kinetic tests were conducted both with bromide-spiked laboratory water and Dan River water (Eden, NC). While SIACs removed up to 9% of bromide from laboratory water, SIACs did not produce measurable bromide removal from Dan River water. However, two of the three ion exchange resins effectively removed both bromide and NOM, as measured by total organic carbon (TOC). After a contact time of 60 minutes, one IX resin was able to remove 74% of bromide and 19% of TOC from Dan River water with a dose of 1 mL/L and >99% of bromide and 48% of TOC at a dose of 10 mL/L. The MIEX resin was somewhat less effective for bromide removal (42% at 1 mL/L, 90% at 10 mL/L) but more effective for TOC removal (43% at 1 mL/L, 64% at 10 mL/L).

Session 2, C12
The development of image processing algorithms to determine the concentration and size distribution of radioactive microspheres
Bo Ning Mechanical

Mentors and/or Co-Authors: Gregory Buckner Mechanical and Aerospace Engineering

This research focuses on the development of image processing algorithms to determine the concentration and size distribution of radioactive microspheres, SIR-Spheres (Sirtex Medical, North Sydney Australia). These microspheres, which range in diameter from 20-60 microns, are used in radioembolization procedures to treat patients with unresectable liver cancer. Presently, physicians have no means of accurately measuring the doses administered to patients (which range from 10-60 million microspheres), as clinical and laboratory counting equipment is not compatible with radioactive materials. The development of automated optical counting techniques has the potential to improve the accuracy and efficacy of radioembolization procedures, and the clinical outcomes of liver cancer patients. The MATLAB-based image processing algorithms presented here automatically determine the precise location, number, and diameter of microspheres deposited onto a glass slide. These algorithms accommodate for variations in image contrast, lighting, and focus to accurately identify isolated and clustered microspheres. Preliminary results indicate a counting accuracy of over 98%. Remaining work will focus on applying these algorithms to adjoining images acquired from computer-controlled microscope stages.
Session 2, C15
Battery Management System Testbed for PHEV
Applications: PHEV Emulator
Haoyuan Qu
Electrical Engineering
Nan Wang
Mentors and/or Co-Authors: Mo-Yuen Chow
Electrical & Computer Engineering

Plug-in hybrid electric vehicles (PHEVs) mark the trend of future transportation to reduce greenhouse gas emission, local air pollution and dependency on petroleum. One major challenge of the large-scale penetration of PHEVs in the transportation market is reliability and efficiency of batteries. Lack of effective battery monitoring system prevents consumers from enjoying a smooth trip by arousing anxiety and causing delays due to the recharging time. In this project, we have set up a comprehensive battery testbed to demonstrate, test and validate battery monitoring algorithms. To simulate the powertrain of a PHEV, the battery drives an electric AC motor through a DC-AC inverter. The dynamometer connected to the AC motor applies different torques and speed limitations to emulate different driving conditions, such as ramp up and ramp down. Remote control through the DAQ board and relay circuit which is connected to a PC enables the switching between AC power supply and battery power supply. The battery testbed is aimed to acquire data with DAQ board and dynamometer and allow future experiments to be easily conducted via a LabVIEW graphical user interface (GUI) that is developed by another group, whereas our project mainly focuses on building up the electric vehicle emulator. By implementing the battery monitoring algorithms on this PHEV testbed, the algorithms can be evaluated and optimized and thus make PHEV batteries more reliable.

Session 2, D11
Detection and Correction of Prediction errors in Multi-Class Classification Algorithms
Jinfeng Rao
Computer Science and Technology
Mentors and/or Co-Authors: Nagiza Samatova
Computer Science-Engineering

Prediction using historical databases frequently occurs in significant modern applications such as global climate forecast. Traditional data mining approaches focus on designing a new classifier to improve prediction accuracy, while there is a bottleneck under limited training data and random noises. In this paper, we propose a new method DETECTOR to detect and correct prediction errors of results generated by an existing classification algorithm. DETECTOR is in view of whole-part principle between target-system and non-target system. DETECTOR consists first of applying an existing classifier to generate the non-target system predictions, and finally deriving the conflicts with target system and taking appropriate correction action. Experimental results show about 5% prediction accuracy increase in seasonal forecasting of tropical cyclones, hurricanes, rainfall of different areas.

Session 2, A13
Is link signature dependable for wireless security?
Wei Shen
Information
Cheng Lei
Mentors and/or Co-Authors: Huaiyu Dai
Electrical & Computer Engineering

The security aspect of wireless communication network is now drawing people's attention for wireless communication's increasing widespread use. As one of the most fundamental issues, effective creation of shared secret between two communication parties establishes the basis of transceiver identifications, message integrity, etc. The Link signature, as a physical layer security mechanism, which uses the unique and reciprocal wireless channel characteristics between a pair of transceivers to generate the sought-after common secret, is a possible way of shared secret. Our research endeavors to explore whether the link signature is dependable. Specifically, the goal of our research is to show the vulnerability of the link signature and the fact that multiple attackers will further enhance the attack as compared to a single attacker. We start from verifying the fact that two receivers' channel correlation could be non-negligible even when they are separated over half a wavelength and when attackers take advantage of the space channel correlation, security of the link signature itself may become not worthy of confidence. In addition, how multiple collaborative attackers can utilize the channel correlation to degrade the security of link signature is further demonstrated. Moreover, we endeavor to explore the mathematical relation between the channel correlation and the corresponding receiver spatial separation, through modeling/measuring the Power Azimuth Spectrum (PAS) of the incoming signal. Also, how the strength of Line of Sight (LOS) component will affect the channel correlation is instantiated to motivate the design of more advanced attacking/defending schemes.

Session 2, B12
A Recombineering Gene System in Arabidopsis
Zhaoyue Shi
Biomedical
Mentors and/or Co-Authors: Jose Alonso
Genetics

The goal of my project is to generate whole-gene GFP fusions by means of recombineering. The recombineering technology utilizes a homologous
recombination system engineered in bacteria to manipulate any DNA sequence carried in the bacteria. This methodology has several advantages when compared with other classical approaches. For example, the same experimental conditions can be used for any gene independently of its size. It also allows for the manipulation of large DNA fragments ensuring the presence of all regulatory sequences of the gene of interest. Specifically, my project consists of tagging with a reporter a set of Arabidopsis genes related to the biosynthesis and transport of the plant hormone auxin. The genes contained in large transformation-competent bacterial artificial chromosomes (TACs) are first introduced by electroporation into the recombinining E. coli strain SW105. Existing recombineering cassettes are amplified by PCR using primers containing the required 50 nt gene-specific sequences necessary to target the cassette to the desired location in the gene of interest. These PCR fragments are then electroporated into E. coli and recombination is induced by heat shock to introduce the reporter gene into the desired location in the gene of interest. Next, the selection marker present in the recombineering cassette is removed by means of an inducible flipase also engineered in the SW105 E. coli strain. Finally, upon sequence verification, the modified TAC clones are transferred to Agrobacterium. These Agrobacterium strains will then be used to transform plants and to study the expression patterns of the genes of interest.

Session 2, A9
Surface-engineered Alumina Particles as Phosphate-selective-hemofiltration Media in Hyperphosphatemia Treatment
Shangchi Tsai Material Science and Engineering
Mentors and/or Co-Authors: Marian McCord Textile Engineering Chemistry and Science

Hyperphosphatemia is one of the most serious complications in End Stage Renal Disease (ESRD) patients. It may bring about cardiovascular diseases and increase the mortality. There are many reasons that lead to hyperphosphatemia, including the reduction in renal excretion, increased absorption in gastrointestinal tract, food, and drug. The most significant reason is reduction in renal excretion. Current methods to control blood phosphates, including hemodialysis, dietary phosphate restrictions, and phosphate binding medications, are not satisfying to control the patients’ blood phosphate to reach clinically acceptable targets. The ultimate goal of this research is to develop some phosphate-selective filtration media to create a safe, effective phosphate adsorptive device, which will be integrated in the hemodialysis process. In this study, highly porous alumina particles, with surface treated by trimesic acid (TMA), were tested for their morphologies, phosphate adsorption capacities and blood compatibilities. Effect of particle diameter, surface area and phosphate concentration were studied. Results showed that the surface-engineered alumina particles demonstrated excellent phosphate adsorption in both buffer solution and bovine whole blood. The material is hence promising in hyperphosphataemias and will be used in the hemofiltration device in future studies.

Session 2, D15
Exploiting the parallel computing power for circuit simulation
Bichen Wu Microelectronics
Mentors and/or Co-Authors: William Davis Electrical & Computer Engineering

Two parallel circuit simulation methods are compared. As scale of integrated circuit increases in the way predicted by Moore’s law, circuit simulation is facing severe challenge of growing complexity. On the other hand, parallel computing now contributes the major increase of computing ability. Thus, developing parallel circuit simulation method is necessary and urgent. Time-Domain Segmentation Method partitions simulation task in time domain, execute each partitions in parallel, and provides a linear speed-up for circuits with stable, periodic property. Examples are Amplifier, FLASH, SAR and Sigma-Delta ADC. Delay-Based Circuit Partitioning exploits inherent delays in circuits. A state-variable based circuits delay element is presented which implements the coupling between two spatially or temporally isolated circuit partitions. The partitioned sub-circuits are distributed to different cores of a shared-memory multi-core processor and solved in parallel. These two methods are implemented under fReEda framework on a group of circuits, and results are presented.

