welcome to the

11th annual

UNDERGRADUATE RESEARCH

spring symposium and awards

Tuesday, April 19, 2016
1:00 pm - 6:00 pm
Student Center Ballroom

Georgia Institute of Technology

Sponsored by:
Center for Academic Enrichment
Undergraduate Research Opportunities Program

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1:00 pm – 4:30 pm	**Oral Presentations** *Student Center Rooms 301, 319, 320, 321, 343*
3:00 pm – 4:30 pm	**Poster Presentations** *Student Center Ballroom*
4:30 pm – 5:15 pm	**Reception** *Student Center Ballroom*
5:15 pm – 6:00 pm	**Awards Ceremony** *Student Center Ballroom*

Georgia Tech Center for Academic Enrichment

Welcome to the Georgia Institute of Technology's 11th Annual Undergraduate Research Spring Symposium. The work of our students and their faculty advisors demonstrates a commitment to not only investigate, but to resolve the issues of today while anticipating the demands of tomorrow. There is no better demonstration of that commitment than the research of our students presented before the Tech community today. At Georgia Tech, we strive to develop leaders in all fields and leaders in our global society. Our students and the faculty that advise them are the core of that pledge.

I extend my thanks to the entire Georgia Tech community for making today's symposium possible. In addition to the student participants, we rely on more than one hundred faculty, staff, research scientists, postdocs, graduate students, undergraduate students, and other members of the GT community to serve as judges, moderators, registrants, organization and planning support, IT and more.

Go Jackets!

The Center for Academic Enrichment
Georgia Institute of Technology
266 Fourth Street, NW
Clough Commons, Suite 205
Atlanta, Georgia 30332-0252
enrichment@gatech.edu

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Christina Leamon
Mentor: Dr. Yao Xie, ISYE

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Lauren Gardner
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April Gadsby
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Parker Buntin
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Aaron Stansell and Lakshmi Senthilnathan
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Yuntong Zhu
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Oral Presentation Sessions

Student Center, 3rd Floor

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Oral Presentation Sessions

Student Center, 3rd Floor

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Student Center Room 321
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Max Dorn
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Nathan Corbin
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Student Center, 3rd Floor

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Student Center Room 301
Moderator: Ms. Chiragi Patel

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Samantha Houser
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Elizabeth Stayduhar
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Student Center, 3rd Floor

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Student Center Room 343

Moderator: Ms. Sally Hammock

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Matthew O'Shaughnessy
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COLLEGE OF ARCHITECTURE

Poster Presentation # 001
Building Sustainable Cities through Sustainable and Resilient Infrastructure: A Literature Review

Tenesha Kittrell
Baabak Ashuri, PhD (Building Construction)

The development of environmentally sustainable and resilient infrastructure systems has become less of a concept and more of a necessity. In the last 30 years, the United States has experienced an unprecedented increase in population growth. High population growth creates pressure on infrastructure, particularly natural resources. However, population growth is not the leading cause of the depletion of natural resources. Civil engineering construction projects consume the largest quantity of natural resources, both renewable and non-renewable, in the world. To reduce to consumption of natural resources, sustainable building practices have been implemented into the construction of infrastructure. Policymakers are also focusing on how infrastructure systems could positively impact the overall sustainability of a city. While focusing on sustainability is imperative, it is strongly hypothesized that a community can only be sustainable if it is resilient to both man-made and natural challenges. Therefore, this paper reviews the literature on sustainable and resilient infrastructure and how these systems can foster sustainable cities.

Poster Presentation # 002
MuSync: A Smart Glove That Balance Personal Safety and Music Control in Urban Environment

Xueting Zhang; Caity Taylor
Jim Budd, PhD (Industrial Design)

The newly coined term "Ipod Oblivion" Refers to a common urban phenomena: The pedestrians would not be alert to the surrounding environment and approaching danger because of the plugged-in earphones. Although not illegal, this phenomena has caused many vital accidents. We developed an interactive glove that address the safety issue of urban runners. This smart glove response to the environment change and Augment the user's ability when encountered emergencies. It also allows phone control through gestures. Paper has been accepted by the 19th International Symposium on Wearable Computers.

COLLEGE OF COMPUTING

Oral Presentation
Machine Learning SAT Solver Heuristics

William Agnew
William Harris, PhD (Computer Science)

SAT solvers are used in a wide range of applications, including program checking, constraint optimization, and cryptanalysis. Complete SAT solvers work by searching through all potential solutions, using simple heuristics to guide the search, and abandoning a search path when the current formula becomes unsatisfiable. These solvers perform remarkably well on SAT instances derived from practical problems, like scheduling or path planning. This leads us to conclude that the search heuristics take advantage of some structure practical SAT problems have. However, this structure is not well characterized, so it is unlikely the simple heuristics take best advantage of it. Additionally, SAT solvers often have uneven relative performance across different problem types. These observations motivated us to create a heuristic that could both take fuller advantage of whatever structure practical SAT problems have and specialize to particular problems, allowing for better and more consistent performance. We propose using machine learning to guide SAT variable search; that is, training a neural network on SAT problems and their solutions and then choosing the next variable to search based on the network's prediction of the solution for the current boolean formula. By training on instances of the type of the problem of interest, this heuristic can learn and then take advantage of complex problem structure. We found that the machine learning heuristic requires up to 3x fewer search steps (unit propagations) than other leading solvers on the small SAT instances tested. We also discuss potential issues with this approach, specifically the computational resources required.

Poster Presentation # 005
George: An Exploratory Analysis Tool For Anonymous Social Media

Damilola Animashaun
Amy Bruckman, PhD (Computer Science)

Anonymous social media applications have experienced explosive growth in recent years. The anonymity provided by these apps often results in candid discussion that would not occur if the user's identity were associated with the conversation. However, the freedom provided by anonymity does come with a cost. At its very best, the dialogue that occurs on anonymous platforms reflect serious discussion about topics that are relevant to the participants. At its worst, users abuse the anonymity and the conversation devolves into bigotry and outright abuse. As the popularity of anonymous social media applications continue to increase, the amount of content that is generated will soon become overwhelming and the need for aggregation and analytics tools will become even more pronounced. George is a prototypical exploratory social media analysis tool that uses Reddit as its medium. By taking advantage of keyword extraction and sentiment analysis, George uses several information visualization techniques to provide an intuitive interface to explore community generated content.

Poster Presentation # 003
Observing the change in southeastern species' habitat areas due to climate change

Renee Bach
Bistra Dilkina, PhD (Computational Science and Engineering)

The focus of this project is to determine how climate change and human development in the southeastern United States will affect ~300 terrestrial species' habitat and their ability to migrate to keep up with changing climate. Using datasets of species presence records and modern climate data, we can estimate species distribution models to find each species' habitat niche and the locations of suitable habitat. By applying these models to projections of future climate data, we can predict how the species' suitable habitat will change over time. Once complete, these distribution maps will show the habitat suitability from 2010-2070 based on four different climate scenarios: RCP 2.6, 4.5, 6.0, and 8.5. This methodology of this process will be automated so that it is easy to apply our methods to other climate change studies. Our data will also be used in future studies with the ultimate goal of finding results that will help inform policy-makers how to prioritize conservation efforts in the southeastern USA, which is the ultimate goal of our project.

Poster Presentation # 006
Recognizing Error Related Feedback using Machine Learning and Physiological Indicators

Themiya Chandraratna
Melody Jackson, PhD (Computer Science)

Error Related Negativity (ERN), is a type of cortical potential that is induced depending on the success or failure of an action. Electroencephalography (EEG) is a widespread method of interpreting brain activity by monitoring electrical signals emitted through tissue which can be used to record ERN. Despite its many advantages, EEG is highly susceptible to various forms of noise: environmental sources such as electronic equipment and physiological noise such as cardiac signal (electrocardiogram, ECG), muscle contractions (electromyogram, EMG), and ocular signal (electrooculogram, EOG). The purpose of this study is to identify error related negativity by processing physiological indicators such as heart rate, rate of breathing, temperature,

and oxygen saturation using machine learning and pattern recognition. The results of this analysis can be used to help identify error related feedback from EEG in the presence of noise that can distort signals. The anticipated outcome is the correlation of ERN with other physiological indicators which will allow machine learning analysis to accurately predict ERN by utilizing this data. The findings may be useful for a wearable brain computer interface where the resolution of EEG may be limited, but other physiological data exists.

Poster Presentation # 004
M3: Scaling Up Machine Learning via Memory Mapping

Dezhi Fang
Polo Chau, PhD (Computational Science and Engineering)

The ability to compute large out-of-core data sets with machine learning methods has become the foundation of modern data science. Most methods available today focus on using distributed systems to achieve high performances and scalability. However, these methods often suffer from considerable overhead inherent to the complicated nature of distributed systems. Such methods often sacrifice overall performance for their pursuit in scalability. In this paper, we propose a minimalistic approach towards scaling up machining learning by using virtual memory with memory mapping. Prior research with memory mapping has insinuated strong potential that memory mapping can efficiently scale up graph mining algorithms on a single machine, especially when there is strong locality. In this paper, we demonstrate that a similar technique can be applied to general machine learning algorithms. We contribute: (1) our latest findings that memory mapping can be applied to scale up machine learning algorithms efficiently, in our experiments, up to 250GB; (2) a model that existing machine learning algorithms can be easily adapted to take advantage of our technique; (3) preliminary experiments on the model's performance in comparison to Spark.

Poster Presentation # 007
Modeling and Inquiry Learning Application: Explorations in Education and Spatial Simulation

Taylor Hartman
Ashok Goel, PhD (Computer Science)

Within the world of ecological modeling, building simulations of phenomena is not only difficult but oftentimes out of reach for many researchers such as citizen scientists. When training young scientists-to-be in a standard educational setting, this problem becomes magnified. Models and simulations are a gold mine of education opportunities for budding scientists – scientific inquiry skills are learned through trial and error and making connections between experimentation and interpretation of results. Modeling and simulation has the potential to provide students with that opportunity if it is in a simple enough interface. This is where the Modeling and Inquiry Learning Application (MILA) comes in. MILA is a modeling interface that allows users to model a phenomenon conceptually and have it compiled to a simulation for them. This creates opportunities in both education and the research world. At its previous level of development, MILA had shown significant results in middle schoolers' inquiry skills. However, at a higher education level it did not show these same results. This study aimed to examine how to improve the MILA interface and further examine MILA's potentials in education. A spatial component was added to MILA's simulation capabilities in order to increase the complexity of the simulations that MILA could run. This was done in an effort to allow more complex ecological phenomena to be modeled for college-level courses. MILA is now able to simulate agent based food chain ecological phenomena as well as spatially-explicit ecosystems with more advanced interactions.

Poster Presentation # 008
TABLA: A Unified Template-based Framework for Accelerating Statistical Machine Learning

Joon Kyung Kim; Chenkai Shao
Hadi Esmaeilzadeh, PhD (Computer Science)

Machine learning applications are gaining popularity in both industry and academia. However, the performance increase of general-purpose processor cores is falling behind the computational demands of machine learning algorithms. Integration of accelerators to general-purpose cores is becoming an appealing solution to this problem. With careful design and implementation, this can achieve a performance speedup by orders of magnitude. We present TABLA, a framework to accelerate a class of machine learning algorithms that use gradient descent. In particular, we leverage the insight that stochastic gradient descent yields results comparable to those of gradient descent, but with significantly better performance. TABLA targets Field Programmable Gate Arrays (FPGAs) as the platform of choice for acceleration. We chose FPGAs due to its programmable nature and speciality. TABLA provides a cross-stack solution, ranging from a Domain Specific Language to synthesizable Verilog code for target FPGAs. Programmers can focus on implementation of machine learning algorithms without any knowledge or experience on hardware accelerator design.

Poster Presentation # 009
Act Early

Rayner Kristanto; Jolena Yao
Rosa Arriaga, PhD (Computer Science)

There are certain things that a child should do by a certain age which are called developmental milestones. This includes how they act, play and speak. If a child does not reach a milestone by the associated age, there is an increased chance of developing

a developmental disorder such as autism. We are developing a web app that will help parents be informed about their child, track their child's milestones and communicate their child's development with their doctor. Thus, this app will help children be diagnosed and treated earlier which will reduce the severity of the developmental disorder.

Oral Presentation
Appearance-Based Gaze upon Object Estimation

Heng Li
James Rehg, PhD (Interactive Computing)

Knowing which object a person is looking at is important for social communication, joint attention and many interactive activities. Automatically measuring such a signal is a crucial yet challenging problem. I propose a system to address this issue by using a RGB-Depth camera filming the gaze-object interaction. This system consists of (1) a face detection module that localizes faces within an image, estimates their poses and identifies regions of eyes; (2) a gaze estimation module that combines an input of face pose and eye regions to predict gaze direction in 3D using a neural network; (3) a gaze-object module that compares 3D gaze direction to 3D object positions obtained by depth data, and predicts which object is being attended. I have completed a prototype system and preliminary results are promising. My plan is to continue my exploration in this direction.

Poster Presentation # 015
EarBit: A Wearable Approach to Detecting Mastication Activities

Richard Li
Thad Starner, PhD (Interactive Computing)

Dietary monitoring is critical for combating obesity and the chronic diseases that frequently follow. However, very few people have demonstrated the ability to adhere to long-term food journaling due to several factors, such as the inherent difficulty in logging meals or forgetting to log meals consistently. EarBit is an earbud with embedded sensors that are used to automatically detect mastication activities. It does so by measuring deformations in the ear canal with proximity sensors as well as using inertial measurement units (IMU's) to filter out movements of the head. The device was evaluated through studies performed with subjects in the lab and in the wild. In both cases, EarBit was able to correctly identify eating versus other activities with over 90% accuracy. With automatic detection of mastication activities, users could be prompted to record their meal or a camera would know when to begin recording videos of the mouth area (to determine what is entering the mouth). EarBit's accuracy and ubiquitous form factor lend itself to such applications very well.

Poster Presentation # 016
Linear Recurrent Convolutional Networks for Segment-Based Multiple Object Tracking

Erick Lin
Byron Boots, PhD (Interactive Computing)

Automatic object tracking in moving images is of paramount practical importance in many day-to-day scenarios, yet it has remained a long-standing problem in the domain of computer vision. We utilize a variation of recurrent neural networks (RNNs), which are characterized by one or more direct feedback loops from outputs to inputs, to build a fast learning model for tracking all the visible objects in an image over time. While models based on a form of RNN known as the long short-term memory (LSTM) network have performed successfully on tasks such as image annotation, a shortcoming of LSTM networks is that they are composed of nonlinear transformations on input data, so these models require larger quantities of training data to avoid the statistical problem of overfitting, and are hence also more time-consuming to train. By being composed exclusively of linear transformations, our RNN architecture is intended to be feasible for the large dataset sizes typically associated with moving images. The raw video data is passed through a "deep" or many-layered convolutional neural network for classifying superpixels, an average pooling layer, a layer that performs the POISE algorithm to merge superpixels into segments, a sequence of fully connected neural networks (NNs) to perform nonlinear feature mappings of segmentation data, and finally our linear recurrent convolutional neural network model for performing segment matchings between frames. This addition marks the first appearance of such a class of models for object tracking, and with refinement techniques is expected to outperform the state-of-the-art approaches.

Oral Presentation
Quantifying and Predicting Mental Illness Severity in Online Pro-Eating Disorder Communities

Zhiyuan "Jerry" Lin
Munmun De Choudhury, PhD (Interactive Computing)

Social media sites have struggled with the presence of emotional and physical self-injury content. Individuals who share such content are often challenged with severe mental illnesses like eating disorders. We present the first study quantifying levels of mental illness severity (MIS) in social media. We examine a set of users on Instagram who post content on pro-eating disorder tags (26M posts from 100K users). Our novel statistical methodology combines topic modeling and novice/clinician annotations to infer MIS in a user's content. Alarmingly, we find that proportion of users whose content expresses high MIS have been on the rise since 2012 (13%/year increase). Previous MIS in a user's content over seven months can predict future risk with ~81% accuracy. Our model can also forecast MIS levels

up to eight months in the future with performance better than baseline. We discuss the health outcomes and design implications as well as ethical considerations of this line of research.

Poster Presentation # 017
Tell Me About Autism

Safa Quadri
Rosa Arriaga, PhD (Interactive Computing)

The purpose of the Tell Me About Autism project is to create an online repository of information that can provide autistic children's parents with the information they seek in order to properly address the needs of their children. It is particularly focused on aiding parents of autistic children in India who do not have much knowledge about their children's diagnosis due to limited access to resources and the social stigma associated with autism. This portion of the research, conducted before the creation of the website, is centered on (1) recognizing the challenges faced by the families of children with conditions such as autism, (2) understanding how people are appropriating social media when content is stigmatizing, and (3) identifying the producers and consumers of online health information.

Poster Presentation # 018
DigiWrite

Eric Rabinowitz; Boao Xia
Thad Starner, PhD (Interactive Computing)

DigiWrite is a wristband that digitizes handwriting that is performed over any type of 2D-surfaces. The movement tracking is performed by using two Inertial Measurement Units (IMUs) located at two positions around the wrist, one on top of the wrist and one on the side. A kinematic model of handwriting is fitted to the values obtained from the sensors to obtain a writing position. DigiWrite has many potential applications. For teachers, it could virtually turn any whiteboard or blackboard into a "smart board" by digitizing the teacher's handwriting. This would allow the teacher to distribute digital copies of all notes to students without any extra effort. The same theory applies to paperless offices and is therefore environmental friendly. DigiWrite could also be used as an input interface for other devices. Smart watches are too small to have a keyboard. However, by wearing the wristband, users could "write" on their arm to respond to messages and quickly take reminders on their watch. DigiWrite could also be an alternative way to control Google Glass. It could keep users from having to use voice commands which disturb others or open up the user's own privacy. Additionally, DigiWrite could be extended to support multiple simple devices that do not currently have touchscreens and normally have cumbersome interfaces for information input or configuration, such as machinery and control systems inside assembly plants.

Poster Presentation # 010
Robust Partial Equivalence

Nicholas Ryan
William Harris, PhD (Computer Science)

Program equivalence is an undecidable problem. As such, previous works have not been very robust. Current approaches require limits on the space of inputs or control paths considered, the structure of the two programs must be similar, or they require the equivalence to be intertwined with the compiler. We propose a program verifier, Pequod, that can be applied to prove two programs are partially equivalent. Peqoud infers invariants of programs using counter-example guided abstraction refinement (CEGAR). Pequod differs from CEGAR-based safety verifiers by inspecting pairs of program paths and refining the abstraction of multiple programs simultaneously. Pequod has been tested on solutions gathered from popular coding interview practice websites. These solutions were tested against each other to determine equivalence. We have found that Pequod can prove that programs with dissimilar control structures satisfy weak notions of partial equivalence. The properties can be made stronger at the loss of efficiency.

Poster Presentation # 011
Innovative Ideas via using Google Glass

Aatmay Talati
Melody Jackson, PhD (Computer Science)

A staggering idea of interfacing the human mind along with mechanical devices or wearable computing techniques with a captured results of human imaginativeness is called by Brain Computer Interface. My research is conducting an experiment, where the decoded brain signals will flash products on user's Google glass depending upon one's desire and escalate the process further.

Oral Presentation
Intelligent Transportation Systems

Charu Thomas; Aaron McAnally; Walker Powell
Larry Sweet, PhD (Interactive Computing)

Concurrent with emerging interest in self-driving cars for personal transportation, there is significant commercial potential in intelligent transportation for supply chain and logistics. For example, today supply chains for delivery to large format grocery retail, small format convenience stores, food service restaurants, beverage, and the exploding interest in home delivery are all largely redundant, delivering the same or similar SKU's over the same routes to customers in close proximity to each other. In the past few years mobile robot technology has been developed successfully to automate distribution centers for precision order fulfillment with high efficiency. An intelligent logistics

transportation system would extend these concepts beyond the walls of the DC all with way to retail, service, and home consumers. The goal of the proposed project is development of new concepts, discrete event simulation models, and associated algorithms in this domain, and quantification of key performance metrics and system tradeoffs in efficiency, level of service, and environmental impact.

Poster Presentation # 019
Unsupervised Harvesting and Utilization of Recognizable Acoustics (UHURA)

Aditya Vishwanath; Aawantika Sahu; Joan Chen
Thad Starner, PhD (Interactive Computing)

The purpose of the UHURA (Unsupervised Harvesting and Utilization of Recognizable Acoustics) project is to find patterns in animal communication and match them to certain behaviors. This helps researchers effectively analyze animal interaction and communication. The main tool utilizes various machine learning techniques to create a codebook using pre-discovered audio patterns and produces statistics of a given audio file by categorizing similar segments. The tool also clips long audio files into smaller and more significant segments which can then be loaded into Observer (a software used for audio and video visualization) to allow researchers to find potential correlations between animal sounds and the behaviors.

Poster Presentation # 020
Designing Emotional Prosthetics with Affective Brain-Computer Interfaces

Angela Vujic
Melody Jackson, PhD (Interactive Computing)

Facial expressions significantly contribute to emotional expression. Individuals with facial paralysis caused by Amyotrophic Lateral Sclerosis (ALS), strokes, and other conditions have difficulty expressing emotion and may rely on augmentative and alternative communication (AAC) technology for computerized text or speech. Though it is one of the AAC user's "deepest interests to express emotions the same way as everybody else," facial emotional expression has received limited attention in AAC research. Additionally, AACs have been shown to strain an individual's emotional regulation and emotional competence, leading to difficulties in forming relationships. Here, promising affective brain-computer interface (aBCI) research and user requirements research are used to present designs for emotional prosthetics: wearable technology that gathers physiological signals non-invasively, guesses an emotional state by passing signals through machine-learning based algorithms, and provides the option to voluntarily express a corresponding facial expression to conversation partners by a discreet facial exoskeleton or projected display. The future of this technology can contribute to our understanding of ecologically expressed emotions in the field of affective neuroscience, provide opportunities for facial muscle rehabilitation, and allow individuals with paralysis to feel included, noticed, and valuable to improve relationships with caretakers, friends, and family.

Oral Presentation
Lung Doctor - A Smart Electronic Lung Meter for Asthma Patients

Jason Wu
Rosa Arriaga, PhD (Computer Science)

In the past, asthma patients have relied on specialized medical devices known as "peak flow meters" to measure lung capacity and detect asthma symptoms. While accurate and effective, these peak flow meters are often neglected and not popular due to their inconvenience and the negative stigma associated with them. As a result, asthma patients, especially children have a need for a measurement technique better suited to their lifestyles. Current electronic approaches that utilize smartphone hardware require the user to explicitly measure their lung function by blowing into the smartphone's microphone. This form of active measurement still requires a considerable degree of user intervention. Our new approach aims to measure patient lung function by analyzing audio data resulting from natural use of a smartphone – such as phone calls and other voice data.

Poster Presentation # 012
LITMUS: a landslide detection system

Jiateng Xie
Calton Pu, PhD (Computer Science)

We study the problem of using social media data in different languages and physical sensor data in combination to detect multi-hazards, such as landslides. LITMUS is a landslide detection system that employs a integration of data from both physical sensors, such as USGS (US Geological Survey) and social sensors, such as Twitter. We develop a multi-language support to extend the service of LITMUS and add Sina Weibo as an example illustrative of the issue associated with multiple- language services.