Session 1, A17
High frequency high power transformer winding conduction loss optimization using ANSYS
Ningjia Wu Electrical Engineering
Mentors and/or Co-Authors: Alex Huang Electrical & Computer Engineering

For the high frequency high power transformer, usually copper sheet is used for the high current side winding, in which the current density distribution is not uniform and will be determined by the magnetic flux generated by the winding current itself as well as external magnetic field. As the current frequency goes up, skin effect and proximity effect will make the conductor equivalent AC resistance much higher than its DC resistance. Due the complexity of the transformer geometry, it is hard to estimate the winding AC resistance under different frequencies by calculation. In this paper, the above AC resistance has been simulated through ANSYS 2D Finite Element Method (FEM) simulation, which reveals the relation between the winding AC equivalent resistance and winding current
frequency. The current density distribution for the winding copper sheet intersection has also been simulated under a specific frequency. Strategies to reduce copper sheet conduction loss by using either multilayer thin copper sheets or one layer thick copper sheet have been studied and compared. The simulation results will be verified through the experiment measurement.

Session 2, C11
An effective numerical method based on PMP and HJB equation
Yu Xia Mathematics and Applied Mathematics
Mentors and/or Co-Authors: Negash Medhin Mathematics

The aim of this research is to design an effective numerical scheme for optimal control problems. Depending on the existence of optimal control, a currently popular scheme to solve optimal control problems is the shooting method, which is based on Pontryagin’s Maximum Principle. Pontryagin’s Maximum Principle is part of the necessary conditions that an optimal control along with corresponding optimal trajectory of a control problem must satisfy. In Pontryagin’s maximum principle the adjoint variable, which is part of the necessary conditions, is not determined at the initial point of the time horizon. Instead it is known at the end of the time horizon. Thus, the optimal state and adjoint variable constitute a boundary value problem of coupled differential equations. The Hamilton Jacobi Bellman Theory provides a characterization of the optimal value of the objective functional based at points of the time and space coordinate system. This optimal value is called the value function. It satisfies a first order partial differential equation. It is, in general, difficult to solve this partial differential equation. However, a rough approximation can be obtained by numerical computation. The approximate value function can then be used to make a useful guess of the initial value of the adjoint problem improving the effectiveness of the shooting method. I will give two examples to illustrate the approach. The first example is a general control problem and the second comes from a problem in marketing.

Session 2, A14
Simulation of Five-fold Twins Formation in Nanocrystalline Diamond Films
Fangkai Yang Information & Computing Science
Mentors and/or Co-Authors: Jay Narayan Material Science Engineering

Formation of twins in nanocrystalline metals plays a critical role in their physical properties, such as electrical and mechanical performance. For example, recent experiments show that introduction of nanotwins in ultrafine-grained metals can produce an unusual combination of ultrahigh strength and high ductility. In micro-electronic industries, twins in nano-scale grains can change the grain-boundary structure and atomic-diffusion behavior along the boundary. Stepped sites produced by twin boundaries can also provide lower energy barriers for intermediates to bind on and improve catalytic efficiency. In this project, simulation of a five-fold twin in a diamond thin-film was performed. The coordinates of carbon atoms in a five-fold twin were developed, according to the diamond crystal structure and mirror-reflection relationship of twin planes, as the original state for simulation. Hydrogen atoms were attached to the boundary carbon atoms to eliminate dangling bonds. The perfect diamond structure with the same number of carbon and hydrogen atoms was used for comparison. After simulation, several goals were accomplished as follows: 1. The defect energy was calculated using the Brenner potential. 2. The angle distribution of five-fold twins was determined, corresponding to the equilibrium structure. 3. The secondary defect (dislocation) structure along the grain boundaries of five-fold twins was explored.

Session 2, B9
Change Order’s Impact on Construction Productivity -A Data Envelopment Analysis
Hsiao-hui Yang Civil Engineering
Mentors and/or Co-Authors: Min Liu Civil Engineering

Change orders have long been identified to have an impact on the productivity in construction industry. Change orders are issued to correct or modify the original design or scope of work. Most of change orders usually are the main cause in both time and cost overrun, and loss of productivity. In this paper, we study the effects of changes on the construction productivity using Data Envelopment Analysis, (DEA), which is a nonparametric method in operations research and economics for the estimation of production frontiers. Based on a large survey database from Construction Industry, we take totals/cost scope changes and totals/ schedule scope changes as inputs and productivity, as output for this research. The contribution to the body of knowledge is that it will provide a new DEA approach to measure both multiple inputs and outputs and identify efficient input and output target data. According to this information, project managers will be able to focus on the priority easily and follow the Pareto Principle to help to improve the productivity in construction industry.

Session 2, B11
Toward Semi-Automatic Inference of Causal Regulatory Pathways in Phenomenological Physical Models
Jianing Yu Information
Mentors and/or Co-Authors: Nagiza Samatova
Climate system is inherently complex and it consists of plenty of subsystems. Those subsystems would have an influence on some specific phenomenon. A methodology is needed to infer causality between subsystems and specific phenomenon. Rainfall anomaly in the Sahel region of Western Africa is considered as a functional response of the climate system. There exists a multitude of causal association between various subsystems that drive the Sahel’s climate response mechanisms. A data-driven approach is provided in this paper to discover the key players of this complex phenomenon and infer the regulatory pathway between subsystems. Specifically, we propose methods for (a) presenting data coupling to model intrinsic interactions between subsystems, (b) applying three causal mining techniques to infer pathways of causal subsystems and define the network of causal pathways for the rainfall anomaly, and (c) implementing information fusion to incorporate results from varying applied mining methodology to get the final causal regulatory pathways. Domain science validates the correctness of the experimental results. This is a novel proposition for semi-automatic inference in phenomenological physical models.

Session 2, B15
Develop a LabView-Based Battery and Plug-in Electric Vehicle (PHEV) Data Acquisition System
Shaobo Zhang Electrical Engineering
Zijian He
Mentors and/or Co-Authors: Mo-Yuen Chow Electrical & Computer Engineering

Nowadays, the PHEV is getting more and more popular for the rising demand to use sustainable energy resources instead of fossil fuels. However, accurate estimation of the battery parameters and states (State of Charge (SOC) and State of Health (SOH)) is still a serious existing problem in the purpose of optimizing the functionality of Electric Vehicles and avoiding the drivers’ anxiety of relying on the battery power for long distance drives. In order to build a comprehensive battery testbed for demonstrating battery operation in Electric Vehicles, we have developed a LabVIEW-based Battery and Electric Vehicle Data Acquisition System. With our software connected to the hardware built by the other group, user is able not only to read all the data of the battery and the driven AC motor that needed for estimating the battery parameters and states, but also to control the dynamic emulation system by choosing different operating profiles for the motor and sending commands to switch the power between battery and grid through a graphical user interface (GUI) based in LabVIEW. Moreover, a data transmission interface is set up between LabVIEW and MATLAB/SIMULINK based on SIMULINK Interface Toolkit (SIT), which allows researchers to run their own battery estimation algorithm in MATLAB and simultaneously display the estimated parameters and states of battery on the GUI.

Session 2, D10
The Second Bassi-Relay Scheme for the Solution of Elliptical Problems with Discontinuous Galerkin Methods
Wentao Zhang Energy and Environment System Engineering
Jialin Lou
Mentors and/or Co-Authors: Hong Luo Mechanical & Aerospace Engr

The discontinuous Galerkin methods (DGMs) have recently become popular for the solution of systems of conservation laws, which are widely used in computational fluid dynamics, computational acoustics, and computational magneto-hydrodynamics.
The DGMs, originally developed for the hyperbolic type of partial differential equations, have been extended to discretize the elliptic problems, where the difficulties and challenges are how to treat the discontinuities of derivatives of solution between cell interfaces. In the present work, the second Bassi-Refay scheme (BR2), a recently developed and widely used method for the discretization of diffusion terms in the Navier-Stokes equations in the context of the DGM, is employed to solve the 1-D Poisson’s equation both analytically and numerically. It is found it critical to properly impose the boundary conditions for the BR2 scheme to obtain the desired order of accuracy. For a second-order approximation, the averaged solution at interior interfaces and interpolated solution at boundaries computed by the DG(P1)+BR2 method match with the exact solution. In addition, an error analysis indicates a formal accuracy of the numerical scheme in this study.

Session 2, D14
The beauty of polymer brushes
Shanmei Zheng Polymer

Mentors and/or Co-Authors: Jan Genzer Chemical and Biomolecular Engineering

Polymer brushes can be defined as long-chain macromolecules that are attached to the end of certain substrates by chemical bonds. The modification of surfaces with polymer brushes is now widely used to tailor surface properties such as hydrophilicity, biocompatibility and corrosion.

In my research, I make homogeneous and gradient samples on silicon wafer surfaces and grow monolayer assemblies and polymer brushes on that substrate, then try to modify the brushes with various functional groups such as amines/?zwitterions and electrolytes. After making good brushes, I use ellipsometry, water contact angle machine and GPC to characterize the surface thickness, hydrophilicity and molecular weight of the polymer chains on the samples. In addition, I’ll test the stability of polymer brushes samples in solutions under different pH and ionic strength conditions, also in the environment of marine water, try to find out how different parameters influence polymer chain tension, and to see whether the polymer brushes system is suitable for anti-fouling coatings.