Poster Presentation # 014
Machine learning based statistical fault localization techniques

Shaowei Zhu
Alessandro Orso, PhD (Computer Science)

Fault localization techniques play an important role in software testing because it help to locate the source of bugs without extensive computing efforts. The current project examines current fault localization techniques, points out their shortcomings and develops new ideas in this area. Current

thought is to mine the revision history of softwares and bug (with multiple ways to fix them) databases to gain knowledge about possible faults and their inner structure. Also, the project is hoping to develop a reliable standard that could assess the performance of fault localization techniques in a consistent way such that most probable faults will always be ranked first in the findings list no matter how the code is structured. The ideas and methods are still under development and the experiments on the suggested thought has not been carried out yet.

Poster Presentation # 013
Improved Interface Detection and Test Data Generation for Automated PHP Penetration Testing

Zixiang Zhu
Alessandro Orso, PhD (Computer Science)

As web applications are becoming more complex, traditional penetration testing has been proved to be unable to identify security vulnerabilities effectively. Past research has proposed different approaches to address such issue, among which the most promising one is the static analysis algorithm proposed by Halford and Orso [1], which produces a precise summary of interfaces exposed by the application, along with all possible incoming data types associated with each interface. The resulting interface summary is used to generate a more sophisticated test case set for automated penetration testing. The original research was targeted on Java web servlets. However, Java servlets are less common in recent years, and since most of modern web applications are using PHP as the middleware language, it is very necessary to develop an automated penetration testing tool for PHP applications. This research extends the interface detection algorithm by Halford and Orso [1] to the PHP language; it also improves testing efficiency by integrating a precise String analysis on the program into the interface detection system, which has been proved to yield more sophisticated input test data which can help detect security flaws more effectively. Reference [1] Halfond, William, and Alessandro Orso. "Improving Test Case Generation for Web Applications Using Automated Interface Discovery." (2007), Print.

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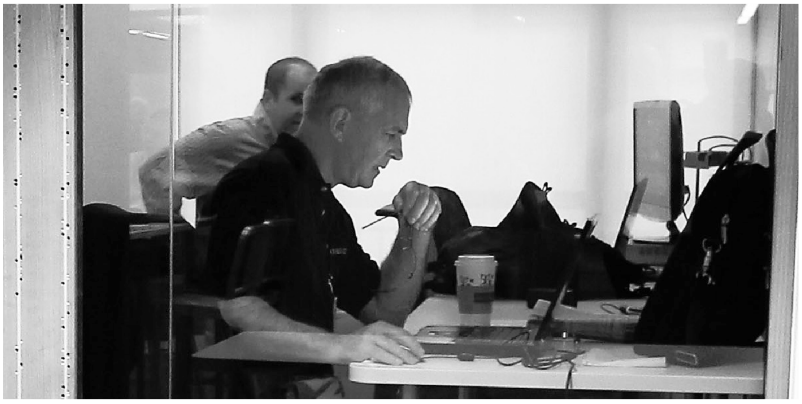

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Poster Presentation # 071
Low Cost 3D Printer for Multiple Materials

Hamed Ammar; Jimin Park
Seung-Kyum Choi, PhD (Mechanical Engineering)

This research project focuses on the development of an additive manufacturing system that integrates the capability to extrude a metallic conductive ink with a traditional printer head for plastic. Commercially available 3D printers that cost less than $3000 often have limitations on materials that can be extruded and the number of printing heads. The primary objective of this project is to modify an existing 3D printer to enable flexibilities in the areas where these printers are restricted. Specifically, the MendelMax 3.0 3D printer is being utilized to achieve this goal. This project will demonstrate how this relatively inexpensive 3D printer can be developed to print multiple materials through multiple heads. Ultimately, this project investigates solutions for printing parts that specifically require conductive material within a body made out of a different material.

Poster Presentation # 022
Aeroelastic and Aerodynamic Modeling and Behavior of Flying Snake

Robert Ashcom
Marilyn Smith, PhD (Aerospace Engineering)

The study of biological systems has advanced engineering through the understanding of complex phenomena in fluid and structural mechanics. An understanding of these phenomena has led to the development of innovative devices that mimic the physics of biological systems. One of the most unique aerial creatures is the flying snake, or the genus Chrysopelea. This gliding creature does not have any special "aerodynamic" appendages such as wings or membranes, yet it outperforms all other animals that are capable of gliding without appendages. It has been hypothesized that, in flight, its flattened body acts as a wing, while the tail provides flight control. This research seeks to understand the flying snake's aerodynamic performance and propulsion during gliding flight. To achieve this, an analysis of three-dimensional effects of the snake's body and movements during the gliding portion of the flight are performed using Fun3D, an aerodynamic flow solver. The analysis is based on observations by biologists of the genus Chrysopelea Paradisi. Aerodynamic data are be used for correlation and analysis of the physics include airspeed, sinking speed, and horizontal speed. The aerodynamic analysis evaluates the reduced equations of motion for fluid mechanics, followed by the Navier-Stokes equations. Correlation of the findings with unsteady aerodynamics theory will be included to determine its applicability. Potential applications include a mechanical robot that can add to its ability to cover land and sea by efficiently travel through the air.

Poster Presentation # 046
Chitosan versus Cellulose: Giving Ink Particles a Choice that Improves Paper Recycling

Jin Young Bae
Sven Behrens, PhD (Chemical and Biomolecular Engineering)

An essential step in paper recycling is deinking, removing ink from paper. Incidents from recycling plants have shown that contaminating the paper recycling procedure with hydrophilic ink can result in requiring more energy to produce recycled paper with specks of unwanted ink and decreased brightness. The current rise of inkjet printing and its use of hydrophilic pigments calls for effective strategies to remove hydrophilic inks. Hydrophobic ink (such as offset and gravure ink) can be effectively removed by froth flotation, but the standard process is not effective for hydrophilic ink, because the hydrophilic, and typically sub-micron sized ink particles interact differently with paper fibers and air bubbles. Our research focuses on removing hydrophilic ink by adsorption with chitosan to answer (1) what is the optimal mass ratio of ink removed to chitosan, and (2) what are the kinetic and thermodynamic limitations for the interaction of ink with chitosan and with cellulose. Although ink can adsorb onto chitosan, it is currently unknown what governs the optimal mass ratio between ink and chitosan. Another problem is that hydrophilic ink can redeposit onto paper fibers during the deinking process to an extent unfamiliar from hydrophobic ink. Two different cellulose based materials, bleached cellulose fiber and microcrystalline cellulose, were selected because they have the same chemical properties but different physical structure as paper fibers. By studying the interactions between hydrophilic ink and the two different fibers, we can gain a better understanding as to why hydrophilic ink tends to redeposit onto paper fibers.

Poster Presentation # 047
Catalytic Non-Oxidative Coupling of Methane at Low Temperature

Yasmeen Belhseine
Chukwuemeka Okolie, PhD (Chemical and Biomolecular Engineering)

Methane is an excellent raw material for the production of fuels and chemicals. However, large amounts of natural gas are located in remote areas where gas transportation in pipelines is technologically challenging, and methane's low energy density makes it especially hard to transport. Conversion of methane to more transportable products is therefore highly desirable. This work addresses the need for a new technology for direct methane conversion by developing catalysts for the selective activation of methane at temperatures below 500 °C through non-oxidative coupling of methane (NOCM) into ethane and

ethylene. Though NOCM is a thermodynamically limited reaction with limited conversion, the conversion of methane can be improved by the use of a membrane that selectivity removes hydrogen by-products to push the reaction forward. Also, this reaction has high selectivities of desired products due to the absence of an oxidizing agent. Catalysts chosen for this work were selected from preliminary FTIR screening. Continuous flow reactions of methane in a non-oxidative environment were performed using a packed bed reactor connected to an online gas chromatograph. With reaction conditions of 72 hours at 450 °C, the conversion of methane went through a maximum at 1.2%. At the start of the reaction, hydrogen was the main product, and the mole fraction of hydrogen and C2 compounds among the products reached 56% and 44%, respectively, at the end of the reaction. The hydrogen selectivity remained higher compared to C2 products even at the end of the reaction due to dehydrogenation of ethane to ethylene.

Poster Presentation # 058
Capillary foams: the role of key ingredients in a new class of materials

Greg Benz
Sven Behrens, PhD (Chemical Engineering)

Foams are an aspect of daily life; they are encountered in bubble baths, soft drinks, or shaving cream. The recent discovery of a new class of foams, called "capillary foams", has triggered a need for more research to assess the stability of and potential applications for these new foams. They are formed through frothing a suspension of colloidal particles with the crucial addition of small amounts of oil that aid the particles in stabilizing foam bubbles against coalescence and creaming. Our research is aimed at gaining more information about the mechanism of formation of capillary foams, and at analyzing the role of oil and particle properties, including the amount and polarity of the oil used, as well as the concentration and interfacial properties of the particles. We discovered that less than 1 wt% of oil is necessary to form stable capillary foams, while there seems to be no restriction on the type of oil chosen. Testing particles with different wettability led to the conclusion that the largest foam volume can be achieved using particles that are neither extremely hydrophilic nor hydrophobic, but have intermediate wettability. In addition, the foam volume was found to increase with increasing particle concentration up to a certain point at which the volume plateaued. With a better understanding of the formation mechanism it will be easier to determine the foam's potential for real-life applications. Some possible applications for capillary foams are enhanced oil recovery, oil spill remediation, lightweight porous materials, and waste water treatment.

Poster Presentation # 027
Expression of Heat Shock Proteins and Oxidants in the Presence of Oxidative Stress in Amyotrophic Lateral Sclerosis Mouse Model

Kamren Bernhardt
Cassie Mitchell, PhD (Biomedical Engineering)

Oxidative stress is caused by an increased amount of reactive oxidant species (ROS) within a biological system. This increase prevents cells from detoxifying, and causes damage within the cell. Free radicals within patients who have Amyotrophic Lateral Sclerosis (ALS) are elevated above normal to toxic levels, causing an increase in oxidative stress. Increased oxidative stress within ALS patients causes an imbalance in oxidant levels, antioxidant levels, growth factor levels, and enzyme levels resulting in motor neuron degeneration, and ultimately death. A meta-analysis of heat shock proteins, a major antioxidant, shows that oxidative stress negatively impacts Hsp concentration and as a result, increases the rate of motor neuron degeneration.

Poster Presentation # 028
Effects of Microgravity on Visual Impairment and Intracranial Pressure

Sruti Bheri
Ross Ethier, PhD (Biomedical Engineering)

When humans go into space for long durations, microgravity causes changes in the body. Sixty percent of long-duration astronauts have reported alterations in their vision, a symptom of Visual Impairment and Intracranial Pressure (VIIP) syndrome. Consequently, a lot of biomedical space research, including research by NASA, has given a high priority to understanding and developing mitigation methods for VIIP. However, due to the diverse range of symptoms, it is difficult to determine the specific cause of VIIP. Tissue remodeling, resulting from an increase in intracranial pressure (ICP) in micro-gravitational conditions, has been hypothesized as one factor causing VIIP. The study of the impact of ICP on optic nerve sheath (ONS) reorganization is a novel method of observing VIIP syndrome's effects. Additionally, research suggests that VIIP correlates with an increase in serum homocysteine (Hcy). Our long-term goal is to determine biomechanical and cellular mechanisms of ONS remodeling and to identify methods to prevent/lessen its occurrence. To simulate elevated ICP, porcine ONS will be attached to a pressure-control system which will apply higher pressures to the ONS. This will be done in the presence and absence of Hcy to simulate increased Hcy effects. The hypothesis is that an increase in ICP and Hcy will synergistically cause the ONS to remodel after exposure to micro-gravitational conditions. Understanding the effect of these two factors will allow for them to be controlled in future cases, potentially reducing the cases of VIIP in spaceflight, and preventing vision loss in astronauts during their space missions.

Poster Presentation # 060
Biped Robot Locomotion

Malavika Bindhi
Patricio Vela, PhD (Electrical and Computer Engineering)

Research in humanoid robots has expanded over the recent past because of their ability to imitate actions by humans and thus act as a very helpful companion. This research proposes modeling and development of walking pattern for a Bioloid GP Humanoid which would be integrated with a TurtleBot to act as an autonomous system. The target purpose of such a system is to navigate through the natural environment exposed to humans. The research aims at developing the humanoid to have the capability of dynamic walking patterns using center of mass and zero moment point. After successful implementation of walking, the TurtleBot would analyze the environment and provide the real-time instructions to the humanoid.

Poster Presentation # 023
Cross-Entropy Optimization for Neuromodulation

Harleen Brar
Evangelos Theodorou, PhD (Aerospace Engineering)

This study presents a reinforcement learning approach to the optimization of proportional-integral gains of a feedback controller commonly represented in models of an epileptic brain. The chaotic oscillator model provides a feedback control systems view of the dynamics of an epileptic brain with an internal feedback controller representative of the natural seizure suppression mechanism within the brain circuitry. Normal and pathological brain activity is simulated in this model by adjusting the feedback gain values of the internal controller. With insufficient gains, the internal controller cannot provide enough feedback to the brain dynamics causing an increase in correlation between different brain sites. This increase in synchronization results in the destabilization of the brain dynamics, which is representative of an epileptic seizure. To provide compensation for an insufficient internal controller, an external controller is designed using proportional-integral feedback control strategy. A cross-entropy optimization algorithm is applied to the chaotic oscillator network model to learn the optimal feedback gains for the external controller instead of hand-tuning the gains to provide sufficient control to the pathological brain and prevent seizure generation. The correlation between the dynamics of neural activity within different brain sites is calculated for experimental data to show similar dynamics of epileptic neural activity as the simulated by the network of chaotic oscillators.

Oral Presentation
Evaluation of Pt-Au and Pt-graphene-Au Surface-Alloyed Nanostructures for the Oxygen Reduction Reaction

Parker Buntin
Faisal Alamgir, PhD (Materials Science and Engineering)

The development of new catalyst systems is of utmost importance when it comes to environmentally clean energy production and solving the challenging problems of energy security. Electrocatalytic oxygen reduction reaction (ORR) is a crucial cathodic reaction for many fuel cell systems and highlights the need for more efficient electrocatalysts. The rising cost of the primary catalytic material, platinum, has also driven research for more efficient catalyst use. Recent findings have supported the suggestions that either alloying or layering Pt with Au can decrease both the rate of catalyst poisoning by species such as CO and the amount of Pt loading necessary in the catalyst. "Core/shell" catalysts utilize monolayers of Pt for the surface shell and other metallic components for the core structure. The overall activity of Pt-Au based catalysts varies based on the compositional architecture of the system. We present careful characterization of surface alloyed nanostructures with respect to the relative core/shell compositions and activity towards the ORR, using electrochemical and x-ray spectroscopic methods. At operating temperatures above 100°C, there is potential for interdiffusion to occur between the primary and support metals of the catalyst system. Single-layer graphene sheets have the potential to transform these architectures and prevent unwanted surface alloying between layered metals. We also present our preliminary findings regarding the use of graphene as a barrier to diffusion and are currently investigating the effects of graphene on Pt-Au alloyed surfaces.

Poster Presentation # 072
Cost Analytics for Cybermanufacturing

Siu Chan; Ming Him Ko
Yan Wang, PhD (Mechanical Engineering)

Cybermanufacturing is a new paradigm that both engineering software and hardware tools are seamlessly integrated by enabling information infrastructure and are accessed as services in cyberspace. This paradigm encourages tool sharing and reuse thus can reduce cost and time in product realization. In this research, a new cost estimation framework is developed based on big data analytics tools so that the manufacturing cost associated with a new job can be estimated based on the similar ones in the past. Manufacturers can use this cost analytics service in their job bidding process, which is currently ad hoc and subjective in industry practice. The new framework is implemented and demonstrated for additive manufacturing, where the similarities of 3D geometry of parts and printing processes are established by identifying relevant features.

Machine learning algorithms are applied to feature vectors to predict the cost based on historical data.

Poster Presentation # 073
Urethra is a biological nuzzle

Anthony Chen
David Hu, PhD (Mechanical Engineering)

Most mammals take 21 seconds to urinate, regardless of their size. What does this phenomenon happen? And why bernoulli's equations cannot accurately predict this timing? There are two factors behind this discrepancy between theoretical prediction and the real urinary system. One is the loss resulted from friction force between the wall and the fluid, called Major loss. And the other one is resulted from the kinematic energy loss of the fluid going through a connection between the bladder and urethra, called minor loss.

Poster Presentation # 063
Cost benefit analysis of natural energy options with a case study of Rwanda

Luyi Chen
Valerie Thomas, PhD (Industrial and Systems Engineering)

Rwanda's energy consumption is dominated by biomass that accounts for about 85% of primary energy use while petroleum accounts for 11% and electricity for the remaining 4%. Lake Kivu, situated on the border between Rwanda and the Democratic Republic of Congo, contains approximately 55 billion cubic meters of dissolved methane. The small country of Rwanda can be viewed as a case study of the natural gas and other energy choices faced by many nations. We have developed a parameterized cost benefit analysis for Rwanda that may be of value of Rwandan decision-makers and provide insight for decision-makers in other countries as well. Three options we are considering are building a natural gas power plant for generating electricity, using natural gas for vehicle fuel or for cooking and heating. For the first option, in order to compare levelized cost with desired electricity price of $0.3/kWh, we calculate net present value of fuel cost, operating and maintenance cost and capital cost. For the second option, we take account of the cost of purifying and pressuring methane, capital cost, fuel cost and additional cost of vehicle. Fuel price should be less than $3/gallon. Rwanda is experiencing deforestation that results from uncontrolled cutting of trees for fuel. Natural gas should be a great substitute. For the third option, we calculate purifying cost and pipeline cost. These three plans all have benefits and drawbacks, but they all can be further used in real situation.

Poster Presentation # 065
Degradation of dental resin through water diffusion

Jiho Choi
Seung Soon Jang, PhD (Materials Science and Engineering)

Dental resin is used in the dentistry field as restorative material that fills out cavity of teeth. It is insoluble, aesthetic, unreactive in dehydration, and inexpensive which makes it a very reasonable option for patients who want their cavity to be cured in more aesthetic way. Dental resin is mainly composed of two polymers called Bis-GMA and TEGMA. However, as times goes by, these resins cannot last longer enough due to environmental issue. One of primary environmental issue would be water diffusion. Most of water molecules that penetrate inside the resin are saliva. These molecules go through all the way down into the gap between the dentin and resin. As water molecules accumulate between these gaps, resins start to get fall apart slowly from dentin and separate completely later.

Poster Presentation # 048
Mechanocatalytic Depolymerization of Lignin

Natasha Chrisandina; Rachael Cooper
Carsten Sievers, PhD (Chemical and Biomolecular Engineering)

Lignocellulosic biomass, a raw material from the agricultural and forestry industries, is a commonly-used feedstock for the pulp and paper industry as well as a starting material for the production of chemicals and fuels from biomass. The three main components of lignocellulosic biomass are lignin, cellulose, and hemicellulose. Cellulose has been extensively utilized and studied as a precursor for biofuels due to the well-defined bonds between its sugar monomers that can be hydrolyzed by enzymes or acids. In contrast, lignin is typically burned for low value heat energy. Lignin is insoluble in many solvents, and attempts to find cheap and effective solvents have not been very successful. Therefore, our focus is on using a solvent-free process to depolymerize lignin into fuels and other useful chemicals. Our process uses mechanical force to induce solid-solid interactions. A ball mill is used to provide the mechanical force in the reaction. Sodium hydroxide has been found to be successful in depolymerizing lignin using this method. Longer milling times are associated with lower average molecular weights. However, even with rather short milling times a decrease in molecular weight is observed. Ball milling forms unstable intermediates, which react with each other in the milling vessel and form larger molecules. Adding ion scavengers such as methanol and ethanol appear to increase conversion to lower molecular weight species, showing that scavengers are able to prevent undesired repolymerization. Our results indicate that mechanocatalyzed depolymerization of lignin is a viable alternative to traditional lignin processing.

Poster Presentation # 074
Slime Mold Growth and Network Pathways

Clara Coblenz
David Hu, PhD (Mechanical Engineering)

Distribution of networks, whether for transportation or for issues such as fluid extraction, are constantly being made more efficient. Various biological models including the growth of slime mold are being used to solve these problems. We are comparing slime mold growth patterns to patterns determined by the constructal theory, which predicts that a nutrient pathway with a high level of branching will yield the fastest growth. This mold will be used in order to help develop a method that will allow for networks to be designed in a direct and efficient manner.

Poster Presentation # 075
Camouflage Feeding: Leaf Bite Patterns Are Proportional to Beetle Body Size

Natasha de Gunten
David Hu, PhD (Mechanical Engineering)

Living on a leaf can be dangerous. The distinctive body shape and color of leaf beetles make them easily seen by predators. However, in this study, we found that leaf beetles bite leaves in a particular and subtle way to camouflage themselves. I will show how these leaf beetles bite holes constrained to a certain size in order to camouflage themselves through time-lapse photography, micro-CT scanning and a human-participant computer program.

Poster Presentation # 076
Localized Gene Expression Effect of mu-dHACM in the Medial Meniscus Transection Model

Nica de Nijs
Robert Guldberg, PhD (Mechanical Engineering)

Osteoarthritis (OA) is the most common degenerative joint disease, affecting nearly 27 million people worldwide with a direct costs of more than $34.6 billion in the United States annually. OA is characterized by chronic degeneration of the articular cartilage through depletion of proteoglycans, hypertrophic differentiation of chondrocytes, surface erosion, lesion formation, and mineralization of the extracellular matrix. In a previous study, the Guldberg lab showed that a micronized dehydrated human amnion/chorion membrane could be used to successfully treat articular cartilage degeneration in the MMT rat model. This study aims to investigate disease-modifying mechanisms involved in the progression and treatment of OA. This is done through the use of the MMT rat model which yields localized lesions centered around the medial side of the tibial plateau. Right legs are not operated on and serve as a contralateral control. After 1, 3 or 6 weeks, the medial and lateral sides of the tibial plateaus are collected for gene expression analysis and full joint samples are used for protein expression analysis as well as histological and EPIC-μCT analyses. These analyses should identify changes in gene expression in order to help develop a more targeted therapy for OA.

Poster Presentation # 049
Thermostabilization of Influenza Vaccine for Microneedle Delivery

Miraj Desai
Mark Prausnitz, PhD (Chemical and Biomolecular Engineering)

Influenza is responsible for several thousands of deaths around the world each year, yet is also one of the most preventable pathogenic infections. By receiving an influenza vaccination once per year, chances of death can be reduced by up to 70%. Currently, the clinical methods for vaccination involve the use of a hypodermic needle and syringe or an intranasal mist, both of which are severely limited with regards to ease of administration and maintaining vaccine integrity. A novel alternative to these methods is the use of microneedle patches with excipient stabilization, which allow for enhanced vaccine thermal stabilization as well as painless administration, reduced biohazardous sharps waste, potential self-administration, and high immunogenicity. This project aims to create a formulation of influenza vaccine that is able to retain activity over the course of long term storage at elevated temperatures that can eventually be used to remove the drug from cold chain dependency.

Poster Presentation # 061
A system to transform humming voice to musical notation for mobile application

Enmao Diao; Shen Yang
Elliot Moore, PhD (Electrical and Computer Engineering)

Historically there has been a lot of research, and a number of methods have been proposed for tracking pitch from monophonic audio sources. More recently efforts have been concentrated on pitch detection and predominant fundamental frequency estimation in polyphonic audio. The idea behind this proposal is to modify some of these methods such that they can be used to implement a real-time mobile application that can be used to transcribe musical notes from hummed or sung queries. Such a system can be used by professional or amateur musicians for transcribing singing or humming into music notations. Human voice is the simplest musical instrument that we can play any time anywhere. With this mobile application, people without any music knowledge can compose music with their own voices.

Oral Presentation
Power Generation from a Sr-90 Betavoltaic Device

Jefferson Dixon
Shannon Yee, PhD (Mechanical Engineering)

Radioisotope-based energy storage devices, commonly referred to as "nuclear batteries," are an attractive form of energy storage due to their potential for higher energy densities and longer battery lifetimes compared to other modes of energy storage. These factors make them ideal for applications in which a self-sustaining power source is needed for a long period of time. Direct-conversion betavoltaics safely use the ionizing radiation of a beta-emitting source isotope in conjunction with a p-n junction to work analogously to a photovoltaic device. However, such betavoltaic devices typically operate on the nanowatt to microwatt scale, with typical efficiencies below 1%, and are thus only useful for extremely low power applications. This project explores a device using energy-dense Sr-90 as its source isotope. A device is designed with length scales to match the energy deposition profile of Sr-90 and its daughter isotope, Y-90. The resulting device architecture matches well with that of modern solar cells while taking advantage of their radiation hardness from nearly defect-free fabrication. P-n and p-i-n devices are tested under high and low energy electron sources, with the final p-n device yielding an efficiency of 19.1%. Modern solar-cell manufacturing technologies could thus produce a nearly defect-free Sr-90-powered betavoltaic device which would produce 1 W of power for up to 57 years. Such a device explores the physics of high-energy electron power generation while opening the field of remote, self-sustaining electronics.

Oral Presentation
Optimizing the Thermoelectric Properties of n-type poly-Ni-ett

Arnold Eng; Olivia Meek
Shannon Yee, PhD (Mechanical Engineering)

Nickel ethenetetrathiolate (Ni-ett) polymers have been shown to have promising properties as an n-type thermoelectric material. These polymers are produced by reacting 1,3,4,6-tetrathiapentalene-2,5-dione with an alkyl ammonium salt or alkali methoxide followed by the addition of nickel (II) chloride. Potassium nickel ethenetetrathiolate (poly[Kx(Ni-ett)]) is the best performing n-type thermoelectric material with a reported electrical conductivity of 40 S/cm and a Seebeck coefficient around -115 μV/K near room temperature. Despite these attractive thermoelectric properties, poly[Kx(Ni-ett)] has challenges for applications in a thermoelectric generator owing to its infusible and insoluble nature in common solvents such as methanol and water. One possible solution is to make a composite by combining poly[Kx(Ni-ett)] with a polymer matrix in a solvent suspension in order to open avenues for solution processing. However, this method has been shown to significantly reduce the electrical conductivity and Seebeck coefficient of the material thereby affecting its thermoelectric potential. In this work, we perform studies that involve varying the oxidation time during the reaction, film processing optimization, and blends to optimize the thermoelectric properties of poly[Kx(Ni-ett)]. On the application side, a thermoelectric generator with a novel architecture was fabricated using this material thereby enabling low $/W devices for waste heat recovery.

Poster Presentation # 029
SDF-1α Loading and Release from Hydrolytically-Degradable Heparin Based Microparticles

Alyx Falis
Johnna Temenoff, PhD (Biomedical Engineering)

Microparticles (MPs) are a promising delivery strategy, in part because they are injectable and can locally retain and control release of therapeutics. Furthermore, heparin, a highly sulfated glycosaminoglycan, can be incorporated within MPs and binds positively-charged proteins such as stromal cell-derived factor-1 (SDF-1). Previous studies show SDF-1 has recruited pro-regenerative cell types and enhanced vascularization after muscle injury. To achieve controlled release of SDF-1 for future in vivo delivery, we fabricated degradable heparin-based MPs and investigated their degradation rates and ability to release SDF-1. It was hypothesized that increasing the concentration of a hydrolytically-degradable crosslinker, dithiothreitol (DTT), within MPs would increase degradation rate in aqueous conditions, and that SDF-1 would release from MPs over 5 days. MPs were fabricated via water and oil emulsion and free radical-initiated crosslinking with 10 wt% N-desulfated heparin, 90 wt% poly (ethylene glycol)-diacrylate, and 20, 35, or 40 mM DTT. MP degradation studies were conducted with 0.5 mg/mL MPs in 0.1 wt% BSA solution and phase microscopy images were taken every 2 days. For loading and release, 200 ng SDF-1 was incubated with 0.2 mg MPs overnight, supernatant was removed at 0 hr, 3 hr, day 1, 3, 5, and 7, and SDF-1 was quantified with an SDF-1 ELISA kit. MP degradation was dependent on DTT concentration, whereby 40 and 20 mM DTT MPs degraded by day 8 and 30 respectively. 35 mM DTT MPs loaded ~60% of the SDF-1 after incubating overnight, and released a total of 5.7 ng SDF-1 over 5 days.

Poster Presentation # 077
The Fluid Mechanics of Ejaculation

Carissa Fernandez
David Hu, PhD (Mechanical Engineering)

While ejaculation has been researched, a complete model has not been established. Forming a comprehensive fluid mechanics model of mammalian ejaculation is crucial to understanding insemination and, by extension, fertilization. We aim to understand fertilization in mammals by correlating thrust frequencies during copulation with body size, penile size, health,

age, and mass. We show that the lower the animal's mass, the higher the thrust frequencies. A complete model of ejaculation will provide insight into impotence, possibly leading to the development of artificial insemination technologies such as prosthetic penile implants.

Oral Presentation
An Innovative and Sustainable Pavement Preservation Technology: Micro-Milling and Thin Overlay

April Gadsby
Yi-Chang James Tsai, PhD (Civil and Environmental Engineering)

The Georgia Department of Transportation (GDOT) has developed and implemented a new pavement preservation method that uses micro-milling in conjunction with a thin overlay to cost-effectively replace only a deteriorated, thin open-graded surface layer (¾ - 1 ¼ in) without removing a sound underlying layer. Many innovations have been created in developing this new method including a new performance indicator and sensing device for quality control. The new method was first implemented in 2007 on a 15.3-mile section, on I-75 near Perry, Georgia and resulted in a significant saving. In considering whether to adopt the new method as standard practice, it is essential to evaluate its long-term performance. This presentation reports the long-term performance of the new method using 8-years of pavement condition data collected by GDOT and sensing data collected using the GaTech Sensing Vehicle. Based on the data, the pavement on I-75 is still in good condition after 8 years (with 6% of raveling in 2015). Based on the current condition and GDOT's past experience using open-graded surface mixes, an additional service life of 2-4 years is expected for the I-75 project. This provides a service interval of 10-12 years - comparable to that of Georgia's conventional pavement rehabilitative strategy for open-graded surfaced interstate pavements, which typically ranges from 10 to 12 years. The cost analysis shows an approximate savings of 726 million dollars over 12 years across the state of Georgia. This information can assist transportation agencies in making decisions about whether to apply the new pavement preservation treatment.

Poster Presentation # 078
Electrospinning Polymers

Sheena Ganju
Baratunde Cola, PhD (Mechanical Engineering)

Abstract polymers are known for their low thermal conductivity, but there are processes that can increase this property with the potential of many industrial applications. One such process is stretching the polymers into highly aligned nanofibers through the electrospinning process. This papers describes an experiment in which polymers are electrospun at high voltages to increase their thermal conductivity and glass transition and melting temperature, increasing the applicability of soft materials as thermal interface materials in high temperature environments.

Poster Presentation # 050
The influence of Organic Microenvironment on Prebiotic Polymerization

Xiaosi Gao
Francis Joseph Schork, PhD (Chemical and Biomolecular Engineering)

The building materials of life are bio-macromolecules like proteins, nucleic acids, and polysaccharides, among which proteins are the most important to function in living bodies. The formation of bio-macromolecules can be roughly divided into three stages [1]: 1) from inorganic substances to simple organic substances; 2) from simple organic substances (monomers) to oligomers and polymers; 3) assembly of oligomers and polymers to create functional bio-macromolecules. My research focuses on the second stage. Because polypeptide formation is difficult without enzymes, it is proposed that they may be formed through some alternate route, for example, from oligoesters through ester-amide exchange reaction. Oligoesters can be formed by polymerization (condensation) of α-hydroxy acids in an oscillating (cool wet / hot dry) ecosystems that models day-night or seasonal transitions. However, oligoesters undergo hydrolysis in wet conditions, so my research introduces an organic microenvironment into the system to reduce hydrolysis. In my system, α-hydroxy acids create an acidic environment. By high-pressure liquid chromatography (HPLC) analysis, it has been shown that oligoesters have a relatively low solubility in acidic aqueous solution. Therefore, it is likely that oligomers will stay in organic phase and thus be protected from hydrolysis. This hypothesis is also supported by HPLC analysis on our day-night cycle. In the cool-wet stage of the cycle, I observed reduced oligomer concentration in the aqueous phase when the organic microenvironment is present, thus confirming the protecting effect of organic phase. These results help to illustrate the evolution of early polymers and better model the complicated prebiotic environment.

Oral Presentation
Using Cardiac Progenitor Cell Derived Exosomes to Improve Cardiac Function Post-Myocardial Infarction

Alex George
Michael Davis, PhD (Biomedical Engineering)

Myocardial infarction (MI) is one of the leading causes of morbidity and mortality in the world. Recent clinical trials have demonstrated that Cardiac Progenitor Cells (CPCs) exhibit regenerative effects on cardiac tissue post MI. Further studies have suggested that paracrine signaling-based mechanisms

involving exosomes play a critical role in these beneficial effects. In this study, we propose to evaluate the role of exosomes derived from human CPCs, segregated by age (neonate (1-30 days), infant (1 month -1 year), and child (1 year -5 years)) and environment (hypoxia vs. normoxia), in murine model of myocardial infarction. Exosomes were generated and delivered to the left ventricle of athymic rats 30 minutes after the ligation of the left anterior descending artery in an ischemia reperfusion model. Echocardiograms were performed periodically up to 28 days post-MI when the rats were sacrificed and the hearts were harvested. Picrosirius red staining and isolectin staining were performed on the heart sections to evaluate fibrosis and angiogenesis post-MI. Our echocardiogram data indicated that the delivery of hypoxic exosomes from all age groups as well as neonatal normoxic exosomes indicated a significantly improved ejection fraction (EF). The results from tissue staining showed that only the delivery of hypoxic exosomes from all age groups reduced fibrosis and increased angiogenesis. We are currently pursuing studies analyzing the exosomal transcriptome as well as investigating apoptosis following exosome delivery to provide molecular mechanisms for our observations. In short, we have demonstrated the regenerative potential of exosomes as a potential therapeutic for heart failure.

Poster Presentation # 030
A Benchtop Investigation of Thrombosis caused by Transcatheter Aortic Valve Replacement Stents

Eve George
Ajit Yoganathan, PhD (Biomedical Engineering)

Transcatheter aortic valve replacement (TAVR) is performed on patients who suffer from severe cases of aortic stenosis (narrowing of the aortic valve during systole) or aortic regurgitation (leaking and reversal of blood flow through the aortic valve during diastole). Valve thrombosis is the formation of a blood clot inside a blood vessel and is attached to or near a surgical valve. These clots pose a clinical risk because they can break from the valve and block smaller downstream arteries. Recent studies which examine clinical data of TAVR patients show that the incidence of subclinical thrombosis post-TAVR is higher than expected. The aim of this study was to determine if the stents in TAVRs could reasonably be contributing to valve thrombosis. A functional steady-state blood loop was built. Multiple blood loop experiments were performed in order to test whether the presence of the stent would result in measurable increases in coagulation activation. Hemolysis and thrombin anti-thrombin (TAT) assays were performed on blood collected from the loop after 0, 60, and 120 minutes. The TAT and hemolysis values showed no statistical difference between with stent and without stent experiments. However, gross clot formation occurred in several experiments with the stent but not without the stent. This implies that although the stent does not exacerbate activation of the coagulation cascade, the presence of the stent encourages clot formation, probably by providing a foreign surface for protein absorption or inducing flow fields favorable for clot formation.

Poster Presentation # 031
Center of Pressure Mean Velocity Predicts Eyes-Closed Single Limb Stance Performance

Ana Gomez del Campo
Lena Ting, PhD (Biomedical Engineering)

Understanding the mechanisms underlying balance impairment is key to improving rehabilitation interventions for patients at risk of falling. To understand impairment we need to understand balance skill, and in order to understand skill we must first quantify it. Previous studies of balance skill have investigated within-subject performance, a few studies tested skilled cohorts, and still fewer studies have analyzed balance failures, but until now none have done all three at the same time. We assessed balance skill using a task challenging enough to elicit losses of balance: an eyes-closed single limb stance test. We collected center of pressure (CoP) mean velocity from 10 professional ballet dancers and 17 untrained novices using six-axis force plates. Data collection stopped at 30 seconds, and the CoP time series was truncated before the loss of balance if the subject fell. We did not find significant differences in time standing between groups, which may be due to trial truncation since we believe that the experts could have stood for longer. However, novices had significantly larger mean velocities than experts ($p<.01$)and Mean Velocity (MV) accounted for variations in time standing across all trials in both experts and novices despite trial- by-trial variability in time standing (power fit, $R2=0.91$). Moreover, time standing was predicted by MV early in the trial ($R2=0.84$) which suggests that: 1) the analysis was not biased by losses of balance and 2) shorter trials are sufficient to predict balance performance. Novices had a larger range of mean velocities, suggesting that novices adopted different strategies across trials. Because mean velocity during eyes-closed single limb stance was able to distinguish between experts and novices, we hypothesize that mean velocity may be sensitive enough metric to identify impairments in skilled populations such as concussed athletes.

Poster Presentation # 032
A Histological Study of the Progression of Stretch-Induced Calcification in the Aortic Valve

Priya Gupta
Ajit Yoganathan, PhD (Biomedical Engineering)

Approximately 12.4% of the US population aged 75 years or more develops aortic stenosis. Aortic stenosis is a valvular disease when narrowing of the aortic valve opening occurs. The aortic valve experiences a range of mechanical stimuli (such as stretch and shear) in everyday life as it ensures unidirectional oxygenated blood flow from the left ventricle into the aorta throughout the body. However, abnormalities in these mechanical stimuli can initiate a pathological process known as aortic valve

calcification, which ultimately leads to aortic valve stenosis. During aortic valve calcification, calcium build-up occurs leading to increased stiffness, narrowing, and loss of valvular function. To study the temporal progression of aortic valve calcification, fresh porcine aortic valve leaflets were subjected to physiological (10%) and pathological (15%) cyclic stretch levels in an ex vivo bioreactor. Experiments were carried out for 7 days and 14 days under both regular and osteogenic media. Regular media contained standard DMEM solution while osteogenic media contained TGF-β1 (a well-known calcification promoter) and was formulated to replicate years (for example, 60 years) of calcification initiation and progression within a very short time. Alizarin Red S and Von Kossa stains were completed for all samples to histologically evaluate the degree of calcification. It was observed that calcification increased non-linearly with time in osteogenic media, which implies it progresses in a positive feedback fashion. This emphasizes the fact that early detection of aortic valve calcification is important in formulating therapeutic intervention for correcting this disease condition before it is too late.

Poster Presentation # 079
Modeling Beetle Hindwing Extension

Nicholas Hayes; Joseph Haines
David Hu, PhD (Mechanical Engineering)

The hydraulic pressure mechanism of beetles can be modeled by party horn extension. In order to determine the relationship between characteristic dimensions and forces, five different party horns with varying diameters were subjected to different pressures. Analysis of the data indicates that extension time scales with pressure to the -0.5 power and diameter to the second power, which is in accordance with our theoretical predictions. These experiments support the notion that beetles use their blood-like hemolymph to expand their hindwings before flight.

Poster Presentation # 066
ARGET ATRP Synthesis of PMMA with Low Polydisperisty

Derek Henry
Mark Losego, PhD (Materials Science and Engineering)

Controlled radical polymerization systems allow for the growth of polymers of targeted molecular weight and low polydispersity. This project followed the construction and development of a polymerization system built to run the Activators ReGenerated from Electron Transfer form of Atom Transfer Radical Polymerization (ARGET ATRP) and a computer model to predict the molecular weight and polydispersity of the end product. This allows for efficient and simple polymer chain growth with low final contamination of the end product. The system and computer model were tested through the production poly(methyl methacrylate). Results indicate that increasing the rate of the reaction lowers polydispersity of the end product by reducing the reaction-stopping effects of solution contaminants.

Poster Presentation # 080
Microfluidic Assays Modeling Vascular Dysregulation in Alzheimer's Disease to Understand the Role of Amyloid Beta (Aβ)

Andrew Hong
Levi Wood, PhD (Mechanical Engineering)

Amyloid beta (Aβ) plaques have long been linked to the progression of Alzheimer's disease; however, the exact mechanisms behind this phenomenon remain unknown. Over the past decade, the belief that Aβ is linked to microvascular dysregulation within the brain has become increasingly popular and warrants further study. It has also been shown that human microvascular endothelial cells (hMVECs) normally reconstruct their cytoskeleton as a result of flow-induced shear stimulating the shear receptors of the cell. Therefore, this study will investigate the mechanisms that propagate vascular dysregulation through the introduction of Aβ in a microfluidic context with physiologically relevant geometries and shear stresses up to 16 dynes/cm2. Devices are made using PDMS, which is poured over molds etched using standard soft lithography methods. These devices are then seeded with hMVECs and allowed to grow into a confluent monolayer. Flow is introduced and maintained for periods upwards of twelve hours in control and Aβ experimental groups. During the flow experiment, cells are live-imaged and later analyzed for changes in cytoskeleton geometries, which may lead to vascular dysregulation in the context of Alzheimer's disease.

Oral Presentation
The Fluid Mechanics of Aortic Regurgitation- A Simplified Experiment

Samantha Houser
Ajit Yoganathan, PhD (Biomedical Engineering)

Aortic regurgitation (AR) is a cardiovascular disease in which the aortic valve does not close properly, leading to continuous backflow of blood into the left ventricle during diastole. The pulsatile flow entering the left ventricle through the mitral valve forms a vortical structure, which has been shown to conserve the momentum of the flow and minimize energy dissipation, while simultaneously redirecting toward the aorta for ejection. AR is characterized by a high velocity regurgitant jet (RJ), disturbing the formation of the mitral vortex resulting in energy losses. The aim of this study was to analyze the interaction between these structures using flow visualization in a simulator modeling the fluid mechanics of the left heart. The mitral inflow volume was set at a constant length to diameter ratio, while

the RJ was varied to replicate mild, moderate, and severe AR, according to the American Heart Association. Three different aorto-mitral angles were modeled based on in-vivo observations. The ratio of the momentum of the RJ to that of the vortex yielded a non-dimensional value (Mj/Mv) showing the relative strength of the RJ to the mitral inflow vortex. While Mj/Mv was low, the vortices entrained the RJ, however, at higher Mj/Mv ratios the RJ led to vortex breakdown. This suggests that as Mj/Mv increases, there is potentially greater energy dissipation and less conservation of momentum. Further development of this relationship could provide a more accurate measure of AR severity in patients, which would allow physicians to make more confident and timely interventional decisions.

Poster Presentation # 034
A Meta-Analysis Assessing the Role of Tau and Amyloid Beta in Cognitive Decline in a Preclinical Model of Alzheimer's Disease

Colin Huber
Cassie Mitchell, PhD (Biomedical Engineering)

Alzheimer's disease is the leading neurodegenerative disease in the world with nearly 50 million people currently afflicted. There is no definitive cure, and the only treatment simply delays the onset of symptoms without slowing disease progression. The hallmarks of Alzheimer's pathology are marked by the onset of disease with accumulation of extracellular amyloid-beta (Aβ) plaques in the brain followed by phosphorylated tau (pTau) self-assembling into intracellular neurofibrillary tangles (NFT). Each of the protein accumulations also damage synapses and neurons themselves ending in diminishing brain mass and cognitive function. Many researchers in the field believe that amyloid-beta is the main cause of degeneration in Alzheimer's, but there has been no definitive treatments or cures found through research following this belief. The presence of Aβ does cause a decrease in cognitive performance; however, further accumulation of Aβ does not correlate with cognitive decline. Instead, it is suggested that other Alzheimer's pathologies including the hyperphosphorylation of tau are the functional cause of degeneration after the initial onset of disease. My team's study aims to compare the effects of Aβ and tau levels on cognitive performance through meta-analysis of preclinical experiments. A compilation of the field's work will give a more definitive answer to whether Aβ or tau has a larger effect in Alzheimer's pathology. My team will also assess the possible ties between Aβ and tau steering the field in a new direction toward tau or combination therapies that more effectively reverse the symptoms of Alzheimer's disease.

Oral Presentation
Fluid Mechanics of Animal Grooming

Jessica Imgrund
David Hu, PhD (Mechanical Engineering)

Compulsive bouts of oral grooming accounts for 4% of total daily activity for house cats. In this talk, I will reveal the connection between the properties of the saliva and tongue in relation to the properties of the fur in order to estimate the cleaning efficiency and create a full grooming model. Understanding the major features and mechanisms of cat grooming can also assist in the development of animal brushes which more closely resemble natural grooming for cats incapable of cleaning themselves due to injury or illness. This research can also contribute to the development of more effective brushes for fabric and carpet cleaning by means of fluids and abrasion.

Poster Presentation # 067
The Effect of Halogenation of Erythrosine B on Amyloid-Beta 40 Monomer Aggregation and Neurotoxicity in Alzheimer's Disease

Hanbyeol Jin; Jin Eun Shin; Jae Hyun Kim; Haeun An Seung Soon Jang, PhD (Materials Science and Engineering)

Alzheimer's disease (AD) is one of the most common type of degenerative dementia. Investigation about the mechanism of Aβ40 protein aggregation found that the initial α-helical Aβ monomer structure formed an intermediate state of aggregation. Erythrosine B (ER) is a well-known food dye approved by FDA. Dr. Kwon of the University of Virginia observed that ER inhibited the formation of Aβ fibril through in vitro experiment. To study such mechanisms, we used molecular modeling methods such as docking and molecular dynamic simulations, to analyze the specific effect of modified ER on the Aβ40 monomer. Docking simulation by AutoDock Vina was used to determine two highest binding energy approximate binding site of ER, EOY and FLN. These binding sites were used for MD simulations. RMSD was performed to see the change in the backbone structure of the Aβ40 from the initial position through time. DSSP analysis showed that there was a deformation of the α-helical structure and a β-sheet structure was maintained in the Aβ40 without a drug. When treated with ER, the α-helical structure was maintained throughout the entire duration of simulation. When treated with EOY, the desirable α-helix and β-bridge structures were maintained for a while although it was not able to prevent the formation of the β-sheet structure. This analysis was confirmed with a contact map which demonstrates the contact between the residues of the Aβ40 placed with different drugs. Therefore, ER is a more effective drug than EOY.