Session 2, B17
The estimation of VaR in stock markets
Jinze . Zhou Financial mathematics
Xueyang Liang economics;
Zhe Zhang statistics mathematics

Mentors and/or Co-Authors: Tao Pang Mathematics

Value at Risk (VaR) is a measure of risk that has widely used in financial risk management nowadays. Since there are many models to calculate VaR, it’s necessary to find an appropriate method which can just accurately apply to Chinese stock market. Besides, we also focus on the American stock market to find the difference since it’s an open market while limitations are set in our Chinese stock market. Firstly, we choose Hushen 300 index and Standard & Poor 500 index to represent Chinese stock market and American market respectively. We calculate VaR under the assumption that the loss in one day follows the normal distribution and perform back testing using the real market data. In this way, however, VaR is always underestimated.

Then GARCH model is constructed to describe heteroskedasticity. Finally, after finding that the fat tails always occur, we use GARCH model in the calculation of VaR assuming that the loss follows student-t distribution and generalized error distribution respectively. We achieve the result that t-distribution can present the condition of Chinese market, and for American market GED-statistic is more suitable.
Session 2, B13
Adapting A Visualization of Flowing Text for Use in the Hunt Library
Tianmin Zou Computer
Jiawei Zhang
Mentors and/or Co-Authors: Benjamin Watson
Computer Science

Visualization is a form of visual communication, revealing hidden relations in data. Skimmer is a visualization tool for monitoring text streams, such as the news, blogs, Twitter, Facebook and more. It maps important words to moving agents that display themselves as circles sized by the frequency with which they occur, and that move in real time to depict live changes in data content. In our summer project, we adapted Skimmer for use on the very large displays that will be installed in the Hunt Library. Challenges included restoring Skimmer to functionality, making use of all display real estate, supporting fully automated and yet compelling display, and finding and incorporating NCSU data sources. A prototype of the text visualization system is partly finished, implemented in HTML5 and JavaScript.
Session 1, B21
Plant Parasitic (Root-knot) Nematode Infectivity
Morgan S. Barham  Biology
Mentors and/or Co-Authors: David Bird  Plant Pathology

Root-knot nematodes (RKN; *Meloidogyne* spp.) are microscopic roundworms that parasitize virtually all crop species and cause excessive yield loss. RKN penetrate host roots systems and establish feeding sites by corrupting normal plant developmental pathways. These obligate parasites require an acute awareness of host and environmental biology for optimal growth. Plant biology is ultimately controlled by circadian rhythms and we hypothesize that RKN biology is regulated by host biology in this manner. To better understand nematode perception of hosts, a time course study was conducted to assay nematode root-penetration as a function of circadian rhythms. Briefly, experiments were conducted in complete random designs and the plant host (*Medicago truncatula*) was infected with RKN second stage juveniles at various intervals over a 24hr period. Nematode infection (penetration) was assayed 24hrs after inoculation by quantitative PCR, and adjusted relative to total plant material. Statistical power was achieved by multiple technical (>6 plants per time point) and experimental replicates. Significance was determined by student t-test. The results of these assays may shed light on RKN perception of host and possibly increase the efficacy of RKN management practices.

Session 1, B13
Silence of the Worms...via RNAi
Harper E. Niver  Biology
Mentors and/or Co-Authors: Rick Davis  Plant Pathology

Species of *Meloidogyne*, the root-knot nematodes (RKN) are microscopic roundworms that attack the roots of many economic and staple crops worldwide including tobacco, *Nicotiana tabacum*. The RKN parasitism gene *16D10* encodes an effector peptide that is secreted into selected plant root cells by the nematode to help induce elaborate changes in those plant cells. One drastic change includes the formation of giant-cells that are required for nematode feeding and life cycle. Post-transcriptional gene silencing using RNAi against *16D10* in transgenic *Arabidopsis thaliana* with expression driven by the constitutive CaMV35S promoter has been shown to dramatically reduce successful RKN infection of plant roots. The purpose of this study was to create three RNAi constructs, *pART27:NtCel7:16D10I:PDF*, *pART27:NtCel7:16D10I:PDF*, and a control construct, *pART27:NtCel7:GFPRNAi:PDK*, that will be used to produce plants genetically-engineered for resistance to RKN. *NtCel7* is a tobacco cellulase promoter that is upregulated in giant-cells, allowing for RNAi expression to be targeted more specifically to the feeding cells. The RNAi constructs were created through cloning with the use of restriction enzymes. Gel electrophoresis of full and digested constructs followed by DNA sequencing confirmed the correct identity of constructs. Successful constructs transformed into *Agrobacterium* are used to develop transgenic *Arabidopsis thaliana* and tobacco lines, which are then brought to homozygosity for RKN infection and resistance assays.

Session 2, D3
Nematodes: a suitable home for viruses? A potential opportunity for biocontrol
Casey Loraine Ruark  Molecular Biology
Mentors and/or Co-Authors: Steven Lommel  Administration-Research Service

Soybean cyst nematode (SCN) or *Heterodera glycines*, is responsible for infecting sixty-percent of soybean acreage in North Carolina and dramatically reducing yields from four to eight-percent each year (Koenning and Wrather, 2010. Plant Health Progress). Recently, four RNA viruses were reported in three highly inbred Tennessee (TN) lines of SCN (Bekal et al., 2011. J Gen Virol). We wanted to determine if NC nematodes are also a reservoir for viruses by testing SCN races specific to NC. Total RNA’s were extracted from four races (1–4) of inbred NC SCN lines. Primers specific for each negative-sense RNA virus were used to deduce if viral sequences were present within SCN second stage juveniles. Initial quantitative real-time PCR (qRT-PCR) results suggested that at least 2 of the reported viral sequences were also present within NC SCN races. A second set of PCR primers based on the viral sequences was utilized to produce larger PCR products to validate the original qRT-PCR results. These PCR products were cloned and sent for sequence analysis. Viral sequences were detected for SCN nyavirus within race 4, as well as SCN phlebovirus within races 2–4. SCN nyavirus showed 100% identity between TN strains and NC race 4. There was sequence variation between TN and NC isolates for SCN phlebovirus in races 2–4. Lastly, there was further confirmation of SCN phlebovirus sequences in races 2 and 3 from detection with longer primers. The discovery of viral sequences may lead to a novel avenue for biocontrol of *Heterodera glycines*.

Session 1, A16
CSI Dublin: Hunt for the Potato Killer
Kathryn Ann Schneberg Biology with a concentration in botany

Mentors and/or Co-Authors: Jean Ristaino Plant Pathology

As the current most efficient way to amplify sequences of DNA, the polymerase chain reaction (PCR) followed by gel electrophoresis has become a widespread and crucial lab technique. Yet, most students learn this technique in their later years of their undergraduate degree. This project is aimed to teach high school students the principles and process of DNA extraction, PCR and gel electrophoresis. Five lessons have been outlined where upper level high school students will learn about the plant pathogen responsible for the Irish Potato Famine (Phytophthora infestans). Students will track the history of the pathogen spread throughout the United States and study details about the social and agronomic influences of the Great Famine. After understanding the societal impact of the Great Famine, the students will learn to isolate the pathogen and they will run a PCR and gel electrophoresis on DNA extractions from healthy and infected potato leaves. The students will learn about plant pathogens, food security, responsible farming practices, and common molecular lab techniques. This project is a validation of the lesson plan originally developed by Keenan Teaching Fellow, Rebecca Hite.

Session 1, A8
Screening for Resistance to Wheat Stem Rust: Locally Combating a Global Epidemic
Anthony John Wenndt Biology

Mentors and/or Co-Authors: Christina Cowger Plant Pathology

Puccinia graminis f. sp. tritici, causal agent of wheat stem rust, is a biotrophic basidiomycete fungus with aerially dispersed uredospores capable of traversing vast distances. In 1999, race Ug99 was identified in Uganda and found to be virulent against several previously effective wheat resistance genes. Subsequent spread of Ug99 and derived races in Sub-Saharan Africa and the Middle East has devastated wheat production and made the development of resistant wheat varieties an issue of utmost importance for maintaining food security. To help introgress resistance from wild wheat relatives into modern, hexaploid wheat, two U.S. races of the pathogen were screened against segregating wheat populations. Families with potential resistance from Triticum monococcum accession PI427443 backcrossed into the adapted soft wheat cultivar Jamestown were screened for resistance to rust race RCRS in a growth chamber. In total, 21 families were screened, with variety McNair 701 used as the susceptible control. Seven- to 10-day-old seedlings were inoculated with a dilute solution of Soltrol® 170 and uredospores, using an atomizer. Infection was rated after 14 days. Data collection is underway. Additional screening was conducted on multiple, segregating, single-seed descent families of hexaploid wheat using race QFCS, with the goal of identifying adult-plant resistance. Further, an unknown isolate of the pathogen collected from winter wheat near Aurora, North Carolina, in 2012, was race-typed. For race identification, the standard differential set was inoculated with the isolate in a randomized, complete block design with three replicates. Preliminary results suggest the isolate is QFBSC, a common U.S. race.

Session 1, C5
Genetic structure of modern U.S. genotypes of Phytophtora infestans
Meghan Rebecca Wyatt Biology

Mentors and/or Co-Authors: Jean Ristaino Plant Pathology

The oomycete, Phytophthora infestans (Mont.) de Bary, is the plant pathogen responsible for late blight, which causes billions of dollars in crop damage each year. The fungus-like organism was first described in the 1840s when it decimated Ireland’s potato crop during the famine. Modern isolates of this pathogen have been collected, isolated, and stored in labs around the U.S. so that the genetic diversity of the pathogen can be analyzed. The purpose of this study was to examine the genetic structure of modern strains of P. infestans that are prevalent in the US based on four nuclear genes: Intron Ras, Ras, AVR2 (as well as its haplotype AVR2-like), and AVR3. The two avirulence genes allow the pathogen to infect resistant plants containing R2 and R3 genes. DNA was extracted from 61 samples and amplified using PCR. The PCR product was sequenced and analyzed with SNAP Workbench. Phylogenetic trees were made to examine the evolutionary relationships among the genotypes. This information along with phenotypic data (fungicide sensitivity) will be used to help track outbreaks of the disease and recommend management options to growers via the USAblight.org web portal.
Research Experience for Undergraduate Mathematics: Modeling and Industrial Applied Mathematics

Session 1, D2
Chaotic Dynamics of an Epidemic Model with Periodicity
Veronica J Bunn Mathematics
Tyler Wales Mathematics;
Teresa Shoemaker Mathematics;
Christina Davis Mathematics
Mentors and/or Co-Authors: John Franke Mathematics

We analyze the bifurcation behavior of an SIS model with 2-periodic constant demography. A traditional non-periodic SIS model does not result in period doubling bifurcations; however, when adding periodicity the model undergoes a period doubling route to chaos. We numerically detect the first period doubling bifurcation as a function of one and multiple parameters. We simplify the original transcendental equation by using the Taylor approximation of the transmission rate. The total population is globally attracted to a 2-cycle, so we must use the 2-fold composition of the infected class equation to encompass both population values.

By using the Period Doubling Bifurcation Theorem, we are able to analytically find parameter values that give rise to these bifurcations. The two major conditions in this theorem reduce to two cubic equations in I, the infected class, and the 5 model parameters. Using conditions imposed on the parameters in our model together with two other reasonable conditions on the parameters, we establish that each of the cubic equations has one real root. Equating these real roots gives an equation in terms of our parameters that, when satisfied, results in a period doubling bifurcation.

Session 1, B3
Assessing Wolbachia Releases in an Age-Structured Population
Jorly Chatouphonexay Mathematics
Breanne Hollie Zoology;
Marie Encarnacion Zoology
Mentors and/or Co-Authors: Alun Lloyd Mathematics
Michael Robert Biomathematics;
Timothy Antonelli Biomathematics

Dengue fever, which affects 50-100 million people each year, is transmitted primarily by the bite of the mosquito, Aedes aegypti. Current measures for controlling Aedes aegypti have had limited success in controlling the disease and are expensive to maintain long-term. Thus, novel control strategies have been proposed. One such strategy involves introducing mosquitoes infected with the bacterium Wolbachia, which reduces the mosquitoes' ability to spread the virus, due to both lifespan-shortening effects and interference with dengue replication within the mosquito host. Wolbachia is a maternally inherited bacterium whose spread is facilitated by cytoplasmic incompatibility (CI), which causes unviable offspring to be produced when a Wolbachia-infected male mosquito mates with an uninfected female. This leads to infected females producing more viable offspring than uninfected females when infected males are present. We developed an age-structured population dynamic model, based on a population genetic model developed by Huang et al. (2009), that incorporates density dependence to study the spread of Wolbachia-infected mosquitoes in a native population. We studied the effectiveness of releases of different age classes (e.g. immatures vs young adults vs older adults), and relate these results to the reproductive values of the age classes.

We examine the release threshold to determine the age-specific minimum initial release frequency needed in order to guarantee that Wolbachia invades the native population entirely. We compared and verified the simulations from this model to results obtained from an analogous matrix model.

Session 1, C2
Principal Component Analysis in Financial Risk Management

Alphabetical Listing of Lead Student Presenters by Program
The volatility of stock returns is important to financial institutions and regulatory bodies, both of which aim to accurately measure the risk of investments. Value at Risk (VaR) is a common measure of portfolio risk that is used today. We begin by calculating VaR under the assumption that daily stock returns are normally distributed. The calculations under this method underestimate risk because the distribution of daily returns has heavier tails than the normal distribution. We improve the accuracy of calculations by considering distributions with heavy tails, such as the Student’s t-distribution. Expanding the model based on Student’s t to consider a portfolio of assets likewise results in successful calculations. The implementation of a GARCH model to allow for dynamic VaR also improves accuracy with respect to both in-sample and out-of-sample testing. We then evaluate the method of Principal Component Analysis (PCA) for dimension reduction and discover that dimensionality can be significantly reduced without sacrificing much accuracy. Finally, we apply PCA to find macroeconomic factors that explain asset price movements in particular industries and market indices, and we discover that both the industries and indices share many explanatory factors.

Session 2, C6
Tournaments and Tournament Solutions
Ran Ji Mathematics
Melanie Panosian Mathematics;
Michelle Maiden Mathematics
Mentors and/or Co-Authors: Molly Fenn Mathematics
Allison McAllister Mathematics;
Scott Moser Government

Social Choice Theory is a field where political science and mathematics intersect. This field deals with voter preferences, measured through aggregate comparisons of alternatives. Such comparisons produce majority preference relations where, for example, candidate x is majority-preferred to candidate y. Combining these relations yields a finite tournament, which can be represented as a complete, asymmetric, directed graph. There are many fields in which tournaments arise, such as sports, computer science, political science, and economics. Since majority-preferences are often not transitive, problems arise when choosing winners in a tournament. A cyclic relationship between candidates creates an unclear ranking of the alternatives. Mathematical tools can be employed to study different methods of choosing winners, called tournament solutions. We studied three such solutions in depth: the Banks Set, the Heresthetically Stable Set, and the Weak Uncovered Set. Historically, the Banks set is important because it is the set of possible outcomes under any given agenda, assuming voters are sophisticated when casting their ballots. A newly proposed solution, the Heresthetically Stable Set, is a refinement of the Banks Set that additionally considers the relative strength of candidates with respect to their dependence on each other. We began by considering common properties of tournament solutions as they apply to the Heresthetically Stable Set. Next, we looked at containment relations between the Heresthetically Stable Set and the Weak Uncovered Set. Through this process, we have arrived at several new results about the Heresthetically Stable Set and tournaments in general.

Session 2, C22
Stochastic Modeling of Wolbachia Infected Mosquitoes
John Andrew Lombardi Math
Sean Plummer
Mentors and/or Co-Authors: Alun Lloyd Mathematics
Timothy Antonelli Biomathematics;
Michael Robert Biomathematics

Dengue fever, caused by a mosquito-borne virus, affects millions of humans each year, and there are numerous public health costs and concerns associated with the spread of the disease. Currently, there are no prophylactic drug treatments or vaccinations available to guard against infection, so control of the disease relies primarily on controlling the principal mosquito vector, Aedes aegypti. One proposed vector control strategy is to introduce mosquitoes infected with the bacterium Wolbachia into a native mosquito population. Mathematical modeling of mosquito population dynamics, dengue epidemiology, and Wolbachia dynamics can help assess the feasibility of Wolbachia-based vector control methods for controlling dengue fever. We developed a stochastic model to study the spread of Wolbachia in a mosquito population and used numerical simulations and analytic approaches, when possible, to quantify whether introducing Wolbachia into a native population is a viable and effective strategy.

Session 2, D6
Physiologically-Based Toxicokinetic Model of PCBs in Zebrafish
Star-Lena Jaramillo Quintana Mathematics
Jamal Horne Mathematics;
Emmalena Illia Mathematics
Mentors and/or Co-Authors: Hisham El-Masri
Systems Biology Branch, Integrated Systems Toxicology Division (ISTD)

Traditional toxicology studies investigate the impact of
environmental pollutants on human health. These investigations require the use of costly and time consuming experiments using rats or mice. An alternative to these models is the use of zebrafish because of their low cost and rapid maturity rate. However, data obtained from zebrafish studies need to correlate to data generated by mammalian systems. We seek to demonstrate toxicokinetic similarities between zebrafish and rats using physiologically based toxicokinetic (PBTK) modeling. These models incorporate mathematical descriptions of significant in vivo toxicokinetic determinants for absorption, distribution, metabolism, and excretion (ADME) of chemicals. We constructed a PBTK model describing the toxicokinetics of PCB 18. Our model was used to simulate the changing concentration in zebrafish in comparison to literature data where zebrafish were kept in water with a constant concentration of PCB 18 for thirty days, then moved to chemical-free water for the next thirty days. We then used the PBTK model to estimate unknown parameters such as in vivo liver metabolism. The PBTK model performed well when compared to literature data. This model can be used for comparisons of in vivo metabolic rates for PCB 18 among various species.

Session 1, C7
Polarized Morphogenetic System (PMS)
Daniel S Savelle Mathematics and Economics
Lucas Ortiz Mathematics;
Teresa Portone Mathematics
Mentors and/or Co-Authors: Sharon Lubkin Mathematics

Epithelial morphogenesis is driven by the formation, growth, and bending of thin sheets of cells with distinct interior (apical) and exterior (basal) sides. In this study we attempted to improve on past particle-based cell models to form a model of morphogenesis based on a two-particle polarized cell structure. We began by modeling a stable cyst-like structure. We then tested and calibrated the viscoelastic properties of our model by compressing the cyst like structure to simulate cell growth and a theoretical version of a basal lamina. With minimal refinement, this model should generalize to 3D.