Poster Presentation # 024
The Effects of Sweep and Taper on Static Propeller Performance for Small Propellers

Tobi Kadri
Brian German, PhD (Aerospace Engineering)

My project is exploring the concepts of propeller sweep and

taper to quantify the effects thereof for small propellers. The propellers were 3-D printed and will be tested using a static test rig that measures the thrust and torque each propeller will produce over a range of RPMs. The results will be in the form of non-dimensional forms of thrust and torque vs. RPM curves that will show how those curves change as taper ratio and sweep angle change, independently.

Poster Presentation # 081
The Fluid Dynamics of Defecation

Candice Kaminski
David Hu, PhD (Mechanical Engineering)

Just like humans, when animals have to go- they have to go. But do the similarities between different animals and defecation cease there? The answer is no: We have discovered the similarities between different mammals relating to the dimensions of the rectum, dimensions of feces, and the duration of defecation. The duration of defecation is constant among mammals regardless of their mass.

Poster Presentation # 068
The Effects of DHMA and NMN on AB40 Monomer Aggregation Using Molecular Dynamic Simulations

Joy Kim; Jacob Lee; Chong In Shin
Seung Soon Jang, PhD (Materials Science and Engineering)

Alzheimer's disease is the one of the most common types of degenerative dementia. It is known to cause memory loss and loss of other intellectual abilities. The formation of neurotoxic plaque composed of beta amyloid fibrils has been found in a relatively high portion of patient's brains. Investigation about the mechanism of beta amyloid protein aggregation found that the initial beta amyloid monomer structure misfolds to form oligomers and fibrils as the disease progresses. 3,4 – Dihydroxymandelic acid and noremetanephrine are two metabolites of norepinephrine found in the brain. These chemical have been found to have an effect on fibril formation and aggregation through in vitro experiments. In this study, molecular dynamic modeling methods will be used to discover the effect of 3,4 – dihydroxymandelic acid and noremtanephrine on the amyloid beta 40 monomer as well as try to understand it's mechanism.

Poster Presentation # 082
The Biomechanics of Digestion

Victoria Kravets
David Hu, PhD (Mechanical Engineering)

Our intestines are constantly moving, mixing and propelling our food as we digest the nutrients our body needs. What contraction frequency, amplitude, and density contribute to the most ideal mixing and propulsive dynamics? This research seeks to determine what laws govern the movement of the small intestine. Perhaps by studying the brilliant phenomenon of intestinal motion we can understand more about ideal hydrodynamic environments.

Poster Presentation # 098
Advanced Algorithms for Contact in RVE Models Using Object Oriented Programming

Martin Kurien
Raghu Pucha, PhD (Mechanical Engineering)

In continuum mechanics for a heterogeneous material, representative volume element (RVE) [1] can be considered as a volume that represents a random heterogeneous material statistically, which is small enough to be considered for macroscopic property representation and sufficiently large to ensure the independence of boundary conditions. The use of such models can be used to numerically compute the homogenized properties of material by simulating a their physical likeness on a micro, or even nano, scale. In the case of Carbon Nanotube (CNT) Composites, RVEs with cylindrical CNT fillers can be rapidly generated and analyzed for electrical, mechanical, and various other physical characteristics such as percolation (see left). The programs designed to generate and analyze these RVEs all rely heavily on a contact algorithm that is used to find how close CNTs are to each other. This research concentrates on efficient algorithms for determining filler to filler contact in RVE models of CNT Composites based on an Object Oriented approach. The poster will present the benefits and trade-offs of each algorithm in the context of their use (e.g. RVE generation utilizes contact algorithms in distinctly different ways from percolation or electrical analysis). Also included in the presentation is a detailed explanation on the structures and utilities granted by an object-oriented approach and how they impact previous ways of approaching the design of a contact algorithm.

Poster Presentation # 051
Developing Novel Experimental and Analytical Methods to Quantify Differences in C. elegans Swimming Behavior

Katherine Lanthier
Hang Lu, PhD (Chemical and Biomolecular Engineering)

If a species experiences a significant change in its environment, it is necessary for it to be able to adapt over many generations in order to survive and reproduce. Over time, the environment can provide enough selective pressure on these species to develop distinct phenotypes that suit their new environments. In this case, a wild Caenorhabditis elegans species was domesticated in two different lab settings over fifty years. One strain, LSJ2, was

adapted to a liquid environment, while the other, N2, on solid agar plates. Over hundreds of thousands of generations, these animals developed new locomotive behavior in order to navigate and survive in their respective environments. By developing and implementing new experimental and analytical methods, we investigated which behaviors were optimally selected through evolution on these laboratory adapted strains. A 3D printed master mold was developed to allow for the production of an easily repeatable and consistent experimental platform to obtain a large quantity of behavior videos. Subsequently, automated image analysis algorithms were optimized to analyze this data in order to quantify the various behavioral differences between the two strains. In the future, the genetic regions associated with the different behavioral phenotypes could be identified using quantitative trait locus mapping and other bioinformatics methods which will lead to key insight on how environment plays a role in evolution.

Poster Presentation # 036
Hematopoietic stem cell softening mediates mobilization due to G-CSF and AMD3100, thereby increasing count in peripheral blood

Alvin Laohapant
Wilbur Lam, PhD (Biomedical Engineering)

Hematopoietic stem cells (HSCs) have the ability to differentiate into any blood cell as well as self-renew, giving rise to their pluripotent attribute. With the ability to differentiate, HSCs have the potential to be transplanted from healthy donors to matched patients with hematological malignancies as well as bone marrow failure. While the bulk of HSCs are located within the bone marrow, mobilization into the peripheral blood is required for accessible collection of HSCs, which ultimately eliminates the need for surgical procedures. Previous research findings have found that hematopoietic growth factor cytokines, more specifically Granulocyte colony-stimulating factor (G-CSF), as well as the mobilizing agent, plerixafor (AMD3100) increase mobilization of HSCs into the peripheral blood. While G-CSF and AMD3100 have both been scientifically proven and approved to increase HSC mobilization, the mechanical properties of HSCs have yet to be observed when mobilizing from the bone marrow to the peripheral blood. Here we use HSCs flowing through a microfluidic model to represent mobilization and hope to see cell softening due to G-CSF and AMD3100 during transit through the microfluidic device. By investigating the mechanical properties of HSCs during mobilization in the presence of G-CSF as well as AMD3100, clinical significance can lead to further studies as well as alternative mobilization techniques for use with HSC transplantation for patients with hematological malignancies.

Poster Presentation # 052
Developing drug-based therapies for uterine leiomyoma

Blake Lash
Michelle Dawson, PhD (Chemical and Biomolecular Engineering)

Uterine leiomyomas (fibroids) are non-malignant smooth muscle tumors that develop in the myometrium of over 70% of pre-menopausal women. Approximately 30% of these cases will require treatment, accounting for an annual financial impact of almost $34 billion. Though most cases do not become malignant, fibroids can cause significant uterine bleeding, pelvic pressure, pain, and reproductive problems. Currently, symptomatic leiomyomas are treated with surgical removal, sometimes necessitating a hysterectomy. Current non-invasive treatment procedures such as gonadotropin-releasing hormone agonists have proven to have significant detrimental side effects including bone loss. The focus of my research is to investigate the link between extracellular factors secreted by leiomyoma cells and phenotypic changes in non-diseased myometrial cells. Based on previous research done with mesenchymal stem cells and tumor-conditioned media, I have hypothesized that myometrial cells treated with fibroid conditioned media will begin to exhibit a more fibroid-like phenotype than typical myometrial cells. In-vivo this mechanism could account for part of the growth of fibroid tissue. Based on the extent of fibroid-like characteristics, I plan to slow this change by inhibiting mechanosensitive pathways known to be sensitive in typical fibroid development. Studies have shown that increases in mechanical stress activate pathways like the Rho/ROCK pathway, leading to changes in cell morphology and motility. Fibroids also respond to many other pathways including PI3K and MAPK, which have a role in increasing cell proliferation. My goal is to develop a drug-based therapy to slow this phenotype change, which will hopefully translate to slower growth in-vivo.

Oral Presentation
Change Detection of Tectonic Plate Movement in Santorini, Greece

Christina Leamon
Yao Xie, PhD (Industrial and Systems Engineering)

The islands of Santorini, Greece make up an active volcanic caldera and sit just northwest of the major subduction of the African. Given the potentially dangerous geological conditions, it is imperative that geologists are able to detect gradual tectonic plate movement to analyze risk to the island. Georgia Tech analyzes data from five nodes carefully placed around the caldera and record three axis of nodal movement – north/south, east/west, z-axis. With this multi-sensor data updated daily, we are able to detect changes in movement using a slope change detection algorithm that assumes when there is no change, observations are independently distributed with a mean

of zero. Using this data, we define a change-point when there is a change in the mean of subsets of data from our original zero mean. A mixture statistic is used to assign a probability p0 to the system that tells us the likelihood of movement from a subset of sensors. Additionally, a generalized log-likelihood ratio statistic is used since we do not have to assume the magnitude of the change. The algorithm can detect the change as quickly as possible. We can also estimate the moment when the change happens retrospectively. Our algorithm can deal with the non-homogeneous sampling patterns of the data stream, since from time to time sensors may be shut down and do not record any data. We have tested our algorithm on the real dataset and demonstrate its good performance. We have found multiple change points in the islands' movement over time.

Poster Presentation # 069
Effect of Incorporation of Lysolipid on the Stability of Dipalmitoyl Phosphatidylcholine Bilayer Membrane

Keewon Lee; Hansol Jang; Heeyoung Yoon; Joonsu Han; Lianhua Shen; Miree Jang
Seung soon Jang, PhD (Materials Science and Engineering)

Previous studies have found that incorporating monopalmitoylphosphatidylcholine(MPPC) lysolipids into PEGylated dipalmitoylphosphatidylcholines(DPPC) membranes of conventional thermosensitive liposomes lowers their phase transition temperature and promote rapid release of the encapsulated drug. Lysolipid has only one acyl chain, arranging the molecule into a conical shape with a relatively large head group compared to its single hydrocarbon tail. In this research, we present a full atomistic molecular dynamic study on the interfacial properties of the lysolipid-incorporated lipid bilayers as a function of structural variable of lipid compositions. We prepared two probable structural configurations of 10% MPPC incorporated DPPC bilayers: a 'dispersed' configuration of which the MPPC lipids are embedded evenly among the DPPC molecules to form a system of lipid layer that have lysolipids evenly distributed over the whole layer, and an 'island' configuration of which a cluster of MPPC lipids is embedded into DPPC molecules forming a island of lysolipid-agglomerate in the bilayer. Using two configurations, our aim is to analyze how the intermolecular configuration of lysolipid-incorporated lipid bilayer affects the macroscopic properties of the bilayer between the water phases. For this purpose, the energetic profiles, density profile, and the structural correlations of the molecules where characterized for both configurations of 'island' and 'dispersed' system. This study not only determines the probable structural composition of mixed MPPC/DPPC lipid bilayer but also better understands the role of the lysolipids affecting the overall behavior of the lipid bilayer.

Poster Presentation # 083
Butterflies Draft to Oscillating Airflow

Richard Lehner
Patricia Yang, PhD (Mechanical Engineering)

Birds fly in a "V" formation to save energy during flight using a concept called steady stream drafting. However, have you ever noticed that butterflies and other bugs don't exactly follow this same type of flight? It raises the question: do these insects even save energy at all? To find out, we studied how butterflies react to an environment with a non-steady airflow. We found that the butterflies adjust the rate and amplitude of their wing beats to match the rhythm of the surrounding air. This suggests that butterflies do have a way to save energy, and that we have much to learn from them.

Poster Presentation # 084
Process-Oriented Data Exchange for Interoperable and Verifiable Additive Manufacturing

Yanglong Lu; Chenliang Yang
Yan Wang, PhD (Mechanical Engineering)

The advancement of additive manufacturing (AM) or 3D printing technology provides designers and engineers great flexibility to fabricate complex parts with high precision. However, the lack of verifiability for AM processes is a major hindrance for quality assurance. Typically, the boundary representation of geometry in the format of STL or AMF is taken from computer-aided design (CAD) models. The layer-by-layer fabrication paths are then generated by individual vendor-specific slicing and path planning algorithms. As a result, the fabricated parts from the same 3D model may have significant variations of geometry and quality from different processes or printers. The main source of such deficiency is the lack of means to specify crucial process parameters by designers after accomplishing the overall geometry in CAD software, which furtherly results in the lack of interoperability between AM equipment. In this research, a new data exchange scheme is proposed to enable users to include process-oriented information at phases from designing to manufacturing, where both geometry and detailed process parameters such as temperature, path, and setup can be specified and AM process becomes verifiable. A software tool to convert data between the new file format and machine-dependent G-code is developed.

Poster Presentation # 053
Peptide-based nanoparticle as a vehicle for intracellular delivery of functional antibodies

Cyril Lukianov
Julie Champion, PhD (Chemical and Biomolecular Engineering)

The cell membrane remains a formidable barrier for antibody-based therapies, and efficient intracellular delivery of functional antibodies may be critical for modulating important intracellular signaling mechanisms and protein-protein interactions. This study utilizes protein engineering techniques to develop a novel nanoparticle that is capable of delivering functional antibodies to the intracellular environment. Each nanoparticle is capable of delivering up to six functional antibodies, and may bind different functional antibodies with the same affinity. The current study is focused on enhancing the specific targeting properties of the nanoparticle as well as the efficiency of intracellular antibody delivery. This novel design has great potential for many diverse applications due to its simplicity, biocompatibility, as well as modular design.

Poster Presentation # 064
Less Expensive and More Sustainable: Weighing Fuel Type Options for Drivers in Rwanda

Sichao Ma
Valerie Thomas, PhD (Industrial and Systems Engineering)

Due to the lack of resources, the price of gasoline in Rwanda is 20% higher than the average world price of gasoline. Air pollution accounts for 1 in 8 deaths globally. Rwanda is estimated to be one of the major global emitters of pollutants in 50 years. It is essential for Rwanda's government to develop a method that can find a both economical and sustainable fuel type. Most evaluation models do not measure environmental cost directly, limiting our understanding of a sustainable system's value. To address this, this project is attempting to develop a model that can compare costs for different type of fuel options with economic and environmental factors. Natural gas, gasoline and diesel are the most commonly used vehicle fuels. Each cost for the fuels is going to be based on both its dollar per mile cost and its life cycle assessment consideration. In order to analyze the profitability of the project quantitatively, net present value will be used for costs of each fuel types. Future costs, which include all the cost of converting fuels to energy, will be set as variables through the calculation due to Rwanda's uncertainty of price of commodities. In order to compare each fuel type's pros and cons, the more easily-accessible US data is used to get a better picture of what factors would most likely be significant. By using this model, an expectation of choosing cleaner fuel with a lower cost for both Rwandan government and drivers is supposed to be reached.

Oral Presentation
Ex vivo Chondrogenic Expansion on Decellularized Cartilage Derived Microcarriers

Elizabeth Marr
Robert Guldberg, PhD (Mechanical Engineering)

Osteoarthritis (OA) is the most common form of arthritis, and affects nearly 27 million in the U.S. alone [1]. Though multiple surgical treatment options exist, many do not promote cartilage regeneration and are ineffective in the long-run, often leading to complete joint replacement [2]. One of the few therapies aimed at regenerating cartilage is autologous chondrocyte implantation (ACI), a procedure that depends heavily on the ex vivo expansion of chondrocytes, but is currently hindered by their slow proliferation and loss of phenotype during expansion [3]. The objective of this study was to develop microcarriers (μCs) that provide a microenvironment that more closely mimics the complex extracellular matrix (ECM) of native cartilage for chondrocyte expansion and retention of phenotype. Porcine cartilage was isolated, lyophilized, milled, and sifted overnight to obtain μCs approximately 450 μm in average diameter. The carriers were decellularized using a series of enzymatic and chemical washes. Chondrogenic ATDC5 cells or primary human chondrocytes were seeded on the μCs and viability, proliferation, and ECM production were evaluated. Decellularization removed more than 95% of the DNA content from the μCs, which was quantified via PicoGreen Assay. ATDC5 cells proliferated and maintained high cell viability up to 7 days, and produced sulfated glycosaminoglycans. Primary human chondrocytes cultured on the cartilage μCs over 21 days showed similar proliferation and viability. Ongoing studies are examining chondrogenic phenotype on cartilage microcarrriers in comparison to traditional 2D culture and culture on other commercially available microcarriers. A microcarrier culture platform that supports healthy chondrogenic expansion could clinically lead to more regenerative treatments of osteoarthritic joints as an alternative to complete joint replacement. References: [1]: Lawrence RC, Felson DT, Helmick CG, et al. (2008) [2]: Minas T, Chiu R (2000) [3]: Schrobback K, Klein TJ, Schuetz M, et al. (2011)

Poster Presentation # 054
A Low-Cost Fluorescent Microscope for Rapid Biological Analysis in Vivo

Sean Martin
Hang Lu, PhD (Chemical and Biomolecular Engineering)

Conventional fluorescent microscopy methods commonly used to analyze microorganisms in vivo are expensive (~$5,000) and slow to use. Previous attempts at low-cost alternatives ignore the true cost of data collection, storage, and analysis. A newly developed cost-effective microscope creates an inexpensive system for collecting data on microorganisms, like C. elegans. This low-cost fluorescent microscope is well-suited to quantify gene expression using green fluorescent proteins (GFP) by taking images and recording videos without significant sacrifices in quality. GFP is a well-established technique for characterizing the protein activity in C. elegans, but requires expensive fluorescent microscopes. Cost-effective alternatives allow researchers to parallelize data collection (and replication) because multiple low-cost microscopes can collect more data than one expensive

microscope. This is useful in large-scale genetic and lifespan studies were it is not feasible to manually collect all data on a single microscope. A Raspberry Pi, a $35 on board computer, runs algorithms to automatically collect and interpret data. This limits potential human bias and accelerates data collection. Microfluidic devices further automate the process through built-in hardware controls. Additionally, these devices are attractive in biological assays because they reduce waste of valuable reagents, possess more precise process control, and increase overall throughput. Microfluidics and low-cost fluorescent microscopy are combined to characterize the effect of environmental pollutants on the development of C. elegans.

Poster Presentation # 037
Co-incubation of wildtype and mutant cysteine cathepsins uncovers the proteolytic dynamics of cathepsin cannibalism

David McKellar
Manu Platt, PhD (Biomedical Engineering)

Cysteine cathepsins are a group of potent proteases which have been shown to cleave many extracellular matrix proteins including elastin and collagen. The over-expression of cathepsins has been implicated in many diseases that involve the degradation of tissues. In order to treat these diseases, pharmaceutical companies have developed specific inhibitors to reduce activity of the proteases. While these treatments have shown to be effective at stopping disease progression, many cause considerable side effects. Our lab previously uncovered a mechanism, referred to as cathepsin cannibalism, by which cathepsins hydrolyze each other in addition to traditional substrates. Analysis of co-incubation of cathepsins S and K showed a decrease in substrate degradation as compared to incubation with a single species. Co-incubation with cathepsin S at a ten-fold higher concentration compared to cathepsin K showed a reduction in collagenolytic activity compared to the naïve model of superposition of the individual cathepsins. We hypothesize that these cathepsin-cathepsin interactions extend to other species and that this regulation ultimately reduces the overall concentration of certain cathepsins. Further, we believe these changes may cause the unwanted side effects previously mentioned. To study this phenomenon, we created two types of mutant cathepsins: (1) active-site mutants, with a changed amino acid in the active-site of the cathepsin; (2) cannibalism-resistant mutants, with a substitution where cleavage is hypothesized to occur. Co-incubation of mutant and wildtype cathepsin species will allow for the identification of specific interactions between species and lead to a better understanding of the proteolytic dynamics of cysteine cathepsin cannibalism.

Poster Presentation # 025
Extracting Pressure and Velocimetry in Vortical Flows

Jackson Merkl
Narayanan Komerath, PhD (Aerospace Engineering)

The research presented covers advancements made in extracting transient surface pressures and other flow data from complex rotorcraft flows. Two primary test cases are investigated to test current SPIV methods as well as a pressure extraction technique created by the applicant. The pressure extraction method relies on velocity vectors supplied by SPIV that are then converted into a field of frictionless pressures whose boundaries serve as the boundary conditions for a full Navier-Stokes solution capable of extracting pressures on and off the surface. The first case is a rotating rotor blade in reverse flow at various speeds and azimuth angles. The other test case, a low aspect ratio (AR: 1) cylinder in yaw, is used to validate the applicant's pressure extraction method against conventional intrusive techniques for a simple flow, as well as results produced by Computational Fluid Dynamics simulations. The conclusions of the tests validate the lab's existing model to characterize spanwise development of trailing edge vortices. Using the applicant's pressure technique and the lab's SPIV tools, sharp-edge vortices are shown to form at highly swept conditions, convecting when perpendicular from the flow, and then detaching when fully retreating. From the cylinder test case, the effects of viscosity in off-body vortex flow pressure computation obtained by SPIV and analyzed by Couette flow analysis is observed to be very minimal, giving excellent prospects for pressure distributions generated by SPIV data. Therefore, the further work presented focuses on the development of the lab's SPIV tools and pressure extraction method.

Oral Presentation
Designing a High-Pressure Optically Accessible Combustor

John Miltner
Timothy Lieuwen, PhD (Aerospace Engineering)

The impact of emissions on the environment motivates stricter regulations on emissions standards on gas turbine engines. These regulations drive combustion towards cleaner burning modes, which means generally leaner burning conditions. Leaner burning is much more susceptible to combustion instabilities. One common mode of combustion instability involves a coupling between acoustics, fluid dynamics, and heat release. Therefore, a new combustion test rig has been designed in order to study the effects of acoustics and fluid dynamics on the flame. This rig will be built and installed in the Ben T. Zinn Combustion Lab. The combustor rig consists of a test article, which simulates an industrial combustor liner, as well as air and liquid fuel injection systems. In order to operate at high pressure, the rig also consists of a pressure vessel, which encloses the test article. The

challenges associated with such a design are to manufacture a pressure vessel and combustor liner that are optically accessible for high speed imaging and laser diagnostics while maintaining the air and fuel flow characteristics of interest to the sponsor. As with any large combustion rig, heat loading poses another challenge, which is addressed through both air and water cooling strategies. A third challenge that faces this rig is the potential soot deposition on optically accessible components, which must be kept clean with air films. This presentation discusses the details of these challenges and the design approaches used to mitigate them.

Poster Presentation # 085
Like a moth to pheromones: dynamics study of moth antennae

Nina Mohebbi
David Hu, PhD (Mechanical Engineering)

Many moth species utilize their antennae to pick up a low concentration of pheromones over large distances despite atmospheric turbulence. Understanding the structural and fluid dynamics of the unique and intricate moth antennae could have implications for sensor and filter development. The dynamics of flow with respect to the antennae has not been well understood due to difficulties encountered when studying phenomena at such a small scale. This research aims to study how particles flow through and around antennae structures.