Session 1, D7
HIV Patient Health Prediction Using Data Mining Techniques
Glenn Daniel Sidle Mathematics
Jay Xu Applied Mathematics and Statistics;
Kayla Coleman Mathematics;
Lauren Grana Math and Physics
Mentors and/or Co-Authors: John David Applied Mathematics
Hien Tran Mathematics

Many models of HIV infection require some sort of underlying assumption about the biological mechanisms of infection, and simple statistical techniques often struggle to capture the nonlinear dynamics of this system. In order to capture these nonlinear dynamics without impressing biological assumptions on the system, we will examine the use of data mining techniques. The techniques we use are artificial neural networks, a type of generalized nonlinear regression modeled after biological neural networks, and regression trees, a type of data mining procedure modeled after a decision flow chart. We will use these techniques based on past patient CD-4 count, CD-8 count, viral load, and drug adherence to predict future patient health. We will describe techniques for creating both patient-specific models and a model created for all patients. After analyzing the model's ability to predict both short and long term patient health, we will describe how we can use these techniques to create a “virtual” clinical cohort on which we can evaluate the impact of different clinical trials. Finally we will show how this model can be used by physicians to understand how to optimally treat each patient.

Session 1, C3
Cardiac baroreflex in humans and rats: mathematical modeling of complex physiological mechanisms
Mia Sato Tackney Mathematics
Kaitlyn Ferguson Mathematics;
Patrick Daniels Mathematics and Economics;
Kheri Hicks Mathematics and Computer Science
Mentors and/or Co-Authors: Adam Mahdi Mathematics

The regulation of blood pressure by the cardiovascular system is an intricate and extensive process. In the afferent component, baroreceptors detect changes in arterial pressure and relay signals to the central nervous system. In the efferent component, sympathetic and parasympathetic nerves control heart rate response. While empirical investigation alone into this system poses difficulties, mathematical modeling can provide qualitative and quantitative insight into essential physiological mechanisms.

Firstly, we test a recently developed baroreceptor model for its ability to fit data and demonstrate known pressure-response relationships. Secondly, we propose an improved model of the heart rate with an increased capacity to fit data. The integration of the baroreceptor model with the heart rate model results in a comprehensive representation of the cardiovascular system. Lastly, parameters of the overall model are estimated across distinct strains of rats and compared between rats and humans.
Session 2, C19
Iterative Consensus Clustering: An Innovative k-Determining Clustering Algorithm
Kevin Eapen Valakuzhy Mathematics / Computer Science
Mindy Hong Applied Mathematics / Economics;
Robert Pearce Applied Mathematics / Physics
Mentors and/or Co-Authors: Carl Meyer Mathematics

Cluster Analysis is a field of Data Mining used to extract underlying patterns in unclassified data. Many existing clustering algorithms are inadequate in that they require knowledge of how many clusters exist in the data, otherwise known as k, and that their underlying assumptions make them ineffective in certain situations. The method of Consensus Clustering seeks to rectify the latter problem by incorporating the results of multiple clustering algorithms to achieve one final grouping. We investigate a novel method of Iterative Consensus Clustering (ICC) which solves both issues. By clustering the consensus matrix as if it is a new set of data, we can achieve agreement between the underlying algorithms. In addition, by using ICC instead of traditional consensus clustering, the accuracy of k obtained through the use of the eigengap statistic is improved.

Session 1, A9
Orders and orbits of generalized symmetric spaces
Jasper O. Weinrich-Burd Mathematics
Andrew Tollefson Mathematics and Physics;
Russell Stinson Mathematics
Mentors and/or Co-Authors: Aloysius Helminck Mathematics

Symmetric spaces were originally formulated as quotients of real matrix groups. We generalize this theory by studying a similar quotient of the permutation group $S_n$. There exists a bijection that maps this quotient to a nice subset $Q$ defined by a certain group action of $S_n$. It is known that $Q$ is a subset of a larger set $R$, also within $S_n$. The precise properties of $Q$ and $R$ are not well understood. We present several new theorems and conjectures that classify the elements and sizes of $Q$ and $R$. We also investigate the structure of $R$ as it breaks down into orbits under the same group action of $S_n$.

Session 2, C23
Extrapolation Techniques Using Physiologically Based Pharmacokinetic (PBPK) Modeling
Charles Andrew Wilson Mathematics
Lider Leon Discrete Applied Mathematics and Mathematics of Finance;
Lauren Beesley Mathematics
Mentors and/or Co-Authors: Marina Evans Pharmacokinetics;
Megan Sawyer Mathematics;
Christopher Eklund US EPA

Lindane is a neurotoxin that has been used as an agricultural pesticide and for pharmaceutical treatment of lice and scabies. Physiologically based pharmacokinetic (PBPK) models are used in applications of risk assessment. A PBPK model for lindane is generated and optimized over time-course data for Wistar rats when considering an oral dosage of lindane. Optimized values in rats, such as partition coefficients for blood and skin ($P_{bld} = 1.7252$ and $P_{skin} = 26.219$) are then extrapolated to adult humans, and the model is fit to the time-course data for humans. Also, an in vitro model for absorption of lindane through the skin is developed, which includes a follicular compartment. Optimized parameters from this model, such as the uptake rate into the follicular compartment from the media reservoir (10.1222 (hr-1cm-2)), are extrapolated to an in vivo study. Acceptable ranges for $K_{media}:skin$ in in vivo are explored using optimized in vitro values and literature values. Our results provide methods to model not only lindane, but also many other chemicals. Disclaimer: This is an abstract or a proposed presentation and does
not necessarily reflect EPA policy. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.
Characterization of the Morphology and the Model Drug Release Profile of Polymer Nanofibers Made by Shear Nanospinning

Ransom Kumar Kochhar Chemical Engineering
Mentors and/or Co-Authors: Orlin Velev Chemical and Biomolecular Engineering

Shear nanospinning utilizes the shear-driven extension of polymer solution droplets in fluid flow to fabricate nanomaterials. By using this process invented in the Velev group at NC State University, we fabricated fibers with micron and sub-micron sized diameters. The sizes, morphologies, and drug release characteristics of these fibers are influenced by many parameters, including polymer concentration, polymer molecular weight as well as antisolvent concentration. To examine the effect of the process parameters on the nanofiber size and morphology, polystyrene fibers were prepared using solutions that contained various concentrations of the polymer. These fibers were then observed under a scanning electron microscope to view changes in size and cross-section shape. Poly(lactic acid) fibers containing the model drug rifampicin were also prepared from varying polymer concentration solutions. Immersing these fibers in a Tris-HCl buffer solution with Proteinase K facilitated the release of the drug from the fibers, while the amount of drug released was monitored over time. The results suggest that the polymer concentration in solutions used in the process strongly affects the size and morphologies of the resulting fibers. Future research will reveal the drug release dependence on the size and morphologies of the fibers.
results revealed consistent hydrogen and oxygen production. The data point out that such coatings are promising as components in future photobiological fuel cells.

Session 1, C17
Investigation of the Inverse Transition Temperature of 16GVG(VPGVG)3 Peptide System
Ramyata Upmaka Materials Science and Engineering, Biomedical Engineering
Mentors and/or Co-Authors: Yaroslava Yingling Material Science Engineering

Elastin-Like Peptides (ELPs) are highly coveted biopolymers for biomedical applications such as drug delivery. These peptides display a unique change in conformation when the temperature is raised beyond a certain value, called the inverse transition temperature (ITT), by collapsing from an extended state into aggregates. In this study the question of whether the ITT is a collective phenomenon is examined through the use of the molecular-dynamics approach. The change in end-to-end distance, radius of gyration, solvent-accessible surface area (SASA), secondary structure motifs, and hydrogen bond formation over the temperature range of 12°C - 77°C (285K-350K) was analyzed for the GVG(VPGVG)3 single peptide and the 16GVG(VPGVG)3 peptide system. The measurements were made for the 15 nanosecond timepoint of the simulations. Results indicated that the ITT seems to be a collective phenomenon with a value between 27°C-52°C (300K-325K) for the 16GVG(VPGVG)3 peptide system.
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| Session 2, D2 | **Daniel Anthony DiCorpo**  
Biochemistry & Molecular Biology | Photo-Activated Toxins in Black Sigatoka | NSF Integrative Molecular Plant Systems REU |
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| Session 1, C14 | **Erika J England**  
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| Session 1, D8 | **Brandon James Eudy**  
Chemistry | Creation of new functional ingredients by sorption of black currant polyphenols onto whey proteins | Chemistry REU Program |
| Session 2, D21 | **Eyob Abebe Eyualem**  
Biomedical Engineering | Developing a Novel Calibration Method for Electrochemical Data Using Charging Current Collected in vivo | Initiative for Maximizing Student Diversity (IMSD) |
| Session 1, D16 | **Hua Feng**  
Electrical | A simulation model and strategy for voltage source inverters in FREEDM system based on proportional-resonant control | OIA-SRE, Office of International Affairs - Summer Research Experience |
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| Session 1, A21 | **Elisabeth Wilson Foster**  
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| Session 1, D23 | **American University** | How much light does it take to kill pathogenic bacteria? | NC State Independent Researchers |
| Session 1, D20 | **Amanda Leigh Freeman**  
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Alphabetical Listing of Lead Student Presenters

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Session 1, C4 | **Ian Thomas Hill** | **Biochemistry AND Polymer and Color Chemistry** | ATM-Mediated Regulation of Rac1 | NC State Undergraduate Research Awardee |

Session 1, D6 | **Matthew Felix Hin** | **Math** | Hole Closing of a Surfactant Layer on a Thin Fluid Film | NSF Physics REU |

Session 1, C16 | **Jonathan Michael Hodiak** | **Animal Science** | IMAGINE Safe Drinking Water in South Africa: Student/Community Collaborations to Assess Nitrate Contamination in Ground Water. | OIA-SRE, Office of International Affairs - Summer Research Experience |

Session 1, A1 | **Richard Sayanagi** | **Hole Closing of a Surfactant Layer on a Thin Fluid Film** | NSF Physics REU |

Session 2, C2 | **Cynthia Kay Holland** | **Biology** | Metabolic Engineering and Biosynthesis of Limonene in Camelina sativa | NSF Integrative Molecular Plant Systems REU |

Session 2, B8 | **Yu-chien Hsu** | **Power Electronics and Power Systems** | Testing of Second Use Traction Batteries in Grid Application | OIA-SRE, Office of International Affairs - Summer Research Experience |

Session 2, D8 | **Ming-chiang Huang** | **Business Administration** | The sharing world--Collaborative Consumption | OIA-SRE, Office of International Affairs - Summer Research Experience |

Session 2, C9 | **Hsin-yu Huang** | **Plant Pathology and Microbiology** | What you eat is not just a pepper - Isolation and Identification of Microorganisms in a High Salt Fermented Pepper Sauce | OIA-SRE, Office of International Affairs - Summer Research Experience |

Session 2, D17 | **Chima U Igboho** | **Biomedical Engineering** | CNT Deposition in Microfluidic Channels | Initiative for Maximizing Student Diversity (IMSD) |

Session 2, A20 | **Mollie B Jenkins** | **Professional Biology & Industrial Chemistry** | A Novel pH Sensor Produced Via Atomic Layer Deposition on Textiles | NSF Engineering the Grid Program |

Session 2, C6 | **Ran Ji** | **Mathematics** | Tournaments and Tournament Solutions | Research Experience for Undergraduate Mathematics: Modeling and Industrial Applied Mathematics |