Poster Presentation # 038
A Comparative Study between Calf and Fetal Bovine Pericardium

Michael Moon
Wei Sun, PhD (Biomedical Engineering)

Cardiovascular disease remains the number one cause of death (WHO, 2013), and among industrialized nations, calcific aortic valve disease (CAVD) is the most prevalent form of cardiovascular disease. Traditionally, surgical aortic valve replacement (SAVR) has been the gold standard for treatment of CAVD, however, over the past decade, transcatheter aortic valve replacement (TAVR) has emerged as a viable alternative for high-risk patients who have been excluded from surgical candidacy due to comorbidity. TAVR uses a transfemoral or transapical catheter approach to deploy a balloon-expandable or self-expanding stent attached to artificial heart valve leaflets constructed from calf bovine pericardium (CBP) or porcine valve tissue. In the rapidly growing field of TAVR devices it is clear that the industry is trending towards lower-profile devices that minimize incisions to access vessels, facilitate easier advancement of TAVR devices to the aortic annulus and minimize major vascular complications. Our goal of this experiment is to determine whether CBP can be replaced with fetal bovine pericardium which as a lower thickness compared to CBP and therefore serve as a viable alternative. We will be comparing collagen orientation and mechanical properties between the sample groups. The mechanical properties of the samples will be tested via uniaxial testing to look at the stress and strain curve. Collagen orientation will be performed through histology using Picro Sirius Red stain.

Poster Presentation # 026
Alternate Tether Configurations in Bluff Body Unsteady Aerodynamic-Dynamic Interaction

Jagadeesh Movva
Marilyn Smith, PhD (Aerospace Engineering)

Helicopter slung loads are subject to unsteady aerodynamic forces, causing dynamic interactions in all 6 degrees of freedom, which if not accounted for can decrease the performance and safety envelope of the vehicle severely. Bluff body interactions with slung loads are not limited only to helicopters, but are also important for cranes and airdrops as well. For many of these applications, the dynamic problems with aerodynamic forces are not analyzed due to the complexity of solving through high fidelity CFD. In the Nonlinear Aeroelasticity Laboratory, Professor Smith and her group have created their solution, known as Georgia Tech Aerodynamics of Bluff Bodies. The GTABB code is a reduced order physics-based model for bluff bodies with and without tethers. This code so far has been applied to tethered load simulations for rotorcraft, and it is being evaluated for airdrops and crane operations. The research goal for the work will be to implement a new model for bluff body tethers into GTABB. The current system of fixing the body to the reference frame will be replaced with on that that can accept more conditions regarding the dynamics of the tether cables. The solution being evaluated is to create a tether segments of the entire tether to more accurately measure the tether dynamics. It will then be possible to use GTABB for other tether configurations. The closing goals for this research would be to run various test cases with different test set-ups, and validate the given solution against flight test data.

Poster Presentation # 039
Compliance Validation Method for In Vitro Study of the Total Cavopulmonary Connection

Brady Munz
Ajit Yoganathan, PhD (Biomedical Engineering)

The Fontan procedure, a palliative treatment for single-ventricle congenital heart defects, results in the anastomosis of the venae cavae to the pulmonary arteries, generating the total cavopulmonary connection. Although the procedure improves patient perioperative outcomes, there are several long-term complications linked to altered hemodynamics, resulting in Fontan failure. Numerous in vitro studies exist exploring the hemodynamics, but even the most advanced models include

simplifications that affect modeling accuracy. The development of the first compliance-validated model will enable Fontan hemodynamic modelling with greater precision. The model was generated from a compliant resin via a spin molding technique. Its compliance was measured under a sealed injection series with simultaneous collection of volume and pressure change data. The model's compliance was validated using in vivo flow data obtained by magnetic resonance image segmentation and aged-matched catheterization pressures. Validation was achieved by iterating on model wall thickness until reduction of error to less than 10% was achieved. The number of iterations was reduced by using finite element simulations with experimentally developed material properties based on the in vitro compliance measurements. The in vivo compliance was found to be 1.36 mL/mmHg. A model of 1.36 mm wall thickness produced a compliance of 1.4 mL/mmHg, satisfying the error tolerance. The successful validation of model compliance ensures the most accurate results in its use for analyzing Fontan hemodynamics. Precise modeling can improve the understanding of how the Fontan circulation differs from a bi-ventricular circulation, leading to solutions for the long-term complications associated with the Fontan procedure.

Poster Presentation # 062
Demagnetization Fault Monitoring and Diagnostics of Permanent Magnet Synchronous Machines in Electric Vehicles

Delgermaa Nergui; Ollie Foo; James Song
Thomas Habetler, PhD (Electrical and Computer Engineering)

Although popular electric vehicles (EVs) such as the Nissan Leaf, Chevrolet Volt, and Toyota Prius all use Internal Permanent Magnet Synchronous Motors (IPMSMs), the permanent magnets can cause problems. These magnets can stay magnetized indefinitely under standard conditions; however, prolonged exposure to high temperatures while operating can demagnetize the magnets of the motor to the point of irreversible demagnetization. Demagnetization faults could occur which cause low output torque and reduce the lifespan of EVs. The purpose of this project is to improve the reliability of electric vehicles by monitoring the demagnetization effects on interior permanent magnet synchronous machines (IPMSMs). Among all existing thermal monitoring techniques, the installation of embedded temperature sensors is the most accurate, but is not cost-effective for many low-to-medium horsepower motors. To make it worse, the permanent magnets are embedded inside the rotor, indicating no direct access to the magnet. The rotor is also spinning at a very high speed in operation mode, thus more expensive wireless sensors are required rather than cheaper and conventional sensors with transmission wires. Therefore, a sensorless thermal monitoring and demagnetization detection method, which employs only the available voltage and current information, will be investigated. In addition, the non-intrusive nature of this method offers easier implementation since it requires no hardware change to the existing field-oriented-controlled (FOC) drive system and brings minimal interference to normal EV motor performance.

Poster Presentation # 055
In Vivo Microfluidic Mechanical Sensory Imaging in Developing C. elegans

David Oakland
Hang Lu, PhD (Chemical and Biomolecular Engineering)

Mechanosensation is an important modality to touch, balance, and hearing in humans, however, the underlying mechanism for mechanosensation is not well understood. Since several disorders, such as deafness and hyperalgesia, are developed as infants, studying mechanosensation in developing animals is necessary for identifying, combating, and preventing such conditions. This study, however, would be impossible to conduct in humans as perturbing physiological conditions is difficult and manipulating genetic factors is impossible. Caenorhabditis elegans, a nematode, is a suitable model organism: it has mechanosensory neuronal circuits, and a transparent body, which allows for in vivo imaging. By combining microfluidics and calcium imaging, the Lu group has developed a novel technique to increase reliability, robustness, and throughput: using pneumatically actuated structures, the developed system can deliver mechanical stimuli to adult worms robustly while allowing for high-quality imaging for calcium transients in cell bodies and sub cellular processes. However, this system has been designed for fully developed worms. Thus, to understand the underlying mechanism of mechanosensation in developing animals, we designed and characterized a microfluidic device that can provide robust mechanical stimuli to smaller worms. When converting to a smaller sized worm new challenges arise, including worm handling in the small size of the imaging channels and blockages from small particles that contaminate the devices. With this system, I will perform drug screens to identify and test targeted molecules that affect the neuronal response to lead to cures to neurological disorders that can develop during early childhood.

Oral Presentation
Localizing embeddings using paired comparisons for recommendation systems

Matthew O'Shaughnessy
Mark Davenport, PhD (Electrical and Computer Engineering)

Recommendation systems predict the preferences of users (who may be, for example, customers of an online shopping website or moviegoers), to various items (for example, consumer products or movies). One way this information is modeled is the ideal point model of preference, in which items and users live in an n-dimensional Euclidean space where each dimension represents

an attribute and a small distance between an item and user indicates the user has a preference for that item. We seek to determine an embedding of many items and users given only binary pairwise comparisons of the form "user x prefers item i to item j." First, we present an optimization-based framework for localizing new items and users given an existing embedding. We demonstrate that user localization can be formulated as a simple constrained quadratic program. Further, we show that although item localization produces a quadratically-constrained quadratic program which is difficult to solve, we can make the problem more computationally tractable by strategically combine comparisons to make the quadratic constraints into linear constraints. Finally, we show that by iteratively applying this localization method to every item and user, we can recover an embedding that agrees with almost every comparison, allowing us to iteratively improve the accuracy of a noisy embedding or even create an embedding using no a priori knowledge apart from the list of pairwise comparisons. Throughout, we present implementation details and optimization algorithms which make the recommendation system computationally efficient.

Poster Presentation # 086
Hydrogels with Magnetic Nanoparticles and Fluorescent Component

Camila Pagan
Andres Garcia, PhD (Mechanical Engineering)

The purpose of this study is to define a parameter of movement for nanoparticles. The nanoparticles are enclosed in a hydrogel matrix that have a fluorescently tinted magnetic component to track their movement. The nanoparticles are stoichiometricly created, allowing for condition reproducibility. Stress on the particles is produced by an external Neodymium magnet. Movement is recorded in a MatLab run program that outlines the fields created. The program will be able to predict future trends in nanoparticle movement when applied to the human body. Hydrogel research incorporates magnetic nanoparticles into the network because of their specific properties and possible applications. Studies show that one of the main human applications of magnetic hydrogels is for targeted drug delivery. Despite research supporting the benefits of this technology, a parameter of movement has not been defined causing inconsistencies between studies. Expected conclusions include defined parameters of movement of the magnetic nanoparticles in order to place in cells and use it for targeted drug delivery. Final results are pending.

Poster Presentation # 056
Particle Affinity to the Air-Water Interface – a Testbed for Advanced Froth Flotation

Jonathan Pang; Ryan Baptiste
Sven Behrens, PhD (Chemical and Biomolecular Engineering)

Paper recycling is extremely important to reduce the removal of trees and to increase environmental sustainability. Current paper recycling processes utilize pulping followed by flotation in order to remove the inks printed on paper. In flotation, air bubbles are blown through the mixture of fibers, inks and water. Due to the affinity between hydrophobic ink particles and air bubbles, the air bubbles attach to inks, lift the ink to the surface, and form a thick froth layer that can be removed. This widely used procedure works well for the removal of traditional offset ink, which is hydrophobic in nature. Due to environmental concerns and printing feasibility, however, inkjet printing is now seeing a much faster growth, and new inkjet inks differ from offset inks in terms of their pigment particles' size and wettability. Specifically, particles in inkjet ink are much smaller and more hydrophilic than those in offset inks. As a result, inkjet ink is not compatible with flotation deinking. Similar problems occur with flexographic inks, which paper mills have been struggling with for over 20 years. Our research focuses on the relationship between particle wettability and the ability of particles to attach to air bubbles. Specifically, silica particles with different surface modifications and wettability are utilized as a model system and the correlation between the particles' wettability and their removal by froth flotation is measured. Results of these experiments will later be used to test strategies for improving the particle-bubble affinity and achieving more complete particle separation from water.

Poster Presentation # 040
Effects of Multiple Electrical Stimulation on Axon Regeneration

Sohee Park
Arthur English, PhD (Biomedical Engineering)

Every year in the United States, there are about 200,000 new traumatic peripheral nerve injuries. Full functional recovery from these injuries is rare. One experimental treatment for promoting axon regeneration is exercise (English 2015). Even moderate daily exercise applied after nerve injury induces prolonged high expression of brain derived neurotrophic factor (BDNF) in neurons (Gomez-Panilla et al, 2001) and this expression promotes significant regeneration of injured axons (Wilhelm et al, 2013). However, exercise after peripheral nerve injury and surgical repair might not always be possible. As an alternative to exercise, brief electrical stimulation (ES) of the injured peripheral nerve has proven its ability to promote axonal recovery (Almajed et al, 2000a). Most of the time, the treatment has to be given right after one receives a peripheral nerve injury, because delaying application of either exercise or electrical stimulation reduces or eliminates its effect on axon regeneration, elongation and reinnervation (Zhang 2015). Therefore, an alternative to exercise and electrical stimulation is needed. The most commonly used ES treatment is a single application of one hour of continuous stimulation at 20Hz at the time of surgical repair of cut nerves. Multiple electrical stimulation for 2 weeks has been applied to the animals and there was no significant difference from one time ES. It was concluded that there are

more factors that affect regeneration other than BDNF alone.

Poster Presentation # 87
Comparative Study of Polyamide-6 Reinforced by Glass Fiber and Clay Minerals

Yuzhe Peng
Kyriaki Kalaitzidou, PhD (Mechanical Engineering)

Polyamide-6 is a crystalline thermoplastic that has gained popularity in a wide range of engineering applications due to its unique combination of good processibility, high mechanical properties, and chemical resistance. Despite the excellent properties conferred by polyamide-6 which make it an economic choice for various end-use applications, its performance is largely limited by a tendency of moisture absorption and low resistance to crack propagation in the presence of a notch. While the inclusion of glass fiber fillers has proved effective in addressing these issues, recent development is suggest solutions in other reinforcing agents. The goal of this project is to compound various types of unknown clay minerals with and without glass fiber in polyamide-6 matrix in order to test for potential improvements in its mechanical and thermal properties. The polyamide-6/clay nanocomposite was first introduced at Toyota research center, Japan, and the incorporation of clays has led to desirable improvements in mechanical and chemical properties observed by various researchers. In this project, polyamide-6 with and without glass fiber reinforced by various clay minerals are fabricated and compared in terms of their tensile strength, impact strength, flexural strength, and heat deflection temperature. Improved properties are expected to be found in samples with the incorporation of clay minerals. The results from this study can potentially be used in the development and fabrication new polyamide-6 nanocomposite with improved performance.

Poster Presentation # 041
Hemodynamic comparison of the traditional Fontan baffle and Y-graft modification under simulated exercise conditions

Kacey Rice
Philip Trusty, PhD (Biomedical Engineering)

A Fontan surgery is able to circumvent blood around a dysfunctional ventricle by implanting a baffle from the inferior vena cava (IVC) to the center of the pulmonary arteries (PA), resulting with a total cavopulmonary connection (TCPC). The Y-graft modification utilizes a bifurcated baffle, which extends from the IVC and branches to the LPA and RPA to induce a more even flow distribution. Limited exercise capacity is a common characteristic among Fontan patients and results from power loss through the TCPC. In the study, twenty patient-specific geometries of each baffle type were constructed and meshed for computational fluid simulations to calculate power loss in the TCPC. Past studies have shown that exercise capacity is related to power loss; therefore, exercise was simulated by monitoring indexed power loss at 1x, 2x and 3x resting conditions. The goal of the study was to compare hemodynamics during simulated exercise between both the traditional and Y-graft baffle types to determine if one confers a better exercise capacity. Y-grafts were shown to have a significantly higher iPL at all three activity levels than the traditional Fontan group. Also, a correlation between power loss at rest (1x) and power loss at max exercise (3x) was shown for the Y-graft modification ($R2 = 0.98$, $p<0.05$) but not for the traditional Fontan group.

Poster Presentation # 059
Evaluation of the Effect of Aortic Regurgitation on Ventricular Mechanics Using Magnetic Resonance Imaging

Kathleen Rooney
Ikay Okafor, PhD (Chemical and Biomolecular Engineering)

Evaluation of the Effect of Aortic Regurgitation on Ventricular Mechanics The aortic valve (AV) promotes unidirectional blood flow from the left ventricle of the heart to the aorta. Aortic regurgitation is defined as blood backflow occurring at the AV. Cases of aortic regurgitation are classified as mild, moderate, or severe. There are already measures to determine severity, but there are not protocols that classify severity by considering how the regurgitant jet affects ventricular mechanics. Magnetic resonance imaging (MRI) data sets of the aortic valve were obtained in order to study this relationship. The contrast magnetic resonance (CMR) files were segmented to capture the area of the AV throughout the cardiac cycle. Each CMR file had a corresponding phase contrast magnetic resonance (PCMR) file that contained the magnitude of the blood flow. Both files were used to plot the velocity vectors through the AV. The data from the velocity vectors were exported, and the spatially averaged velocity of both the forward and reverse blood flow was calculated. Next, the PCMR files were analyzed to calculate the orifice area of the AV. Finally, to find the flow rate for each patient, the spatially averaged flow velocity was multiplied by the orifice area at each corresponding time point. Four trends were observed. Aortic regurgitation was found to have a higher severity with increasing end systolic volume, end diastolic volume, minimum orifice area, and left ventricle volume. This study can lead to better ways to classify aortic regurgitation based on ventricular deformation.

Poster Presentation # 088
Developing a method for quantification of lymphatic vascular permeability in vivo via near-infrared imaging

Mindy Ross
Brandon Dixon, PhD (Mechanical Engineering)

The lymphatic system is a network of vessels, nodes, and accessory organs that serve many essential biological functions such as immune cell trafficking, absorbing and transporting lipids from the digestive system, and restoring fluids extravagated from the circulatory system. Despite these essential functions, little is known about the role of the lymphatics in the progression of a variety of diseases. A better understanding of the lymphatic system would facilitate the discovery of cures as well as provide a means for early detection for many lymphatic diseases such as lymphedema. Recently, studies have been conducted that measure the changes in vessel permeability in vivo, which has been implicated to play a role in the development of lymphatic disease. This project aims to modify the original method by developing a minimally-invasive technique to measure the permeability of a lymphatic vessel in vivo using a fluorescent dye previously developed and near-infrared (NIR) imaging. The permeability measurements will be compared to measurements in models with increased vessel permeability caused by induced-inflammation in the region of interest. The results of this project will be used in future experiments by applying the established method to models of diet-induced obesity to determine the changes in lymphatic permeability under conditions similar those present in patients with lymphedema.

Poster Presentation # 042
Gait optimization to improve foot deformations or ulcers, using the transcutaneous electrical stimulation.

Bharathimurugan Saravanabhavan; Seong Ho Yeon; Anthony DeFilippo
Brandon Dixon, PhD (Mechanical Engineering)

Nearly 30 million people in the United States, or approximately 9%, experience some stage of diabetes. Within diabetes, diabetic peripheral neuropathy (DPN) is one the most common issues, with nearly 50% of patients developing the condition within 10 to 15 years. The development of the neuropathy leads to the degeneration of the peripheral nerves within the lower limbs. This ultimately leads to sensory and motor feedback systems being diminished and affect the biomechanics and gait associated with the foot. One critical component of measurement, peak plantar pressure, is shown to be significantly higher with subjects that have diabetes and DPN compared to those that do not. Therefore, these changes in the plantar pressure during gait lead to foot deformations and foot ulcers, and finally result in amputation. The goal of this project is to optimize the gait by restoring sensation and pressure distribution of the foot, by evoking the plantar sensation using the electrical stimulation. The system will gather the spatial pressure distribution of the foot and apply the corresponding electrical stimulation to the tibial, sural, and peroneal nerves innervating the plantar surface of the foot via the surface electrodes on the ankle level. We expect the stimulation would restore plantar sensation and pressure distribution by reconnecting the feedback loop of peripheral nervous system, and ultimately improve gait. This would also reduce the likelihood of developing foot deformations and ulcers.

Poster Presentation # 089
Isolated CNT Models to RVE-based Continuum Models

Walter Scott
Raghuram Pucha, PhD (Mechanical Engineering)

The manufacture of composite materials that use carbon nanotubes (CNTs) as fillers can be aided by the development of computational models that predict the mechanical properties of the composite. Due to the difference in scale between CNTs and the polymer matrix, molecular scale models are computationally inefficient for predicting composite properties. This creates a need for the development molecular to equivalent continuum models of isolated CNTs for non-linear stress-strain behavior that can be incorporated in to RVE-based continuum models. This research takes two approaches toward the development of isolated continuum models. Molecular mechanics is the representation of a nanotube as a space-frame structure. Bonds between carbon atoms are represented by beams, which exhibit a force-strain behavior described by a modified Morse potential for carbon-carbon bonds. In molecular dynamics, the motion of each individual carbon atom is modeled as the temperature and forces acting upon it due to the interatomic potentials with surrounding atoms. The CNT is placed in a simulation box, with periodic boundary conditions to simulate a bulk system. The model is loaded axially in force increments and stretched in distance increments respectively, with the resulting force and displacement data being used to determine the nonlinear stress-strain behavior of isolated CNT. This data is determined for CNTs of varying lengths, diameters, and chirality will be incorporated in RVE models to predict the stress transfer mechanism and effective modulus of CNT-polymer composites.

Poster Presentation # 043
Microfluidic Approach for Imaging ROS and Calcium Crosstalks during T Cell Activation

Xiaoshan "Melody" Shao
Melissa Kemp, PhD (Biomedical Engineering)

T cells are an important part of the adaptive immune response and become activated by antigen presenting cells in the body. Abnormal T cell activation is connected to multiple autoimmune diseases. Upon activation, T cells undergo a change in intracellular signaling that involves secondary messengers, such as calcium, and reactive oxygen species (ROS). Particularly, the mitochondria, as the energy house of the cell, is where ROS is abundantly produced as a byproduct of increased energy metabolism. The signaling molecules mentioned are interconnected but it has previously been difficult to discern the interactions due to bulk measurements of populations of cells. In this work, we visualized single cell dynamics in a microfluidic device while stimulating them with a specific calcium signal and reporting the intracellular hydrogen peroxide production. To enable the visualization of hydrogen peroxide (H2O2) response of the cells, HyPer plasmid transfected cell lines were used. Yellow

fluorescent protein HyPer can be excited at two different wavelengths to reflect oxidized v.s. reduced states. It can also be localized in sub¬compartments of the cell to indicate H2O 2 concentration of the particular compartment. As such, two cell lines, HyPer¬Mito and HyPer¬Cyto, were used to visualize H2O 2concentration change in the mitochondria and cytoplasm, respectively, under calcium stimulation. This allows us to visualize and better understand the relationship between calcium and hydrogen peroxide behavior across different cell compartments in an unprecedented fashion.

Poster Presentation # 070
The effect of deformation rates on the mechanical properties of dental resin composites using molecular dynamics simulations

Jaeho Shin
Seung Soon Jang, PhD (Materials Science and Engineering)

Improvements in dental composite materials, particularly in resin-based filling composite, have modernized the field of dentistry. Dental resin composites, which are tooth-colored materials used as adhesive or restorative materials, have replaced a mercury in dental amalgam due to aesthetic appeal. Most dental resin composites are composed of bisphenol-A-glycidyl-dimethacrylate (BisGMA) and triethyleneglycol-dimethacrylate (TEGDMA). Despite of these beneficial advances, there are still limitations on the use of composites in dental restoration. Accordingly, our research team have put an increasing effort on researching the mechanical properties of dental composites resins. Regarding the fact that success of the dental resin restoration relies on the molecular nanometer scale interactions between resin polymeric networks and human dental resin, utilization of the molecular dynamics (MD) simulations is a great tool to investigate the mechanical properties of the resin composites in atomistic point of view. MD is a classical molecular simulation tools that imply the Newton's equations of motion into the atomic interactions of the system at discretized simulation time. Monomer complex composed of 1:1 BisGMA and TEGDMA was created by cross-linking reaction using Cerius2 software and Jaguar at 310.15K and 1 atm. Molecular dynamic simulation, LAMMPS, was utilized to perform uniaxial deformation with strain of 50 %. Furthermore, to investigate the effects of different deformation rate, the simulation was performed for 1 nanosecond and 2 nanoseconds. For the analysis, volume change, radial distribution function (RDF), and torsion angle change were investigated which revealed higher flexibility of TEGDMA over BisGMA and significant effects by different deformation rates.