Session 1, C1 | **Austin Martin John** | **Statistics** | Expected minimum temperatures for NC by methods of spatial statistics to predict dates of spring | Computation for Undergraduates in Statistics Program (NCSU CUSP) |
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<td>-</td>
<td>Characterization of the Morphology and the Model Drug Release Profile of Polymer Nanofibers Made by Shear Nanospinning</td>
<td>Triangle MRSEC</td>
</tr>
<tr>
<td>Session 1, A11</td>
<td><strong>William Henry Kohlway IV</strong>&lt;br&gt;Microbiology</td>
<td>-</td>
<td>SNP discovery through Genotyping by Sequencing in Conifers</td>
<td>NC State Independent Researchers</td>
</tr>
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<td>Session 2, A19</td>
<td><strong>Jaclyn N. Kovach</strong>&lt;br&gt;Materials Science and Engineering</td>
<td>-</td>
<td>Printed semitransparent silver nanowire electrodes for flexible organic solar cells.</td>
<td>NSF Engineering the Grid Program</td>
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<tr>
<td>Session 1, B18</td>
<td><strong>Erin Jennifer Kuhl</strong>&lt;br&gt;Chemical</td>
<td>-</td>
<td>Photocathodeposition of Platinum on Silicon Photocathodes for Efficient Hydrogen Generation</td>
<td>Advanced Materials for Environmental Sustainability</td>
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<td>Session 2, C8</td>
<td><strong>Yi-Dun Lai</strong>&lt;br&gt;Production Management</td>
<td>-</td>
<td>Simulation of a Drive-through Vaccination Clinic for Disease Outbreak Response</td>
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<tr>
<td>Session 1, A20</td>
<td><strong>Adam Andrew Lee</strong>&lt;br&gt;College Transfer</td>
<td>-</td>
<td>Application of Fluorescence Spectroscopy to attempt identification of Dissolved Organic Matter in the Rocky River</td>
<td>MEAS-Wake Tech Program</td>
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<td>Session 1, D1</td>
<td><strong>Travis T Lekich</strong>&lt;br&gt;Chemistry</td>
<td>-</td>
<td>Synthesis of Heterobimetallic Compounds for the Purpose of Studying Metal to Metal Charge Transfer</td>
<td>NC State Independent Researchers</td>
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<tr>
<td>Session 2, C1</td>
<td><strong>Darryl Devon Lewis</strong>&lt;br&gt;Pharmaceutical Sciences</td>
<td>-</td>
<td>Do putative satellite DNAs from cassava replicate and/or enhance geminivirus replication?</td>
<td>NSF Integrative Molecular Plant Systems REU</td>
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<tr>
<td>Session 2, A12</td>
<td><strong>Wenbang Li</strong>&lt;br&gt;Energy</td>
<td>-</td>
<td>Fuel systems for gasoline direct injection (GDI) applications</td>
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<tr>
<td>Session 2, C10</td>
<td><strong>Yingshuang Li</strong>&lt;br&gt;EE</td>
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<td>Robustness of 1200V SiC MOSFET in Short-Circuit Modes</td>
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<tr>
<td>Session 2, D12</td>
<td><strong>Yiliang Lin</strong>&lt;br&gt;Polymer Science and Engineering</td>
<td>-</td>
<td>The Fabrication of Ultra-Stretchable Metal Wires</td>
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| Session 2, A15 | **Wanxi Liu**  
Optical | Path Planning for Object Recognition | OIA-SRE, Office of International Affairs - Summer Research Experience |
|---------------|-----------------|---------------------------------|---------------------------------------------------|
| Session 1, A18 | **Elliott Nelson Locke**  
Chemical and Biomolecular Engineering | Synthesis and Studies of a Hexacoordinate Bis(2,2?-bipyridine)-2,2?-bipyrolesilicon(IV) Complex | NC State Independent Researchers |
| Session 2, C22 | **John Andrew Lombardi**  
Math  
**Sean Plummer**  
Chemistry | Stochastic Modeling of Wolbachia Infected Mosquitoes | Research Experience for Undergraduate Mathematics: Modeling and Industrial Applied Mathematics |
| Session 1, C24 | **Jialin Lou**  
Mechanics | A Reconstructed Discontinuous Galerkin Method for Elliptical Problems | OIA-SRE, Office of International Affairs - Summer Research Experience |
| Session 1, A7 | **Kendall J Lough**  
Biology | The Role of p38 MAPK in LPS-Induced MARCKS Expression | NC State Independent Researchers |
| Session 2, A17 | **Chenlu Ma**  
Geographic Science(Land Resource Management) | Recent Trend of China's Housing Prices | OIA-SRE, Office of International Affairs - Summer Research Experience |
| Session 2, A6 | **Yan Ting Mak**  
Biochemistry | Efficacy of Salmonella Detection in Poultry: Evaluating Different Sampling Methods to Minimize Number of Animal Use | NC State Independent Researchers |
| Session 1, D3 | **Shengkai Alwin Mao**  
Undeclared | A Quest For An Elusive Companion Star | NSF Physics REU |
| Session 2, B2 | **Lynnicia Naomi Massenburg**  
Plant Biotechnology | Roles of Iron Deficiency Response Proteins PYE, ILR3 and BTS in Arabidopsis Roots | NSF Integrative Molecular Plant Systems REU |
| Session 1, B14 | **Andrew Mark McLean**  
Biological Sciences - Human Biology Concentration | Progress Toward the Synthesis of Analogues of Alotamide A | NC State Independent Researchers |
| Session 2, B18 | **Kelsey Elizabeth Meyer**  
Physics/Materials Science and Engineering | Investigation of Phase Separation in Copper-Silicon Thin Films | Advanced Materials for Environmental Sustainability |
| Session 1, A23 | **Shaneice Renee Mitchell**  
Biochemistry | Ion Concentration Effects on Centroptilum triangulifer | NC State Undergraduate Research Awardee |
| Session 2, A16 | **Yao Nie**  
Environmental | Effectiveness of silver-impregnated carbons and ion exchange resins for the removal of bromide | OIA-SRE, Office of International Affairs - Summer Research Experience |
| Session 2, C12 | **Bo Ning**  
Mechanical | The development of image processing algorithms to determine the concentration and size distribution of radioactive microspheres | OIA-SRE, Office of International Affairs - Summer Research Experience |
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<th>Session, Location</th>
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<th>Major(s)</th>
<th>Title</th>
<th>Program/Initiative</th>
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<tr>
<td>1, B13</td>
<td>Harper E. Niver</td>
<td>Biology</td>
<td>Silence of the Worms...via RNAi</td>
<td>Plant Pathology Kelman Scholars</td>
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<tr>
<td>1, B15</td>
<td>Currey Allen Nobles</td>
<td>Chemistry</td>
<td>Synthesis, Characterization, and Metalation of Cycloparaphenylenene</td>
<td>Chemistry REU Program</td>
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<tr>
<td>1, A15</td>
<td>Elias Kemuel Pabûn-Vázquez</td>
<td>Chemistry</td>
<td>Tyrosyl Radical Formation in Dehaloperoxidase: Sacrificing Substrate Reactivity for Enzyme Stability</td>
<td>NC State Independent Researchers</td>
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<tr>
<td>1, B9</td>
<td>Nicholas John Panzena, B.S. Geology</td>
<td></td>
<td>Controlling Factors of South Central Crete's Topography</td>
<td>NC State Independent Researchers</td>
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<tr>
<td>1, C18</td>
<td>Kelly Rochelle Perkins, Plant Biology</td>
<td></td>
<td>Genetic manipulation of the CYP71AV1 gene expression to understand biosynthesis of artemisinin and increase production of the antimalarial medicine</td>
<td>NC State Independent Researchers</td>
</tr>
<tr>
<td>2, A18</td>
<td>Michelle Elizabeth Phillips, Mechanical Engineering; Sarah Butz Industrial Engineering; Jamie Yannayon Industrial Engineering; David Lenz Mechanical Engineering</td>
<td></td>
<td>Thrill-Cost Analysis of Roller Coaster Elements</td>
<td>NC State Undergraduate Research Awardee</td>
</tr>
<tr>
<td>2, A21</td>
<td>Angela Lucy Picciano, Chemistry</td>
<td></td>
<td>Synthesis of 2-Aminoimidazole Biofilm Inhibitors</td>
<td>Chemistry REU Program</td>
</tr>
<tr>
<td>1, A2</td>
<td>Michelle Theresa-Ann Putman, Chemistry</td>
<td></td>
<td>What keeps the water inside the egg patty on your Egg McMuffin? Describing the mystery of the water holding properties of gel systems</td>
<td>NC State Undergraduate Research Awardee</td>
</tr>
<tr>
<td>2, C15</td>
<td>Haoyuan Qu, Electrical Engineering</td>
<td></td>
<td>Battery Management System Testbed for PHEV Applications: PHEV Emulator</td>
<td>OIA-SRE, Office of International Affairs - Summer Research Experience</td>
</tr>
<tr>
<td>2, D6</td>
<td>Star-Lena Jaramillo Quintana, Mathematics; Jamal Horne Mathematics; Emmalena Illia Mathematics</td>
<td></td>
<td>Physiologically-Based Toxicokinetic Model of PCBs in Zebrafish</td>
<td>Research Experience for Undergraduate Mathematics: Modeling and Industrial Applied Mathematics</td>
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<tr>
<td>2, C4</td>
<td>Morjan Bassam Rahhal, Mechanical Engineering</td>
<td></td>
<td>Modeling Biological Systems: Evaluation of Systems Biology Toolbox and Wolfram System Modeler</td>
<td>Initiative for Maximizing Student Diversity (IMSD)</td>
</tr>
<tr>
<td>1, B7</td>
<td>Lydia N Raines, Animal Science</td>
<td></td>
<td>Optimization of Jurkat Cell Transfection Using a Liposomal Reagent</td>
<td>NC State Independent Researchers</td>
</tr>
<tr>
<td>2, D11</td>
<td>Jinfeng Rao, Computer Science and</td>
<td></td>
<td>Detection and Correction of Prediction errors in Multi-Class</td>
<td>OIA-SRE, Office of International Affairs - Summer</td>
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Alphabetical Listing of Lead Student Presenters
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<th>Session, Order</th>
<th>Name</th>
<th>Major/Concentration</th>
<th>Title</th>
<th>Institution/Center</th>
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<tr>
<td>Session 2, A5</td>
<td>Nicholas Andrew Restaino</td>
<td>Chemical Engineering</td>
<td>Modeling polar and nonpolar vanadium oxide surfaces</td>
<td>Advanced Materials for Environmental Sustainability</td>
</tr>
<tr>
<td>Session 1, C12</td>
<td>Dionicio F Rios</td>
<td>Mechanical Engineering</td>
<td>Designing of Photobiological Fuel Cells: Deposition and Characterization of Biocomposite Coatings by Continuous Convective Assembly</td>
<td>Triangle MRSEC</td>
</tr>
<tr>
<td>Session 1, B12</td>
<td>Nathan R Roberts</td>
<td>Electrical Engineering</td>
<td>Overcurrent Protection Relays: Defenders of the Distribution System</td>
<td>NSF FREEDM Systems Center</td>
</tr>
<tr>
<td>Session 1, D24</td>
<td>Detric Elijah Robinson</td>
<td>Biology</td>
<td>Escape responses in wild-derived zebrafish selected for divergent stress-coping styles</td>
<td>Initiative for Maximizing Student Diversity (IMSD)</td>
</tr>
<tr>
<td>Session 2, D3</td>
<td>Casey Loraine Ruark</td>
<td>Molecular Biology</td>
<td>Nematodes: a suitable home for viruses? A potential opportunity for biocontrol</td>
<td>Plant Pathology Kelman Scholars</td>
</tr>
<tr>
<td>Session 2, C5</td>
<td>Jacob Colin Rudolph</td>
<td>Geology</td>
<td>Absorbance of Particulate Organic Matter Positively Correlates with Total Suspended Solids in Small Tributaries to a Larger River Basin</td>
<td>MEAS-Wake Tech Program</td>
</tr>
<tr>
<td>Session 1, D10</td>
<td>Benjamin Donald Rusche</td>
<td>Biochemistry and Microbiology</td>
<td>Predicting Water Use Efficiency in Pinus radiata using SNP Analysis</td>
<td>NC State Independent Researchers</td>
</tr>
<tr>
<td>Session 1, C7</td>
<td>Daniel S Savelle; Lucas Ortiz; Teresa Portone</td>
<td>Mathematics and Economics; Mathematics; Mathematics</td>
<td>Polarized Morphogenetic System (PMS)</td>
<td>Research Experience for Undergraduate Mathematics: Modeling and Industrial Applied Mathematics</td>
</tr>
<tr>
<td>Session 2, C16</td>
<td>Richard Scarborough</td>
<td></td>
<td>African Easterly Waves and Atlantic Hurricanes</td>
<td>MEAS-Wake Tech Program</td>
</tr>
<tr>
<td>Session 1, A16</td>
<td>Kathryn Ann Schneberg</td>
<td>Biology with a concentration in botany</td>
<td>CSI Dublin: Hunt for the Potato Killer</td>
<td>Plant Pathology Kelman Scholars</td>
</tr>
<tr>
<td>Session 2, A1</td>
<td>Alesandra Giamario Seal</td>
<td>Biological Sciences</td>