Poster Presentation # 090
Cellulose Nano-Crystals in Lightweight Composites

Arjun Singh
Kyriaki Kalaitzidou, PhD (Mechanical Engineering)

Lightweight composites with high strength and stiffness have been identified as a key cross-cutting technology by automotive industry, considering that a 10% reduction in the vehicle weight can result in 6-8 % increase in fuel efficiency. The focus of this study is making lightweight hybrid sheet molding compound (SMC) composites for automotive applications by replacing the heavier components, i.e. glass fibers (GF), with a small amount of cellulose nanocrystals (CNC) with no penalty on mechanical performance. SMC, which are materials consisting of short GF impregnated between two layers of thermosetting resin, are composites used mainly in automotive structural applications. CNC are cellulose-based nanoparticles and their low density and high mechanical properties make them attractive for reinforcement in polymer composites. At the first stage, CNC up to 0.9 wt% are introduced in a SMC manufacturing line as a dispersion in the epoxy resin (CNC-epoxy) and it was shown that the CNC addition resulted in enhancement of the mechanical properties of short GF/CNC-epoxy SMC composites (35 wt% GF) up to 50% with no weigh penalty. At the second stage, GF/CNC-epoxy SMC composites with 25 wt% GF (10 wt% reduction in GF and 8% reduction in total weight) were enhanced by addition of 1 wt% CNC and it was shown that their mechanical properties are similar to those of SMC composites with 35 wt% GF with no CNC. The results of this study will enlighten the path toward high volume production of lightweight SMC composites with a better performance in automotive industries.

Oral Presentation
Closed-Loop Optimization of Deep Brain Stimulation Programming

Ravinderjit Singh
Stephen DeWeerth, PhD (Biomedical Engineering)

Deep brain stimulation (DBS) is a procedure used to treat movement disorders such as Parkinson's disease. The current procedure for programming the parameters for DBS is time consuming and prone to error. The DBS programming procedure can be significantly improved using a closed-loop optimization approach. Due to recent advances in quantitative assessment metrics, the capability to translate a closed-loop optimization procedure for DBS programming from simulation to clinic has become more possible. Previous literature has presented closed-loop approaches that utilize evolutionary algorithms. It is very difficult to implement an evolutionary algorithm in the clinic because they typically require a large number of parameter evaluations. A parameter evaluation is testing how well a certain set of DBS parameters work. It is difficult to do a large number of parameter evaluations due to time constraints and patient fatigue. A response surface based closed-loop optimization approach for DBS programming is presented that has higher potential to be translated to the clinic because it requires much less parameter evaluations.

Poster Presentation # 091
Development of Facility for Studying Supercritical CO2 Cycle

Won Sup Song
Devesh Ranjan, PhD (Mechanical Engineering)

In an effort to reduce environmental pollution and meet future energy demand, the recompression supercritical carbon dioxide (S-CO2) Brayton cycle is considered to be a potential replacement for the existing power cycles. Besides the environmentally friendly aspects, the S-CO2 Brayton cycle takes advantage of high fluid density near the critical point to reduce the compression work, thereby, increasing the cycle efficiency. There are, however, unidentified characteristics of the setup and associated challenges with building the facility. First, an appropriate design of heat exchanger needs to be determined to maximize the heat transfer efficiency and minimize the pressure drop across the flow. In theory, an offset-fin heat exchanger is expected to give the best performance in terms of both increased heat transfer and reduced pressure drop due to the offset geometry. The heat exchanger is manufactured and assembled with cooling blocks and thermocouples to calculate heat transfer rate by monitoring the temperature across the heat exchanger. An accurate manufacturing of heat exchangers that promises precise positioning of the thermocouples is required to measure temperatures with small steady state error. In addition to the study of heat exchangers, venturi experiment is set up to observe nucleation process near the critical point. A setup that includes compressor, heaters, volume flow controller, pressure regulators, buffer tank, and most important, transparent sapphire windows that enables to observer the process of nucleation is manufactured and assembled. Associated challenges in this setup includes finding an optimized optical lens that can capture the nucleation process accurately.

Oral Presentation
Material Science Industry Mentoring Program

Aaron Stansell; Lakshmi Senthilnathan
Mary Lynn Realff, PhD (Materials Science and Engineering)

Our research is survey based and focuses around the MSE Industry Mentoring Program. Based off of an earlier publication on the program in 2003, we are re-evaluating the program to see if changes implemented since 2003 have had a lasting impact on the following factors: GPA, major retention, graduation rate, time taken to graduate, and likelihood to become a mentor after graduation. The original study indicates positive impacts in all of those areas, and we are hoping to see that those trends have grown significantly over the last 12 years. By collecting and compiling data from students within our mentoring program, within the MSE Department, and within the College of Engineering, we will compare the aforementioned factors and analyze the statistics to reach a conclusion about the impact of our program. Approximately 1000 total mentors and former mentees will take part in our study.

Oral Presentation
Lumped parameter modeling of the left ventricle to study energy loss during aortic regurgitation

Elizabeth Stayduhar
Ajit Yoganathan, PhD (Biomedical Engineering)

Approximately 11% of the aging US population is affected by aortic regurgitation (AR). AR occurs when the aortic valve fails to maintain unidirectional flow of blood from the left ventricle (LV) into the aorta during the diastolic phase of the cardiac cycle. This backward flow of blood results in pressure and volume overload and increased energy loss and cardiac loading in the LV. When clinical intervention is sub-optimally timed, AR is associated with a high mortality rate. Therefore, there is a need for a better understanding of the physiology of the left-heart in order to provide complimentary knowledge to both in-vitro and in-vivo studies. The main objective of this study was to develop a validated Lumped Parameter Model (LPM) of the LV to understand the cardiac loading imposed by AR. The LPM of the left-heart coupled to the systemic circulation was developed using MATLAB. The model was created as a closed loop circuit driven by two current sources within the left-heart, which allowed for the direct calculation of pressure and volume in the LV based on the shape of the blood flow curves. Finding this pressure-volume relationship gives insight into understanding the efficiency of the heart, preload, afterload, and the work done by the LV. The LPM was first validated with in vitro flow and pressure data before introducing a volume overload (AR) on the LV. The LPM was then used to evaluate the increase in energy expenditures as the severity of AR (volume and pressure overload) increased.

Poster Presentation # 044
Developing an anti-inflammatory peptide aptamer in vitro

Yuyan Wang
Ravi Bellamkonda, PhD (Biomedical Engineering)

Modulation of the macrophages polarities has a significant implication in neuro regeneration and scaffold development. It has been shown that M1 macrophages initiate angiogenesis while M2 macrophages promote vessel maturation. M2 macrophages have also been shown to promote the peripheral nerve regeneration in critical-sized nerve injuries. Interleukin-4 (IL-4) is the common cytokine used to promote the polarization of macrophages toward M2 pro-healing phenotype. Though effective, it is a very expensive protein. It calls for a more economical and easy access substitute of IL-4 in developing macrophages polarization related therapies. Ph8, a peptide derived from IL-4, has been shown to be a partial agonist of

IL-4, mimicking its desirable properties and promoting the polarization toward M2 macrophages in AMJ2-C8 mouse cell line. In this study, a peptide aptamer will be developed as a substitute of IL4. Ph8 will be linked with an aptamer specific to the IFN-gamma active site. The complex is hoped to promote the polarization of M2 phenotype, while inhibit the polarization toward M1 phenotype by blocking the active site of IFN-gamma in vitro.

Poster Presentation # 092
Process Monitoring and Control of Exposure Controlled Projection Lithography (ECPL)

Jenny Wang
Amit Jariwala, PhD (Mechanical Engineering)

Exposure controlled projection lithography (ECPL) is an additive manufacturing process in which a liquid photopolymer resin is cross-linked and solidified with UV light patterned by a dynamic mask. This process has promising applications in the fabrication of micro-optic components. In order to produce precise parts, a real-time in-situ measurement and control method is needed. An interferometric curing monitoring (ICM) system is being developed to monitor the ECPL process, using the principles of interference optics to measure small changes in the dimensions of the cured part. In response to these measurements, the process can be controlled by adjusting either the intensity of the irradiated light or the length of the exposure. The measurement model is calibrated with experimental data, comparing the estimated dimensions of a sample to ex-situ measurements using a confocal microscope. This ICM procedure can be used to refine the ECPL system, improving the accuracy and precision of its performance. The resulting ICM signals are prone to errors caused by multiple internal reflections within the resin chamber. Our lab is currently exploring two methods of reducing the impact of these errors. One method is to theoretically model the resin chamber to identify the sources of error and process the signal. The other method is to experimentally isolate the error signals and only capture information at the point of interest. The poster presents my contributions to identify pros and cons of these methods and develop the overall process monitoring and control capability.

Oral Presentation
Experimental Characterization of Salt Microstructure Evolution during Creep

Haiqi Wen; Andrew Li; Leticia Kechemen Watat
Chole Arson, PhD (Civil and Environmental Engineering)

With the variety of industrial and domestic uses of salt rock, learning this material's properties can boost the efficiency and effectiveness of its everyday uses. Salt rock, or "halite", is the chemical compound sodium chloride (NaCl), and provides a plethora of industrial and domestic uses. For instance in the industrial world, many oil and drilling companies will use salt in the production of underground salt caverns where they can store a variety of materials, from natural gas to raw hydrocarbon materials. Understanding salt rock's properties and how it reacts in specific temperature, humidity, and pressures, can help scientists and engineers better understand salt rocks and how to more effectively utilize them in salt cavern storage. In our study, we will be analyzing the microstructures of salt rock through image processing. We will primarily be utilizing MATLAB because of its strong built-in functions and toolboxes. In addition, Avizo will be used for 3D image reconstruction and analysis. As far as our experiment simulation is concerned, comsol multiphysics provide an ideal platform for our model setup, specifically, Fluid Structure Interaction Module, which will be used for calculations. We will also be utilizing GID software for preprocessing and postprocessing mesh simulation, while using Porofis to conduct our calculations. Through our study of salt rock's behavior under creep pressure in certain conditions, we hope that our image and stress analysis of the rock salts will provide interpretable results about salt rock's strain behavior.

Poster Presentation # 093
Microstructural Evolution in Eutectic Zr-Nb Due to Hot Rolling

Jakob Wetmore
Chaitany Deo, PhD (Mechanical Engineering)

Microstructural analysis of interdicted U alloys may suggest processing paths leading to the establishment of the provenance of interdicted nuclear materials. Derivation of the process path functions of thermo-mechanical processing of these materials provides robust computational means to analyze the microstructural evolutions. Phase transformations, morphology and crystallographic texture evolution are investigated in hot rolled eutectic Zr-Nb. Which considered as a surrogate for U-Nb alloy microstructures show the formation of metastable phases on casting and rolling. The Zr-18.8w%Nb alloy is fabricated by arc-melting which results in extra-large grains with no stored strain energy with a β-α microstructure. The alloy specimens are then heat treated in a tube furnace at 900˚C followed by either water quenching or air cooling. XRD, EBSD, and SEM analysis is used to determine the initial microstructures produced during fabrication. The metal ingots are then hot-rolled at 900˚C in increments of 5% reduction in original height from 10% to 60% total reduction before water quenching. XRD, EBSD, and SEM analysis is then performed again and compared with the initial microstructures to determine the evolution.

Poster Presentation # 094
Stress Transfer in CNT Composites: Role of Interface and Interphase

Rebecca Withers; Won Sup Song
Raghuram Pucha, PhD (Mechanical Engineering)

In polymer composites interface may be described as the boundary between two layers of different chemistry and/or microstructure[1]. However, such boundaries are rarely devoid of chemical interaction, and therefore one can define a region, called the interphase, being the volume of material affected by the interaction at the interface. The term interphase, a three-dimensional zone, as distinct from a two dimensional interface, indicate the presence of a chemically or mechanically altered zone between adjacent phases. An interphase zone will lead to a gradation of properties from one phase to another, rather than the abrupt change necessitated by the acceptance of a two-dimensional interface. In this work the role of interface/interphase is studied in CNT polymer composites and vertically aligned CNT reinforced 3D composites. RVE models are developed and the role of interface/interphase is studied on stress transfer efficiency of composites. Both unit cell and multi-filler RVE models are presented. The effective tensile modulus of composite is considered as a matric for CNT polymer composites and interlaminar stress is considered as a matric for vertically aligned CNT reinforced 3D composites. The interphase zone is modeled with constant, linear and graded properties between polymer and CNT filler. [1] D. A. Jesson and J. F. Watts, "The Interface and Interphase in Polymer Matrix Composites: Effect on Mechanical Properties and Methods for Identification," Polymer Reviews, vol. 52, pp. 321-354, 2012/07/01 2012.

Poster Presentation # 095
Why Farts Matter

James Wroe
David Hu, PhD (Mechanical Engineering)

Animal farts are responsible for around 6% of all greenhouse emissions. Furthermore, the amount of time a mammal takes to fart increases with its body mass. We found there were similarities the gas production of animals, the pitch of their farting, and the dimensions of their anus. We aim to better understand what causes farts and why they behave the way they do.

Poster Presentation # 045
Study of Chronic Change of Hepatic Blood Flow Distribution (HFD) of Fontan Patients

Wenjun Wu
Ajit Yoganathan, PhD (Biomedical Engineering)

Single ventricle congenital heart defects affect 2 in 1000 births. Children born with this defects have only one functional ventricle, which must drive blood through both the systemic and pulmonary circulations. In this case, surgical correction is necessary, and the common procedure is the Fontan operation. Fontan operation is a multi-staged surgery and culminates in a total cavopulmonary connection (TCPC) which directly routes venous return to the pulmonary circulation by bypassing the heart. In general, short-term outcomes can be achieved, nonetheless long-term complications endanger Fontan survivors. Previous studies ascribed some complications to compromised hemodynamics in Fontan. For example, pulmonary arteriovenous malformations were attributed to unbalanced hepatic factor to both lungs (HFD), and energetic dissipation through the TCPC is linked to limited exercise capacity. In order to assess complicated Fontan hemodynamics, computational fluid dynamics have been involved in the past decade. It was also used to understand and optimize the surgical strategies/connections on a patient-specific basis. However, most optimizations were targeted to hemodynamics immediately after the surgery instead of chronic changes. Nevertheless, growth is unavoidable for young patients. Recently, Restrepo et al initiated the investigation on evolvement of Fontan anatomy and flows, as well as chronic changes of the hemodynamic performance. However, they mainly focused on the TCPC energetics and marginally discussed the HFD. To bridge the gap, I retrospective analyzed serial cardiac magnetic resonance scans of a 50 patient and explored the chronic changes of HFD.

Poster Presentation # 096
Investigating inkjet printing methods on a standard FDM printer for low-cost fabrication of three dimensional polymer objects

Dong Yeon Yoo
Hang Qi, PhD (Mechanical Engineering)

The objective of this research is to investigate the possibility of applying conventional inkjet printing methods on a standard fused deposition modeling printer for low-cost fabrication of three dimensional polymer objects. The motivation lies on the previous work of verifying the possibility of transforming a conventional Epson C88+ inkjet printer into a flatbed printing machine that can print ink on the medium choice other than office paper. Attempts were made to test different ink substitutes such as Diamine Silver Acetate (DSA) and VeroWhitePlus (a polyjet material by Stratasys), but both of these inks were too viscous to be injected through the cartridge nozzles even at increased temperatures, resulting in clogging. A different approach of using an off-the-shelf HP C6602 inkjet cartridge has been determined to be capable of printing ultraviolet curable inks. In response to a signal given by the print controller, a minute amount of current flows through a metal plate within the heating element of the ink reservoir, which then vaporizes the ink into a steam bubble inside the nozzle. This forces the ink droplet out of the nozzle and deposits onto the print bed. An Arduino Mega controller with a compatible InkShield was used to provide control over the cartridge nozzles. Hexanediol diacrylate (HDDA) and polyethylene glycol dimethacrylate (PEGDMA) has been proven to be both UV curable as well as low in viscosity to be jetted out of the cartridge nozzles. By injecting these custom inks into the cartridge, they can be deposited onto the print medium and can

be cured using a high wattage LED. Repeating this process over the same area will result in a three-dimensional polymer solid with the printed layers stacking up in the z-direction. A custom dual cartridge printhead assembly has been designed to enable immediate curing of the ink as it is deposited.

Oral Presentation
Design and Fabrication of More efficient method of capturing specific antibodies

Hee Young Yoon; Olivia Taylor; Joseph Buehler
Todd Sucichek, PhD (Mechanical Engineering)

The objective of this project is to design and create efficient Janus particles that utilize the two bi-functional surface properties to capture antibodies. This implementation of cell biology to micro-particles can overcome challenges such as the Ebola crisis back in 2013. Currently, it is extremely difficult to extract antibodies of rare diseases. Therefore we are working to create a novel method of detecting and collecting such antibodies ex-vivo. We have found the optimal size and material of the micro-particles to achieve future milestones. We will first demonstrate that the micro-particles can be bound to antibody secreting cells via targeting of the antibodies in vitro. Also, with the optimal size and material, we will create Janus particles with bi-functionality to collect antibodies directly from cells supplied from our collaborator from Emory University. Lastly, we will validate antigens that can be used to tag the collected antibody and determine if tri-color flow cytometry can detect the complex (antibody secreting cells, beads, collected antibodies, and bound antigens). With successful antibody collection, we can target collection using Janus particles.

Poster Presentation # 057
A new method to predict packing behavior of particles in fluid-fluid interfaces

Ruiyang Zhao
Svens Behrens, PhD (Chemical and Biomolecular Engineering)

The concentration of colloidal particles adsorbed to a fluid-fluid interface, which can be quantified as a particle packing density or area fraction, plays a central role in many scientific problems and practical applications found, for example, in the stabilization of foams and emulsions, food processing, and in the colloidal assembly of functional microcapsules for pharmaceutical, agrochemical, or cosmetic formulations. Predicting the packing density of interfacially adsorbed particles can be difficult, because it is strongly influenced, in ways that are not well understood, by the interaction between particles adsorbed in the interface and the distributions of particle sizes and shapes. Similarly is can be challenging to determine the packing density experimentally, especially for small particles or nanoparticles with a wide distribution of sizes or shapes. Considerable efforts have been devoted to the development of methods that allow the measurement of the particle packing density at the fluid-fluid interfaces, involving e.g. in situ small-angle X-ray or neutron scattering (SAXS, SANS) or grazing incidence X-ray scattering (GISAXS), which can yield reliable data about the average center-to-center distance between adjacent particles. However, these methods require complex sample preparation and sophisticated instruments. Here, we demonstrate that dynamic surface tension measurement, when combined with information about the particles' wetting properties, provide a convenient and accurate way to assess the packing density of particles in fluid-fluid interfaces. The proposed method will be useful for studying the adsorption behavior of particles at fluid-fluid interfaces, and help in the directed assembly of particles for various applications.

Poster Presentation # 097
How Sweat Helps Us Grip

Youmei Zhou
David Hu, PhD (Mechanical Engineering)

A single finger can lift a glass microscope slide! Researchers have proposed that moisture and capillary forces could explain this phenomenon, but this mechanism is not fully understood. Tiny beads of sweat that cover the fingertip create significant surface tension and adhesion forces that can lift objects. We model these forces and compare the human fingertip with the fingertips of other mammals that sweat from their hands and paws. This novel research can lead to advances in prosthetics, interactive electronics, and forensics.

Oral Presentation
Density Function Theory Modeling of Boron Doped Graphene for Energy Storage Applications

Yuntong Zhu
Seung Soon Jang, PhD (Materials Science and Engineering)

Suitably designed carbon-base compounds are promising electrode materials for rechargeable batteries because of the high availability and light weight feature comparing to transition metal oxides. Herein, a series of boron doped graphene materials with different boron concentrations and boron locations are designed and investigated by using density functional theory (DFT) calculation. The electron affinity and HOMO/LUMO energies are calculated to estimate their suitability as electrode materials for lithium and sodium batteries. In this work, C24H12 is employed to conduct the DFT computation. The results show that the amount of boron doping has strong effect on the electron affinity, while the location of boron doping has large impact on the HOMO/LUMO energies. Boron doping significantly increases the electron affinity of graphene. With one boron atom, three possible substitution positions are studied and the edge position delivers the highest electron affinity. With respect to the cases with two or three boron atoms, the relative distance between doped boron atoms impose considerable

impact on electron affinity of the doped graphene. Not only the HOMO/LUMO energies but also the gap between HOMO and LUMO energies can be tailored by adjusting the amount and patterns of boron doping in the graphene structure. These basic properties can affect the electrode capacity, reaction potential, electrode reaction kinetics and structural stability of the boron doped graphene. This work provides better understanding of the graphene property evaluation and valuable information for high performance material design for rechargeable batteries and hydrogen storage devices.

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Poster Presentation # 103
Identification of New Players in the Mechanism of DNA Double Break Strand Repair by RNA in Yeast Cells

Marina Ali
Fracesca Storici, PhD (Biology)

A double strand break (DSB) in DNA can result from an endogenous damage, like a reactive oxygen species, or exogenous damage like radiation or chemicals. DSBs are especially dangerous, because they can cause mutations and chromosomal rearrangements, leading to cell death or cancer. The body fixes DSBs by homologous recombination (HR) or non-homologous end joining (NHEJ). Previous research has shown that genetic information on transcript RNA can mediate DSB repair in yeast cells in a homology-driven manner. Specific mutations were generated in HR genes, and then the frequency of DSB repair by cDNA and transcript RNA was quantified. In my work, I am using an overexpression screening of yeast genes to determine if any of these genes, when expressed at high levels, alter and enhance the frequency of DSB repair by RNA in yeast. So far, I have screened more than 4,300 clones and I have found potential candidates that show a relatively higher frequency of DSB repair by RNA compared to control cells. For the future, I plan on continuing my screen, and at the same time, verifying whether or not the potential candidates show a reproducible higher frequency of DSB repair by RNA.

Oral Presentation
Coordination and Control of Flight in the Hawk Moth Manduca sexta

Rachel Barker
Simon Sponberg, PhD (Physics)

When observing complex animal locomotion, often there is more than meets the eye. An internal controller, the nervous system, navigates highly dynamic behaviors in animals. How exactly the nervous system provides control presents an intriguing question; however, both the mechanical and neurological aspects of behavior must be taken into consideration. Hawk moths are incredible dynamic systems. They can maintain stable hovering flight even in the presence of intense wind and drink from oscillating flowers with great precision. Animals, in general, are feedback control systems. For example, when a moth tracks a flower, it takes in sensory information about its surroundings (its location relative to the flower, the air hitting the wings as they beat, etc.), processes that information in the central nervous system, and sends out motor commands which dictate how the animal moves in order to achieve its goal to maintain a position of close proximity to the flower. This project looks at input-output relationships in the control system of the hawk moth Manduca sexta and their implications on neural control. Differential electromyogram recordings were taken from 10 major flight muscles of the hawk moth during tethered flight. These recordings showed differences in phase relationships and activation between steering muscles and power muscles while moths were performing turning maneuvers. Searching for such patterns of variation associated with mechanical output and determining whether they remain constant across behaviors shines light on the structure of motor coordination and generates a deeper understanding of this segment the feedback control system.

Poster Presentation # 114
Designing a Quadrupole Magnetic Field for a 2-D Atom Trap

Piero Chiappina
Kenneth Brown, PhD (Chemistry and Biochemistry)

The Brown Lab at Georgia Tech is looking to produce a two-dimensional, hybrid cold atom and ion trap set up in which laser cooled atoms and ions coexist in a region of confinement. Although hybrid atom ion traps already exist in three dimensions , a two dimensional magneto-optical trap (MOTion trap for short) provides significant advantages over the 3D configurations, such as the ability to get better overlap between the trapped atom and ion clouds, and a host of technological benefits arising due to miniaturization. The MOTion trap consists of two main parts; the first is a surface electrode ion trap that provides an oscillating RF field that facilitates the trapping of ions, which are then Doppler cooled using laser beams. The second is a pencil shaped magneto-optical trap (MOT), which traps atoms using laser beams that reflect off the polished electrode of the ion trap. To achieve spatial confinement of atoms in a MOT, we must design a magnetic field such that there is an area of zero magnetic field where the atoms are trapped and a strong magnetic field gradient outside the zero field region. This magnetic field gradient produces a Zeeman shift of the hyperfine levels of the atoms, and the MOT lasers exert a force such that the atoms are directed towards the center zero field. My project consists of modeling, designing, and building the magnets to produce the required magnetic field.

Oral Presentation
Effect of Dispersion on the Description of Electronic and Vibrational Properties of Organic Charge-Transfer Crystals

Nathan Corbin
Veaceslav Coropceanu, PhD (Chemistry and Biochemistry)

Charge-transfer organic semiconductors based on electron donors and electron acceptors arranged in a mixed-stack configuration have been widely investigated in recent years. A fundamental understanding of the structural and electronic properties of these semiconductors is essential for developing novel materials with improved performance. Previously, we have used density functional theory (DFT) to study the electronic properties of these crystals and investigate the effect of non-local Hartree-Fock exchange on electronic structure and crystal vibrations. However, conventional DFT approaches miss dispersive interactions, which are known to be significant in molecular crystals. In this work, we examine the impact of empirical dispersion corrections on the cohesive energy, crystal structure, Γ-point vibrations, and thermodynamic stability of two charge-transfer organic semiconductors: anthracene-PMDA (PMDA = pyromellitic dianhydride) and anthracene-TCNQ (TCNQ = 7,7,8,8-tetracyanoquinodimethane). Our results indicate that dispersion interactions strongly affect the lattice parameters, lattice phonons, and sublimation enthalpies of both studied systems. We show that the DFT-D (dispersion) computational results agree very well with the related experimental data. We also found that the inclusion of dispersion corrections is necessary to explain the thermodynamic stability of the present crystals.

Poster Presentation # 099
Inter-Joint Coordination and Movement Decomposition in Post-Stroke Gait

Oliver Daliet
Trisha Kesar, PhD (Applied Physiology)

The term gait refers to the pattern of walking exhibited by a particular individual and is composed of one or more gait cycles. The gait cycle of individuals with post stroke hemiparesis is characterized by abnormalities in both inter-joint coordination and intra-joint coordination. In this study, our purpose was to compare inter-joint coordination of the paretic and non-paretic legs of individuals with post-stroke hemiparesis. Gait analysis was performed on ten post-stroke individuals and ten able-bodied individuals using an instrumented treadmill at a self-selected speed. The data collected from these trials were used to calculate two measures of inter-joint coordination. The first was the average coefficient of correspondence (ACC), which measures the consistency of the strides across multiple gait cycles. The second measure was the decomposition index (DCI), which is an average measure of the "smoothness" of the trajectories in each gait cycle. The innovation of this study is that it is the first systematic investigation of defecates in both hip-knee and knee-ankle in the paretic and non-paretic lower limbs post-stroke. Furthermore, at the time this study was conducted, DCI was not known to have been used to analyze post-stroke gait.

Oral Presentation
Formation and Characterization of Semi-permeable Inorganic Membranes using a Microfluidic Device

Max Dorn
Amanda Stockton, PhD (Chemistry and Biochemistry)

Icy moons such as Enceladus and Europa are perhaps the most common habitable environment in the universe. These moons are characterized by a rocky core surrounded by a subsurface ocean and an icy crust. It is at the rock-ocean interface that hydrothermal activity has been confirmed on Enceladus by the Cassini-Huygens spacecraft. The putative hydrothermal vent systems are likely deep-sea alkaline hydrothermal vents due to the probable lack of ongoing magmatic processes. These vents form an inorganic semi-permeable membrane when the alkaline vent fluid is introduced to seawater containing iron ions. My research takes advantage of laminar flow in order to model these alkaline hydrothermal vent systems on a microfluidic device in a controllable and highly reproducible fashion. Iron-sulfide membranes were chosen to be models as these inorganic membranes have crystal structures that resemble the active sites of many enzymes required for carbon fixation and energy transduction. Solutions consisting of 0.1–5.0 mM FeCl2 at a pH range from 2–5, were introduced to solutions consisting of 0.1–5.0 mM Na2S at pH at ~11-12 on a microfluidic chip to form these membranes. The inorganic membranes are being characterized via microscopy to determine thickness as a function of concentration, flow rate, and pH. In addition, the formation times were are being characterized as a function of concentration, flow rate, and pH.

Poster Presentation # 119
The Effects of Hysteresis on the Dynamic Contact Line

Samuel Finley-Price
Peter Yunker, PhD (Physics)

While a drop of rain rolling down a window may appear simple, fascinating dynamics occur at the drop edge. Liquid, solid, and gas meet at the drop's edge, known as the three phase contact line. Interestingly, the direction that the contact line moves affects the drop's shape; prior work found that the contact angle of the drop is different depending on if the contact line advances or recedes. We intend better understand the moving contact line by using this hysteresis to drive the contact line across a solid surface. To accomplish this we lowered a 3D printed substrate into a tank of water and observed how quickly the contact line travels across its surface. The 3D printed substrate has small ridges oriented horizontally across the piece, so that in order for the contact line to rise back up the piece, and thus minimize its free energy, it must first travel along each ridge. The farther the contact line is pushed below the surface, the faster it moves across the substrate. Surprisingly, when the substrate is pulled

above the water's surface the opposite is true; the farther the contact line is pulled above the surface, the slower the contact line moves.

Poster Presentation # 104
Contact with Macroalgae Affects the Pocillopora verrucosa Microbiome

Shelby Gantt
Fracesca Storici, PhD (Biology)

Hard coral cover is in decline and this decline has generally coincided with macroalgal proliferation in coral reefs (Gardner et al. 2003, Cheal et al. 2010, De'ath et al. 2012). Coral degradation can be caused by many variables (Hoegh-Guldberg et al. 2007, Anthony et al. 2008, Mumby and Steneck 2008) but this study is focused on potential degradation due to direct competition with allelopathic macroalgae under high CO2. Specifically, this study describes how allelopathy by macroalgae affects the microbiome of the reef-building coral Pocillopora verrucosa under high CO2 conditions, 1000 ppm. This study examined this by using the pre-established scale of allelopathic algae demonstrated in Rasher et al. (2011) and placing the algae in contact with corals in CO2 controlled flume systems for about 3 weeks. The taxonomic composition of the coral-associated microbial community (microbiome) from each sample was then analyzed by Illumina sequencing of the bacterial 16S rRNA gene. The experiment demonstrated differences in coral microbiome composition when in the presence of the various macroalgae (Chlorodesmis fastigiata, Amansia rhodantha, and Turbinaria ornata). The corals that showed low PAM readings, indicating reduced coral health and productivity, were the corals in contact with the most allelopathic algae. There was no significant difference between the high and normal CO2 treatments in PAM readings, though the higher CO2 treatment showed more stressing on average. Ultimately, this study explored whether there is a connection between CO2 concentrations and algal allelopathic tendency and whether there is an allelopathic effect on the microbiome of the coral host.

Poster Presentation # 105
Repairing Double Stranded Breaks With DNA-RNA Hybrids: Where in the Yeast Genome is it?

Katherine Gordon
Raghuram Pucha, PhD (Mechanical Engineering)

This research project aims to determine the genetic loci within the yeast genome in which DNA-RNA hybrids can repair Double Stranded Breaks (DSB) in DNA. To test this, we first introduce a plasmid into the yeast strain. Each plasmid contains a vector that includes a different portion of the yeast genome as well as the Gal promoter, which induces a DSB in the His gene. The yeast colonies that contain these plasmids are grown on media that turn on the Gal promoter to induce the DSB. Once the break is induced, the colonies are grown on media that lacks histidine. This selects for colonies that can produce histidine on their own, which only occurs if the DSB in the His gene is repaired. By comparing the successful colonies on His with a control strain, we can determine which colonies underwent more repair. The colonies that have more repair are sequenced in order to determine what part of the yeast genome was inserted into those colonies. With this study, we expect to identify the specific loci within the yeast genome that can successfully undergo DSB repair via a DNA-RNA hybrid. Identifying the locations within the yeast genome where DSB repair can occur via a DNA-RNA hybrid will aid in further studies of this mechanism.

Poster Presentation # 106
Identification of plant species in the honey of Apis mellifera using real-time PCR analysis

Hannah Greene; Lauren Pitz
Jennifer Leavey, PhD (Biology)

Identifying exactly which plant species are visited by Apis mellifera, the European honey bee, for pollen and nectar sources can be difficult due to the vast number of flowers visited by just one bee. Urban honey bees have the unique challenge of a much more restricted selection of plants to forage from, and these restrictions can have adverse effects on colony health. This study attempted to design primers for the internal transcribed spacer regions (ITS) of ribosomal DNA of four plant species that are known to be frequently visited by honey bees: Nyssa sylvatica, Acer saccharum, Oxydendrum arboreum, and Liriodendron tulipifera. Plant DNA was extracted from honey, and real time PCR analysis will be conducted to determine the presence and abundance of the four specified species. Primers for the four species have been designed, and we are currently in the process of amplifying extracted plant DNA using PCR before conducting real-time PCR with DNA collected from honey. By detecting the of abundance of various plant species in honey, we can determine which plants are most vital to the survival of Apis mellifera populations, and therefore which species to plant in order to best provide adequate honey bee nutrition. Honey bees are a critical part to a majority of ecosystems in the United States, and it is crucial that we take every measure to secure their survival.

Poster Presentation # 115
Heme Mitochondrial Retrograde Signaling

Rebecca Hu
Amit Reddi, PhD (Chemistry and Biochemistry)

The mitochondrion is a crucial organelle for cellular metabolism. Mitochondrial retrograde signaling (MRS) is a pathway that enables the mitochondria to communicate with the nucleus to regulate gene expression and enable the cell to adapt to changes in mitochondrial function. The importance of MRS in health and disease is shown by its role in the pathogenesis and progression

of diseases from cancer to neurodegenerative disorders. However, the signals that mediate MRS are not well understood. Because heme is a mitochondrial derived metabolite and there are numerous heme-dependent nuclear transcription factors, we propose that heme acts as a signaling molecule that mediates MRS. We will investigate heme's role as a signaling molecule via heavy metal induced mitochondrial and cellular stress in tandem with our novel genetically encoded heme sensor.

Poster Presentation # 116
Planar Traps as a Method of Cell Sorting

Brendan Kemple
Kenneth Brown, PhD (Chemistry and Biochemistry)

Cell printing is an exciting new form of bioengineering that allows us to insert tissue into an already living organism. Printing works best when cells are quantified and separated based on their fluorescence, which can elucidate characteristics about the cells. Quatification and separation is accomplished through cell sorting. This experiment examines a new strategy for sorting and quantifying a solution of cells for use in cell printing. A piezoelectric dropper with a high-voltage component is used to charge drops as they exit the nozzle, and using a planar ion trap, are caught in an electric field. Cells present in the solution are marked with fluorescent nanoparticles that adhere to the cells. Examining the number of photons that pass through a light filter allows us to determine when there is a cell present in the drop. Future research should allow us to develop a program for sorting the drops based on the photon count, and yield large and exact numbers of cells in a short period of time. Sorting the cells in this manner will allow us to propose a new technique for obtaining and utilizing cells for the purposes of cell printing and many other possible scenarios, and also allows us to have direct control over the motion of each droplet. This new procedure will give us many advantages over the FACS methodology in use currently, such as greater control over droplet motion, simpler electronics by applying a uniform voltage, and branching our traps into many bins for collection.

Poster Presentation # 100
Walking with a transtibial osseointegrated prosthesis attached via a porous titanium implant

Vikram Kumar
Boris Priloutsky, PhD (Applied Physiology)

The focus of this research was on investigating loading of the transtibial prosthesis and compensatory adjustments made by the intact limbs in the cats following the surgical insertion of a porous, osseointegrated hindlimb prosthetic. This research is important to further understand the extent of integration of a porous titanium implant with the residual limb and gait changes following prosthetic implantation. The hypotheses tested were that (1) there would be infection free integration of the porous titanium implant with the residual limb, (2) the ground reaction force of the hindlimb with the prosthetic will be lower than the ground reaction force of that limb prior to the prosthetic attachment due to the fact that the ankle joint was missing in the prosthetic limb. Kinematic and ground reaction force data were collected on the cat walking across a force plate wearing reflective markers prior to and following the surgical attachment of the prosthetic. At the end of the experiment, the animals were euthanized and the limb with implant was harvested for a histological analysis. The behavioral observations and histological analysis indicated no signs of pain, discomfort or infection. The animals loaded the prosthetic limb during standing and walking, however the loading was lower than before surgery. The lower loading of the prosthetic limb was compensated by greater loading of the intact limbs. It was concluded that porous titanium implant has the potential for infection free integration with the residual limb after loading the implant during standing and walking.

Poster Presentation # 107
Modulating DNA methylation for efficient neural differentiation of stem cells

Leyla Larsson
Yuhong Fan, PhD (Biology)

Epigenetic mechanisms are fundamental for gene regulation and transcription, which in turn are crucial to proper functioning of the central nervous system (CNS). Numerous neurological and psychiatric diseases are caused by malfunctions in the CNS. Since epigenetic marks do not affect DNA sequence and are reversible, epigenetic regulation provides an attractive method to treat different types of neurological diseases. DNA methylation, catalyzed by DNA methyltransferases (DNMTs), is an essential epigenetic process for the proper functioning of CNS. Here, I will investigate the impact of DNMT modulation on neural stem cell (NSC) differentiation into the different neural cells, such as neurons, astrocytes, and oligodendrocytes. The results will offer insights as to how DNA methylation can be reprogrammed for effective neural differentiation of stem cells.

Poster Presentation # 108
Identification of biomarkers for the early detection of ovarian cancer: an application of NMR based metabolomics

Kathryn Martin
Julia Kubanek, PhD (Biology)

Ovarian cancer is the leading cause of death from gynecological cancers. A more accurate and efficient detection method is needed as current screening methods are inaccurate, time-intensive, and expensive. 1H NMR metabolomics of urine samples is fast, effective, and accurate in distinguishing between cancerous and non-cancerous subjects in a mouse-model. This

technique should be translated to human subjects to identify biomarkers for the early detection of ovarian cancer.

Oral Presentation
Favia Corals: a new Paleoclimate archive

Shellby Miller
Kim Cobb, PhD (Earth and Atmospheric Sciences)

Projections of future climate change contain large uncertainties stemming from our inability to confirm long-term trends in climate models with short instrumental records. Fossil corals are an important archive of past climate changes in the tropical oceans as oxygen isotopic ratios (δ18O) in their skeletons reflect ambient ocean temperature and salinity during the time they grew. To date, most coral-based reconstructions have utilized cores from the genus Porites. However, this genus is neither evenly distributed across the tropics nor continuously available within the fossil record, so there is a pressing need to expand the types of corals available for reconstruction. Here, we test Favia species from Kiritimati Island (2°N, 157°W) as a paleoclimate recorder by comparing different δ18O timeseries from within a single coral as well as across multiple corals with instrumental sea-surface temperature (SST). There are significant and consistent differences between coral δ18O profiles sampled along thecal versus septa walls, and δ18O in the thecal wall is more reproducible, and more coherent with SST. Slow growth rates (8-10mm/yr), and small inter-colony δ18O offsets suggest that Favia may be an untapped climate archive that is capable of providing robust constraints on natural climate variability in the tropical Pacific. Applying our sampling protocols to two fossil Favia corals from the early 19th century, we demonstrate that high-resolution, accurate reconstructions of ENSO and mean climate in the central tropical Pacific are achievable with Favia corals.

Oral Presentation
How to ride a bike: Adaptation to a Split-Crank Ergometer

Allison Moczynski
Young-Hui Chang, PhD (Applied Physiology)

Asymmetric locomotion can cause a variety of adverse effects, such as unnecessary torques, inefficient force outputs, and overuse injuries in the joints. Split-crank ergometers, in which the bracket connecting the cranks has been cut, have the potential to increase interlimb symmetry. We hypothesized that able-bodied individuals would adapt to a split-crank ergometer in such a way that they increase the symmetry of force output and pedal phasing, while exhibiting consolidation and savings on a subsequent day. Data were collected on 9 able-bodied subjects over a period of two days. Data from 5 of these subjects was analyzed (4 males; age: 29.4 ± 8.4 years; mass: 87.14 ± 3.8 kg; leg length: 92.8 ± 0.16 cm). Subjects pedaled for five 5-minute trials on Day 1 and one 5-minute trial on Day 2. Crank offset decreased by 38.3% on Day 1 from the first minute of pedaling in trial 1 and the last minute of pedaling in trial 5. The crank offsets after 5 minutes of cycling on Day 2 were similar to the crank offsets after 25 minutes of cycling on Day 1; however, the rate of decrease in crank offsets during Day 2 did not change. Resultant forces were not asymmetric during any of the trials and did not change over time. Therefore, our preliminary results show that subjects were able to: (1) adapt to the ergometer, (2) exhibit consolidation but not savings, (3) maintain symmetric resultant forces, (4) modulate something other than resultant force output to improve interlimb symmetry.

Poster Presentation # 101
Does Dehydration Impact Eye-Hand Motor Coordinatorion?

Asahi Murata
Melinda Millard-Stafford, PhD (Applied Physiology)

Recent evidence suggests dehydration may compromise performance on tasks involving the sensorimotor system (e.g. driving). PURPOSE: This study investigated the effects of moderate dehydration due to exercise on eye-hand motor coordination. METHODS: Ten subjects (5 M, 5 F, 24.3 ± 8.2 y) completed 3 h of exercise-heat stress (45 °C, 15 % RH) with 45 min walk/ 15 min rest cycles without fluid replacement (dehydration; DEH) and with replacement of 100% sweat loss (euhydration; EUH). Following exercise-heat stress, a test of eye-hand motor coordination (pursuit rotor; PR) was assessed at two speeds: slow (SLOW; 8) and fast (FAST; 12 rpm). RESULTS: Body mass (BM) significantly decreased during DEH (-2.8 ± 0.5) compared to EUH (-0.3 ± 0.4 %; $p < 0.001$). Differences ($p < 0.001$) were observed in PR accuracy (85.7 ± 7.3, 70.4 ± 9.8 %), time on target (12842 ± 1106, 10526 ± 1474 ms), and deviation (719 ± 539, 2045 ± 1256 pixels) at SLOW and FAST, respectively. No effect ($p > 0.05$) of dehydration was observed for accuracy (EUH: 84.5 ± 8.8, 71.1 ± 10.4; DEH: 87.5 ± 4.9, 72.7 ± 6.2 %), time on target (EUH: 12681 ± 1324, 10644 ± 1556; DEH: 13120 ± 753, 10863 ± 939 ms), and deviation (EUH: 792 ± 510, 1927 ± 1045; DEH: 582 ± 388, 1781 ± 830 pixels). CONCLUSION: Moderate dehydration (~3 % BM loss) did not degrade eye-hand motor coordination, indicating other sensorimotor components are likely responsible for tasks reported to be influenced by dehydration.

Oral Presentation
Near-real-time interactive simulations of complex cardiac cell models in tissue: OpenACC Edition

Amier Naji
Flavio Fenton, PhD (Physics)

Computational modeling has become a new tool to study biological systems in detail. It can complement and sometimes

even guide experiments. In relation to the study of cardiac dynamics and arrhythmias, a large number of heart cell models have been developed over the past few decades[1]. In the past, their complexity has restricted simulation studies to supercomputers and therefore to a handful of research labs in the world. However the use of graphic processing units or GPUs, now standard in most devices, contain multiprocessors that allow parallelization and can effectively act as personal supercomputers. Because of this, it is now possible to create programs of complex cell models that can simulate the electrical activation of cardiac tissue that anyone (from researchers and clinicians to the general public) can run to study and to understand how normal rhythms and arrhythmias are generated in the heart.

Poster Presentation # 121
Listening to Stories

Tiffany Nguyen
Eric Schumacher, PhD (Psychology)

Engaging narratives seem to have limitless abilities—the power to transport readers and viewers into the narrative world, cause narrative-consistent attitudes to be accepted, and persuade readers and viewers to suspend disbelief when narrative aspects are incongruent with reality. The persuasiveness of narratives to affect beliefs and behaviors have been attested to, enjoyed and feared. Research suggests a specific set of brain systems are associated with the feeling of persuasion and is consistent with the idea that persuasion is changing the mental state of an individual to the mental state of the message source. The research body also suggests the complex interconnectivity between brain systems on the encoding of persuasive media and resulting behavioral changes, however research on narratives as a media have been slim. In combination with behavioral findings our research on the neural network encoding of weak or strong arguments within or without a narrative context will clarify how the interplay of suspected brain regions have on a change in participant opinion and provide new information on when weak arguments are presented within narratives. Our preliminary data show increased activity in the ventromedial prefrontal cortex, a region that assigns a value to a message based on an individual's motivations and goals, and the medial prefrontal cortex, shown to be relevant in the processing of persuasive messages and has been previously used to predict spontaneous motor movement before the formation of motor intention which may be involved in behavioral intention and change.

Poster Presentation # 109
Generalizing Disease Association in Non-study Populations

Kane Patel
Joseph Lachance, PhD (Biology)

In this study, I look to see if risk allele frequencies (RAFs) for common diseases can be generalized in genome wide association surveys (GWASs) that are done in different populations other than the original study population. To test this, I compare RAFs gathered from the NHRI-EBI GWAS Catalog and 1000 Genomes Project by study population and see if there is bias towards the study population. If the trend is present, I then look to answer the question of whether or not this is due to an inherent bias from the study population, or a pre-ascertained bias in the genotyping SNP chip array. To test if there is bias in the technology, I compare allele frequencies for disease SNPs and non-disease SNPs on Illumina1M and Affymetrix 6.0 genotyping arrays. If the bias still persists, then there is an inherent bias due to the study population alone. At this point, I examine the role of other contributing factors to differences in disease allele frequencies across populations. These include: type of disease, number of participants in the GWAS, whether alleles have a large effect, etc.