<td>DEVELOPMENT OF A SALMONELLA SPECIFIC ELISA TO TEST THE EFFICACY OF A NOVEL SALMONELLA VACCINE</td>
<td>NC State Undergraduate Research Awardee</td>
</tr>
<tr>
<td>Session 1, D5</td>
<td>Syeda Amina Ikram Shah</td>
<td>Political Science</td>
<td>Smart Growth</td>
<td>NC State Independent Researchers</td>
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<tr>
<td>Session 1, C20</td>
<td>Katie Lynn Shelton</td>
<td></td>
<td>Undergraduate Social Media Use in</td>
<td>NC State Undergraduate</td>
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<tr>
<td>Session, Room</td>
<td>Name</td>
<td>Department</td>
<td>Title</td>
<td>Institution</td>
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<tr>
<td>Session 1, A3</td>
<td>Wei Shen</td>
<td>Political Science</td>
<td>Information Is link signature dependable for wireless security?</td>
<td>Research Awardee, OIA-SRE, Office of International Affairs - Summer Research Experience</td>
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<tr>
<td>Session 2, B12</td>
<td>Zhaoyue Shi</td>
<td>Biomedical</td>
<td>A Recombineering Gene System in Arabidopsis</td>
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<tr>
<td>Session 1, D7</td>
<td>Glenn Daniel Sidle</td>
<td>Mathematics</td>
<td>HIV Patient Health Prediction Using Data Mining Techniques</td>
<td>Research Experience for Undergraduate Mathematics: Modeling and Industrial Applied Mathematics</td>
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<tr>
<td>Session 2, D19</td>
<td>Oscar Javier Silio</td>
<td>College Transfer</td>
<td>Neuse River Basin’s Water Quality</td>
<td>MEAS-Wake Tech Program</td>
</tr>
<tr>
<td>Session 2, D22</td>
<td>Jamie Daniel Skovron</td>
<td>Mechanical Engineering</td>
<td>Characterization of Zircaloy HANA-4 for Nuclear Reactor Fuel Rods</td>
<td>Advanced Materials for Environmental Sustainability</td>
</tr>
<tr>
<td>Session 1, B2</td>
<td>Ethan Hunter Smith</td>
<td>AAS</td>
<td>Osteocyte Density from Mesozoic and Cenozoic Fossil Vertebrates</td>
<td>MEAS-Wake Tech Program</td>
</tr>
<tr>
<td>Session 1, C8</td>
<td>Austin Reese Smith</td>
<td>Biochemistry</td>
<td>Implementing MANS Treatment for Invasive/Noninvasive Cancer Cell Lines (CL1-5/CL1-0)</td>
<td>Initiative for Maximizing Student Diversity (IMSD)</td>
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<tr>
<td>Session 1, C6</td>
<td>Rickey Earl Smith</td>
<td>Food Science</td>
<td>Selection of Starter Culture(s) for Commercial Cucumber Preservation Using a Screening Design for Fermentation Potential and Antimicrobial Activity</td>
<td>NC State Independent Researchers</td>
</tr>
<tr>
<td>Session 2, A7</td>
<td>Ashley Marie Sough</td>
<td>Chemical Engineering</td>
<td>Miniaturization of commercial swine.</td>
<td>Initiative for Maximizing Student Diversity (IMSD)</td>
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<tr>
<td>Session 1, D15</td>
<td>Polite Donald Stewart, Jr.</td>
<td>Physics</td>
<td>Template-Directed Self-Assembly for Anti-Glare Self-Cleaning Surfaces</td>
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<td>Session 2, D4</td>
<td>Andrew Jonathan Stutts</td>
<td>Materials Science and Engineering</td>
<td>On the hardness and crystal structure of FeNiCrCoMn</td>
<td>Advanced Materials for Environmental Sustainability</td>
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<tr>
<td>Session 1, C3</td>
<td>Mia Sato Tackney</td>
<td>Mathematics</td>
<td>Cardiac baroreflex in humans and rats: mathematical modeling of complex physiological mechanisms</td>
<td>Research Experience for Undergraduate Mathematics: Modeling and Industrial Applied Mathematics</td>
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<tr>
<td>Name</td>
<td>Department</td>
<td>Title</td>
<td>Institution</td>
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<tr>
<td>Kheri Hicks</td>
<td>Mathematics and Computer Science</td>
<td>Predicting Observed Soil Moisture Using Statistical Modeling</td>
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<tr>
<td>Joseph Tokeshi Taylor</td>
<td>Meteorology and Marine Science</td>
<td>The influence of early growth on puberty traits in female pigs</td>
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<tr>
<td>Alma Margaret Terpening</td>
<td>BIO</td>
<td>Surface-engineered Alumina Particles as Phosphate-selective-hemofiltration Media in Hyperphosphatemia Treatment</td>
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<td>Shangchi Tsai</td>
<td>Material Science and Engineering</td>
<td>Wind Resources in North Carolina</td>
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<td>Ruth Leigh Tull</td>
<td>Transfer Student</td>
<td>Controlled Self Assembling of Nanoparticles with super-Resolution Optical Microscopy at Liquid-Liquid Interfaces</td>
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<tr>
<td>Ramyata Upmaka</td>
<td>Materials Science and Engineering, Biomedical Engineering</td>
<td>Investigation of the Inverse Transition Temperature of 16G(VPGVG)3 Peptide System</td>
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<tr>
<td>Kevin Eappen Valakuzhy</td>
<td>Mathematics / Computer Science</td>
<td>Iterative Consensus Clustering: An Innovative k-Determining Clustering Algorithm</td>
<td>Research Experience for Undergraduate Mathematics: Modeling and Industrial Applied Mathematics</td>
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<tr>
<td>Mindy Hong</td>
<td>Mathematics / Economics;</td>
<td>Synthesis of Unnatural Amino Acids with Photochemical and Bioconjugation Properties for the Expression of Proteins with New Function</td>
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<td>Robert Pearce</td>
<td>Applied Mathematics / Physics</td>
<td>Lithium-Ion Batteries: Amorphous Carbon Coating of Silicon-Carbon Nanofibers as Anode Materials</td>
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<td>Luis Angel V-zquez-Maldonado</td>
<td>Chemistry</td>
<td>Redshift and Angular Effects on the Detected Duration of Gamma-Ray Burst Light Curves</td>
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<td>Stephen Patrick Vicchio</td>
<td>Chemical Engineering</td>
<td>Expression of a codon-optimized thermophilic lipase for application in biofuel production</td>
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<tr>
<td>Michelle D Villeneuve</td>
<td>Astrophysics</td>
<td>Stress determination in GaN thin films grown by UHVPLD and MOCVD on sapphire and Si(111) substrates by Raman spectroscopy.</td>
<td>Advanced Materials for Environmental Sustainability</td>
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<tr>
<td>Gretchen Elizabeth Walljasper</td>
<td>Biology</td>
<td>Orders and orbits of generalized</td>
<td>Research Experience for</td>
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<tr>
<td>Jonathan Sami Watson</td>
<td>Metallurgical and Materials Engineering</td>
<td>Stress determination in GaN thin films grown by UHVPLD and MOCVD on sapphire and Si(111) substrates by Raman spectroscopy.</td>
<td>Advanced Materials for Environmental Sustainability</td>
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| Session 1, C19 | Mathematics  
Andrew Tollefson Mathematics and Physics;  
Russell Stinson Mathematics | Symmetric spaces | Undergraduate Mathematics: Modeling and Industrial Applied Mathematics |
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| Session 1, C9  | Mathematics  
Matthew Philip Weinstein Electrical and Computer Engineering | Three-Dimensional Atomic Force Nanomachining with X-Y Ultrasonic Vibrations | NSF Engineering the Grid Program |
| Session 1, C9  | Mathematics  
Liya Tquabo Weldegebriel Civil Engineering | Regulated Flux Balance Analysis of Lignin Biosynthesis | NSF Integrative Molecular Plant Systems REU |
| Session 1, A8  | Mathematics  
Anthony John Wenndt Biology | Screening for Resistance to Wheat Stem Rust: Locally Combating a Global Epidemic | Plant Pathology Kelman Scholars |
| Session 1, D17 | Mathematics  
Timothy Steven Wessler | Incorporating Cell Growth into Mixture Models for Articular Cartilage Regeneration | NC State Independent Researchers |
| Session 1, B11 | Electrical Engineering  
Matthew Samuel Wiesner | Data Analysis of a Photovoltaic Installation | NSF FREEDM Systems Center |
| Session 1, A3  | Computer Engineering  
Deon Dontavius Wilkins | Electrically Actuated Micro-Channel Heat-Transfer Device | NSF Engineering the Grid Program |
| Session 2, C23 | Mathematics  
Charles Andrew Wilson  
Lider Leon Discrete Applied Mathematics and Mathematics of Finance;  
Lauren Beesley Mathematics | Extrapolation Techniques Using Physiologically Based Pharmacokinetic (PBPK) Modeling | Research Experience for Undergraduate Mathematics: Modeling and Industrial Applied Mathematics |
| Session 2, D20 | Mathematics  
Shane Davis Wilson  
Robert O’Brien Mathematics;  
| Session 2, B3  | Pharmaceutical Science  
Chanel DiShon Wilson | Exploring the genetic basis of inflorescence architecture evolution in the dogwood genus (Cornus L.) | NSF Integrative Molecular Plant Systems REU |
| Session 1, B22 | Biological Sciences, EEC and Plant Biology  
Meredith Lynn Wojcik | Competitive Interactions between River Oats and Japanese Stiltgrass | NC State Independent Researchers |
| Session 2, C20 | Animal Science  
Vanessa Lorene Wolf | Effect of Zinc Supplementation on Rumen Fermentation | NC State Independent Researchers |
| Session 2, D15 | Microelectronics  
Bichen Wu | Exploiting the parallel computing power for circuit simulation | OIA-SRE, Office of International Affairs - Summer Research Experience |
| Session 1, A17 | Electrical Engineering  
Ningjia Wu | High frequency high power transformer winding conduction loss optimization using ANSYS | OIA-SRE, Office of International Affairs - Summer Research Experience |
| Session 1, C5 | Meghan Rebecca Wyatt | Biology | Genetic structure of modern U.S. genotypes of Phytophthora infestans | Plant Pathology Kelman Scholars |
| Session 2, C11 | Yu Xia | Mathematics and Applied Mathematics | An effective numerical method based on PMP and HJB equation | OIA-SRE, Office of International Affairs - Summer Research Experience |
| Session 2, A14 | Fangkai Yang | Information & Computing Science | Simulation of Five-fold Twins Formation in Nanocrystalline Diamond Films | OIA-SRE, Office of International Affairs - Summer Research Experience |
| Session 2, B9 | Hsiao-hui Yang | Civil Engineering | Change Order’s Impact on Construction Productivity - A Data Envelopment Analysis | OIA-SRE, Office of International Affairs - Summer Research Experience |
| Session 2, B11 | Jianing Yu | Information | Toward Semi-Automatic Inference of Causal Regulatory Pathways in Phenomenological Physical Models | OIA-SRE, Office of International Affairs - Summer Research Experience |
| Session 2, D10 | Wentao Zhang | Energy and Environment System Engineering | The Second Bassi-Rebay Scheme for the Solution of Elliptical Problems with Discontinuous Galerkin Methods | OIA-SRE, Office of International Affairs - Summer Research Experience |
| Session 2, D16 | Yijun Zhang | Biotechnology | Gene expression differences for anxiety in zebrafish | OIA-SRE, Office of International Affairs - Summer Research Experience |
| Session 2, B15 | Shaobo Zhang | Electrical Engineering | Develop a LabView-Based Battery and Plug-in Electric Vehicle (PHEV) Data Acquisition System | OIA-SRE, Office of International Affairs - Summer Research Experience |
| Session 2, D14 | Shanmei Zheng | Polymer | The beauty of polymer brushes | OIA-SRE, Office of International Affairs - Summer Research Experience |
| Session 2, D13 | Yu Zhou | Statistics | Maximum Likelihood and Regularized Estimation for Multivariate Response Generalized Linear Models | OIA-SRE, Office of International Affairs - Summer Research Experience |
| Session 2, B17 | Jinze Zhou | Financial mathematics; Xueyang Liang economics; Zhe Zhang statistics mathematics | The estimation of VaR in stock markets | OIA-SRE, Office of International Affairs - Summer Research Experience |
| Session 2, B13 | Tianmin Zou | Computer | Adapting A Visualization of Flowing Text for Use in the Hunt Library | OIA-SRE, Office of International Affairs - Summer Research Experience |