Poster Presentation # 122
Patterns of Responsive Gaze Behavior: An Investigation of Infants Exposed to Sign Language

Hannah Perkins; Clare Botti; Margaret Jensen
Jenny Singleton, PhD (Psychology)

A study by Singleton & Brooks (2015) suggested that infants exposed to a signed language appear to show earlier self-regulation of gaze-following behavior. We examined the dataset from Singleton & Brooks (2015) involving data collected from 12 infants (ages 8-16 months; 50% female), all previously exposed to American Sign Language (ASL) at birth. Of the 12 sign-exposed infants, 4 are hearing infants of deaf parents (HoD) and 8 are deaf infants born to deaf parents (DoD). The experimental protocol from Singleton & Brooks (2015) featured four target trials designed to elicit infant gaze shifting as well as intertrial toy play. We used Mundy's paradigm of infant joint attention and identified episodes of Responding to Joint Attention (RJA) (Mundy et al., 2007) within squirrel and duck toy play interactions. RJA was classified as anytime the infant looked to the experimenter following a sign or expression from the experimenter. We were able to capture the response latencies of infant's RJA, i.e., how long it took each infant to respond to the experimenter's communication bid. Across the 12 infants, the RJA range was 0.02 to 4.95 seconds. We found that the older group of infants had a quicker average response time of 0.83 second for squirrels and 0.98 second for ducks, compared to the younger infants (0.97 second and 1.36 seconds, respectively). These preliminary findings show a developmental trend (younger vs. older) suggesting that older infants have learned to visually respond more quickly to a signing adult's bid for communication. References Mundy, P., Block, J., Delgado, C., Pomares, Y., Van Hecke, A.V., & Parlade, M.V. (2007). Individual differences and the development of joint attention in infancy. Child Dev, 78(3), 938-954. Singleton, J.L & Brooks, R. (2015). Gaze following and gaze alternation: A comparison of infants with and without early

sign language experience. Symposium Panel Presentation, Society for Research in Child Development. Philadelphia, PA. Vaughn, S. (2015). Title. Unpublished paper submitted in fulfillment of first year doctoral program research project. School of Psychology. Georgia Institute of Technology. Atlanta, GA.

Poster Presentation # 117
Towards the Synthesis of Small Silver Clusters

Andrew Royappa
Joseph Sadighi, PhD (Chemistry and Biochemistry)

Silver, like many other transition metals, is a useful catalyst for a variety of important chemical processes, such as the industrial production of ethylene oxide, asymmetric cycloadditions, group transfer reactions and many others. Our mechanistic understanding of silver catalysts, however, is underdeveloped because the use of silver in well-defined homogeneous systems is limited by the thermal instability and photosensitivity of organosilver compounds. In recent years, the development of N-heterocyclic carbene (NHC) ligands has opened new doors in transition-metal catalysis. NHC ligands provide unprecedented stability to metal complexes, and make novel structures synthetically accessible. To gain a better understanding of silver-catalyzed reactions, we have targeted the synthesis of a singly charged trisilver cation supported by NHC ligands. This proposed mixed-valence system has been synthesized for silver's heavier Group 11 relative gold by Sadighi et al. Our expectation is that the [Ag3]+ molecule will exhibit useful reactivity and serve as a homogeneous model for heterogeneous systems, giving insight into catalytic intermediates and mechanisms, ultimately improving catalyst technology.

Poster Presentation # 110
Behavioral Differentiation in Closely Related Malawi Cichlid Fish

Nicholas Schappaugh
Nicole Baran, PhD (Biology)

A model of the genetic basis for differences in behavior cannot be as easily studied in humans as models for disease. A simplified and genetically manipulable model organism, such as a mouse, nematode, or fish, provides for more research opportunities in this field. African cichlid fish have been studied for many decades now for insights into behavior, proving themselves to be a good model for discrete differences in behavior throughout a set of genetically similar yet rapidly radiating species, with plenty of sequencing data available to assist in research endeavors. One particular behavioral phenotype that has been well-characterized is the extended phenotype of bower shapes in Malawi sand-dwelling cichlids. Prior research shows that the tendency towards building one type over another in these cichlids isn't particularly well stratified across Malawi phylogeny. Further research was conducted to determine how this behavioral trait segregated with other well-studied traits in Malawi cichlids, supporting a proposed stages model for adaptive radiation that hypothesizes courting behaviors like that of types of bowers built as one of the later-stage selective forces responsible for Malawi cichlid speciation. We seek to determine these behavioral differences over long periods of observation in genetic crosses with the help of object recognition in large-scale video recordings and clearly determine the association of such social behaviors with other already well-characterized traits, which could help in finding where these traits derive their genetic underpinnings.

Oral Presentation
A PDE Approach to Color Trend Forecasting

Nicholas Selby
Sung Kang, PhD (Mathematics)

Color trend forecasting is an up-and-coming field in mathematics research. The ability to accurately predict fashion trends drastically increase revenues of fashion giants and provide consumers with a selection more suited to their needs. While neural network applications currently dominate the state of the art, we present a novel PDE approach based on the reaction-diffusion equation.

Poster Presentation # 120
Guided by the Light: A Shrimp's Journey

Krishma Singal
Flavio Fenton, PhD (Physics)

Excitable systems driven by reaction diffusion equations have been shown to not only find solutions to mazes but to also to find the shortest path between the beginning and the end of the maze. In this talk we describe how we can use the Fitzhugh-Nagumo model, a generic model for excitable media, to solve a maze by varying the basin of attraction of its two fixed points. We demonstrate how two dimensional mazes are solved numerically using a Java Applet and then accelerated to run in real time by using graphic processors (GPUs). An application of this work is shown by guiding phototactic brine shrimp through a maze solved by the algorithm. Once the path is obtained, an Arduino directs the shrimp through the maze using lights from LEDs placed at the floor of the Maze. This method running in real time could be eventually used for guiding robots and cars through traffic.

Poster Presentation # 102
Has the Gap in Swim Performance Between Men and Women Stabilized in the United States Since Title IX?

Ann Swanson
Melinda Millard-Stafford, PhD (Applied Physiology)

In 1992, Whipp and Ward extrapolated that women would eventually equal or exceed men in running based on historical rate of improvement. PURPOSE: The performance gap in elite American male and female swimmers was examined from 1972 (since Title IX) to 2012 and relative to maturity (age groups 9-10 to 17-18 y). METHODS: Using a public database, the top eight times from the USA Olympic Trials were analyzed to compute % difference by sex over 40 y. The top 16 Age Group All-Time performances for boys and girls were also compared. RESULTS: The sex difference in swim performance currently ranges from 7.6 ± 0.8% (400 Free) to 13.8 ± 0.7% (50 Free) and increases significantly with age starting from 1.1 ± 0.9% in 9-10 y and 2.5 ± 1.7% in 11-12 y to 8.0 ± 2.3% in 17-18 y groups. Averaging across Olympic Trials over 40 y, significantly greater ($p<0.05$) performance gaps exist in shorter compared to longer distance events. The 40 y improvement across all events was also significantly greater for women vs. men by 2.6 ± 1.4%. However, the overall performance gap in 2012 (11.0 ± 1.7%) significantly decreased from 1972 (13.2 ± 2.0%) and 1976 (12.4 ± 1.7%), but was not different after 1980 (averaging 11.3). CONCLUSIONS: The performance gap in elite American male and female swimmers has significantly narrowed since Title IX, but has been stable for the past three decades. Therefore, the performance gap in USA swimming may currently reflect "true" underlying biological sex differences.

Poster Presentation # 111
Tooth Turnover Rates in the Cichlids of Lake Malawi

Maya Tome
Teresa Fowler, PhD (Biology)

We use the cichlid fish from Lake Malawi as a model organism for biological research because it constantly replaces its teeth throughout life. This mechanism has been lost in many mammals, and we hope that experimenting with cichlids can lead to breakthroughs in regenerative dentistry. We have observed that different species of cichlid replace their teeth at varying rates, but have never experimentally determined these rates of replacement. I plan to compare cichlids with a low density of unicuspid teeth to cichlids with a high density of tricuspid teeth and hypothesize that I will find that the rate of tooth replacement greatly depends on density. More specifically, I speculate that cichlids with a high density of tricuspid teeth will replace their teeth more frequently, since these species implement more wear and tear to their small teeth by scraping algae off of rocks when feeding. To test this hypothesis, I will perform pulse-chase experiments by applying Alizarin Red and Calcein fluorescent dyes, which bind to calcium in the teeth. By differing the application time of these dyes and the length of chase, I can manipulate their fluorescence signals to show tooth turnover rates. From there, I can compare the turnover rates between species with respect to the different tooth densities to determine the validity of my hypothesis.

Oral Presentation
Analyzing Structure of Myosin II and F-Actin in Macrophages During Frustrated Phagocytosis Using SIM Microscopy

Michelle Truong
Jennifer Curtis, PhD (Physics)

Late-stage contractile activity distinguishes phagocytosis from other cell processes. This phase depends directly on the coupling of motor protein, myosin II, and filamentous actin. In experiments involving the fixation of J774A.1 mouse macrophages undergoing frustrated phagocytosis on an IgG opsonized surface, myosin distribution is initially shown to localize to areas of actin accumulation, specifically along the circumference of the cell, as the macrophage spreads out. A hypothesis concerning the increase in the uniformity of myosin distribution throughout the cell as it transitions to contraction is explored. In the stage of contraction, characterized by the presence of membrane tethers, patterns of striation emerge among myosin filaments similar to the structure in cardiomyocytes; however, instead of myosin and actin running parallel inside the cell end-to-end, their bundled stalks are shorter, and myosin II appears to run perpendicular to actin. Actin, on the other hand, starts off as a densely branched structure as it generates forces to extend the cell edges outward and transitions to a structure of bundles once contraction begins. The lack of understanding about the localization, timing, and physical mechanics raises questions about how actin polymerization couples to the membrane locally and drives the aforementioned extension of the pseudopodia in order to enclose the target cell and whether different classes of myosin contribute to its overall efficiency during this process; thus, emphasizing the need for super resolution structured illumination microscopy in order to explore for the first time how non-muscle myosin II is spatially distributed relative to the actin distribution.

Poster Presentation # 118
Forming Prebiotic Polymers that Resemble Nucleic Acids

Katherine Watkins
Nicholas Hud, PhD (Chemistry and Biochemistry)

Contemporary DNA and RNA are genetic polymers composed of a sugar-phosphate backbone and nitrogenous bases that form hydrogen-bonded base pairs. Prior to the emergence of

DNA and RNA polymers it has been hypothesized that these molecules were preceded a simpler proto-RNA. This precursor would have assembled and polymerized spontaneously on the prebiotic Earth and served as the first genetic material. In our attempt to discover the possible structures of prebiotic genetic polymers, we are exploring nitrogenous bases with alterative chemical reactivities and base pairing properties, but with structures that still resemble those of the bases of modern RNA. In this particular study, 2,4,5,6-tetraaminopyrimidine (TetAP) and malic acid were chosen to polymerize due to the strong nucleophilic properties of TetAP and its ability to react with carboxylic acids, and the known ability for malic acid to polymerize upon drying from water. Furthermore, malic acid can form covalent bonds with TetAP during drying reactions. Under dry down conditions, the removal of water aids the polymerization to the point that the TetAP-malic acid reactions form oligomers that may be similar in structure to nucleic acids. The malic acid-TetAP monomer forms a supramolecular structure with cyanuric acid in solution, an assembly that is believed to contain hydrogen-bonded Watson-Crick-like base pairs, which also demonstrates the similarity of this molecular system to modern nucleic acids.

Poster Presentation # 112
Characterization of Metalloproteinases During Neural Crest EMT and Migration

Megen Wittling
Shuyi Nie, PhD (Biology)

In the field of developmental biology, the neural crest is an essential component that is being extensively studied due to its developmental potential as well as role in morphogenesis. Neural crest cells detach from the neural tube and migrate throughout the embryo in what is known as epithelial-to-mesenchymal transition (EMT), which is similar to tumor metastasis. There are many similarities between cancer progression and neural crest development. The Nie Lab has recently identified a group of genes involved in neural crest development and cell migration, and we are looking at a group of Metalloproteinases (MMPs) involved in this process. The model organism used is Xenopus laevis, and molecular biology techniques are used to identify the expression pattern in the Xenopus embryos. Overall, the research project looks at how MMPs are expressed in the embryo as well as how they function and how cell migration and signaling are affected. As neural crest development and cell migration are related to cncer metastasis, this will hopefully shed light on the MMPs role in pathological processes as well.

Poster Presentation # 113
Casting Behavior in Freshwater Copepods

Madison Young
Jeannette Yen, PhD (Biology)

Understanding how certain organisms find and respond to chemical cues in the water is important to understanding how they interact with other organisms in their environment and ecological niche as a whole. Behavioral Ecology is a field that focuses on how organisms interact with their environment. Most previous research that has been done up to this point has been on how copepods respond to chemical cues in the water from simulating mating, feeding, or predation events. Chemical cues in nature are used for many behaviors including locating a mate, identifying food, communicating, and spermatophore placement (Frederick et al 2015). Within the experiments conducted there is a common theme between all tests, especially with the copepod species Hesperodiaptomus Shoshone. They show a behavior known as "casting" where once they have found and followed the trail, they wobble back and forth between the edges of it without leaving (Pender-Healy et al 2012). This behavior can be analyzed using Strouhal's number, a way of determining the efficiency of swimming and flying animals. It is found by dividing the stroke frequency (f) and the amplitude (A) by the forward swimming speed (U). The full equation reads St=fA/U, and ultimately measures the propulsive efficiency of animals over a certain period of time. An ideal Strouhal's number was found to be between 0.2 and 0.4 (Taylor et al 2006), and this research will hopefully lead to an ideal Strouhal number in Hesperodiaptomus Shoshone

Poster Presentation # 123
Utilizing cluster analysis to determine dynamic connectivity of brain networks when resolving cognitive conflicts

Yiran Zhao
Derek Smith, PhD (Psychology)

Cognitive conflict is represented in brain as an exhibitory response antagonistic to desired brain function. In order to control the effect of conflict, several brain functional networks, such as dorsal lateral prefrontal cortex, work together to help human focus on relevant information and pay less attention to conflicting information. Our group aimed to determine the temporal activity of these brain networks when resolving conflicts. The technique we utilized, clustering analysis, was a classification technique commonly used in machine learning. Previous studies have applied clustering analysis on static brain networks across the whole brain, however we were interested in dynamic networks on selected regions of interest. 12 participants were asked to perform two set of tasks involving conflicting information. For each task, a 19600ms functional magnetic resonance imaging of their brains were collected. Clustering analysis was applied on bold signal with 20 selected regions of interest. From results of preliminary tests, we were able to identify a cluster of networks responsible for selective attention between conflicting information and relevant information, as well as a cluster of networks similar to task positive network that was responsible for performing tasks. These results confirmed that our method was valid and allowed us to progress into further analysis.

GEORGIA TECH RESEARCH INSTITUTE

Poster Presentation # 021
Wearable Gesture Recognition with Heterogeneous Cameras

Tyler LaBean
Peter Presti, PhD (Georgia Tech Research Institute)

The purpose of this research is to create a wearable computer system that recognizes gestures of the user, allowing interaction though hand gestures. The user will wear a hat mounted with a regular optical camera and a thermal camera. The combination of these two heterogeneous video streams will be used to recognize the user's gestures in many conditions and environments. Additionally, a video database of gestures will be created and released so that other researchers can compare algorithms and benchmarks using the same data-set.

IVAN ALLEN COLLEGE OF LIBERAL ARTS

Oral Presentation
Suffrage Postcard Project

Lindsay Knapp
Kristin Allukian, PhD (Literature, Media, & Communication)

The Suffrage Postcard Project seeks to understand how feminist digital humanities practices engender new historical narratives of fatherhood in early twentieth-century suffrage postcards. In 2016, we have Twitter, Instagram, and Facebook. A hundred years earlier, there were postcards. In the "Golden Age" of postcards (1902-1915), postcards circulated with the same fervor, albeit not speed, of images on popular social media apps today. This project looks back at the early decades of the 1900s in the context of the women's suffrage movement, a movement that was gaining momentum in the same historical moment of the Golden Age of postcards. Over 700 postcards are currently being entered into Omeka, a digital archive platform developed by digital humanists. After all of our images are entered into Omeka – which will eventually become a stand-alone and public-facing platform to offer data to researchers – and tagged, we will use the API to export data to ImagePlot and Iconclass for data visualization. This data visualization will help us understand how visual images of American fatherhood contributed to the suffrage debate.

Oral Presentation
Galileo: An Example of European Collaboration?

Pedro Maddens Toscano
Vicki Birchfield, PhD (International Affairs)

The European Union has for years underpinned its belief in the importance of a comprehensive space policy by comprehensive actions and programs. As stated in a recent European Commission Communication, "the space sector is both a driver to scientific progress and enables systems and services with growth potential in areas such as telecommunications, navigation and Earth observation." My research has been on how the Galileo satellite navigation system is an example of European collaboration. Specifically, it focuses on the history of the Galileo project and examples of past European collaboration (notably the Global System for Mobile Communications), how the Galileo project is an example of European Collaboration, and fits into European space industry's competitiveness at the global level. In addition, my future research will also include whether the Galileo system is competing or working with the Global Positioning System (GPS).

Poster Presentation # 124
The Impact of Income Inequality on Economic Growth

Wendy Martinez; Ulcka Patel; Anna Hunter
Shatakshee Dhongde, PhD (Economics)

This paper presents an econometric analysis on global income inequality and its effects on GDP per capita. Most economists would argue that income inequality is needed for economic growth. Both income inequality and economic growth are widely discussed topics in which they are considered social as well as economic topics. This paper seeks to agree to the statement that income inequality promotes economic growth as well as test for Kuznets Curve regarding inequality and income per capita. Cross-sectional data from 2012 obtained from the World Bank database is used to observe the relationship between income inequality and economic growth. Factors tested include GDP per capita, national savings rate, Gini index, national unemployment rate, and health expenditure percent of GDP. The experiment results show GDP per capita is positively correlated with the gross national savings, health expenditure percent of GDP, and unemployment. Furthermore, GDP is negatively correlated with the Gini Index of countries. Income inequality has different effects depending on where the country is in its economic development. Income inequality hinders growth for poor countries, while it stimulates growth for rich countries.

Oral Presentation
Income Inequality: A Friend or Foe to Environmental Health?

Jasper Narvil
Shatakshee Dhongde, PhD (Economics and International Affairs)

Sustainable development is considered by many policy makers and analysts to be the holy grail of continued social and economic progress in our society. The UN's recently released "2030 Agenda for Sustainable Development" outlines 17 goals relating to the environment, poverty, and inequality. Being that these themes are crucial to self-sustaining, global development, these problems must be addressed not only efficiently, but effectively. How might the efficacy of proposed plans to tackle these issues be in jeopardy? One or more nexuses between any of these themes could exist, in turn making one impact another and vice versa. In particular, there is value in examining potential linkages between income inequality and environmental degradation. For example, the environmental exploitation of an entire city in India in the infamous "Bhopal Disaster" could be the result of powerful income-disparity dynamics at work. Alternatively, the implementation of environmentally-friendly fuel taxes in countries seeking to mitigate climate change

could disproportionally affect poorer communities while the rich benefit from offset emissions. Is the efficacy or even the existence of robust environmental regulation dependent upon income distribution? Could the relationship actually be inverse, with income distribution dependent on environmental policy? Through analyzing potential connections between gini coefficients and environmental welfare further, we can more accurately access the strength and complexities of such a paramount relationship. Thus, empirical analysis supporting the existence of a socio-ecological nexus among different locations could suggest that we must be cognizant of both factors before attempting to tackle either.

Poster Presentation # 125
Does Education Affect Congressional Voting Patterns? An Analysis of House Roll Call Votes From the Past 100 Years

Lindsay Purcell
Olga Shemyakina, PhD (Economics)

A wide variety of research has been conducted which examines the relationship between characteristics of Congressmen and their voting patterns. But, while this previous research does control for many factors, such as race, gender, income, tenure, etc., most of this research does not control for the Congressman's level of education. This paper will focus exclusively on how education affects Congressional voting patterns and, in particular, it will focus on the relationship between the educational level of a member of the House of Representatives and scores on both the Democratic and Republican party's respective roll call voting indices, which quantify how "Liberal" or "Conservative" a vote was. This analysis will be conducted by running multiple linear regressions between roll call index scores, educational level of the Congressman, and several other political and socio-demographic factors. All 435 members of the House of Representatives for multiple Congressional sessions between 1900-2015 will be analyzed to discover the ceteris paribus relationship between education and voting patterns. In particular, this relationship will be analyzed to discover whether the somewhat stereotypical idea that "more education leads to more liberal thinking" holds within the United States Congress, as it reportedly does within in the general population. By understanding education's role in Congressional voting patterns, constituents, lobbyists, and other Congressmen will be better able to understand why some bills are passed and others not in the United States, and, overall, why our current political system operates as it does.

Oral Presentation
Cross Disciplinary Collaboration in Constructing a Communication Center: Partnerships & Possibilities

Kiran Rampersad
Peter Fontaine, PhD (Literature, Media, & Communication)

This presentation will focus on an inquiry into the practical ways in which undergraduate peer tutors, like me, have contributed to the design and structure of the tutoring center we serve. The Communication Center at Georgia Tech is a multimodal resource where students can develop not only their written skills, but also their verbal, electronic and nonverbal abilities. With the use of state-of-the-art technologies such as a 3D printer, video and audio recording software, and other equipment, professional and peer tutors are actively involved in designing pedagogical and marketing resources. I will highlight the tools we have employed to build and strengthen relationships among tutors in our Center, with our clientele and with other units across campus. Three projects will be featured: a promotional video that has become a cornerstone of our advertising efforts, a scavenger hunt, which has grown into a semesterly event, and a peer tutor handbook, which is currently in production and will consist of tips for undertaking various types of sessions. I will reflect on the numerous unique ways through which undergraduate tutors of varying disciplinary backgrounds have worked with professional tutors in establishing an inclusive, cooperative, and positive tutoring community, which simultaneously serves both peers and institution in our STEM-focused college. How do we negotiate our role as undergraduate tutors? To what extent should the partnership extend among administrators, professional and peer tutors? How do undergraduate tutors and the center as a whole benefit from this collaboration? These are questions that my research will address.

Name	Session	Time	Room
Agnew, William	I	3:30 PM	SC 343
Barker, Rachel	C	1:20 PM	SC 321
Buehler, Joseph	D	2:50 PM	SC 320
Buntin, Parker	B	1:00 PM	SC 319
Corbin, Nathan	F	3:10 PM	SC 321
Dixon, Jefferson	D	3:10 PM	SC 320
Dorn, Max	F	2:50 PM	SC 321
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Gadsby, April	A	1:40 PM	SC 301
Gardner, Lauren	A	1:20 PM	SC 301
George, Alex	H	3:10 PM	SC 301
Houser, Samantha	H	3:30 PM	SC 301
Imgrund, Jessica	D	2:10 PM	SC 320
Knapp, Lindsay	G	3:40 PM	SC 319
Leamon, Christina	A	1:00 PM	SC 301
Li, Heng	E	2:50 PM	SC 343
Lin, Zhiyuan "Jerry"	E	2:10 PM	SC 343
Maddens Toscano, Pedro	G	3:20 PM	SC 319
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McAnally, Aaron	E	2:30 PM	SC 343
Meek, Olivia	D	1:50 PM	SC 320
Miller, Shellby	F	3:30 PM	SC 321
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Powell, Walker	E	2:30 PM	SC 343
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Wen, Haiqi	A	2:00 PM	SC 301
Wu, Jason	I	3:50 PM	SC 343
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Zhu, Yuntong	B	1:40 PM	SC 319

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Special Thanks

to our

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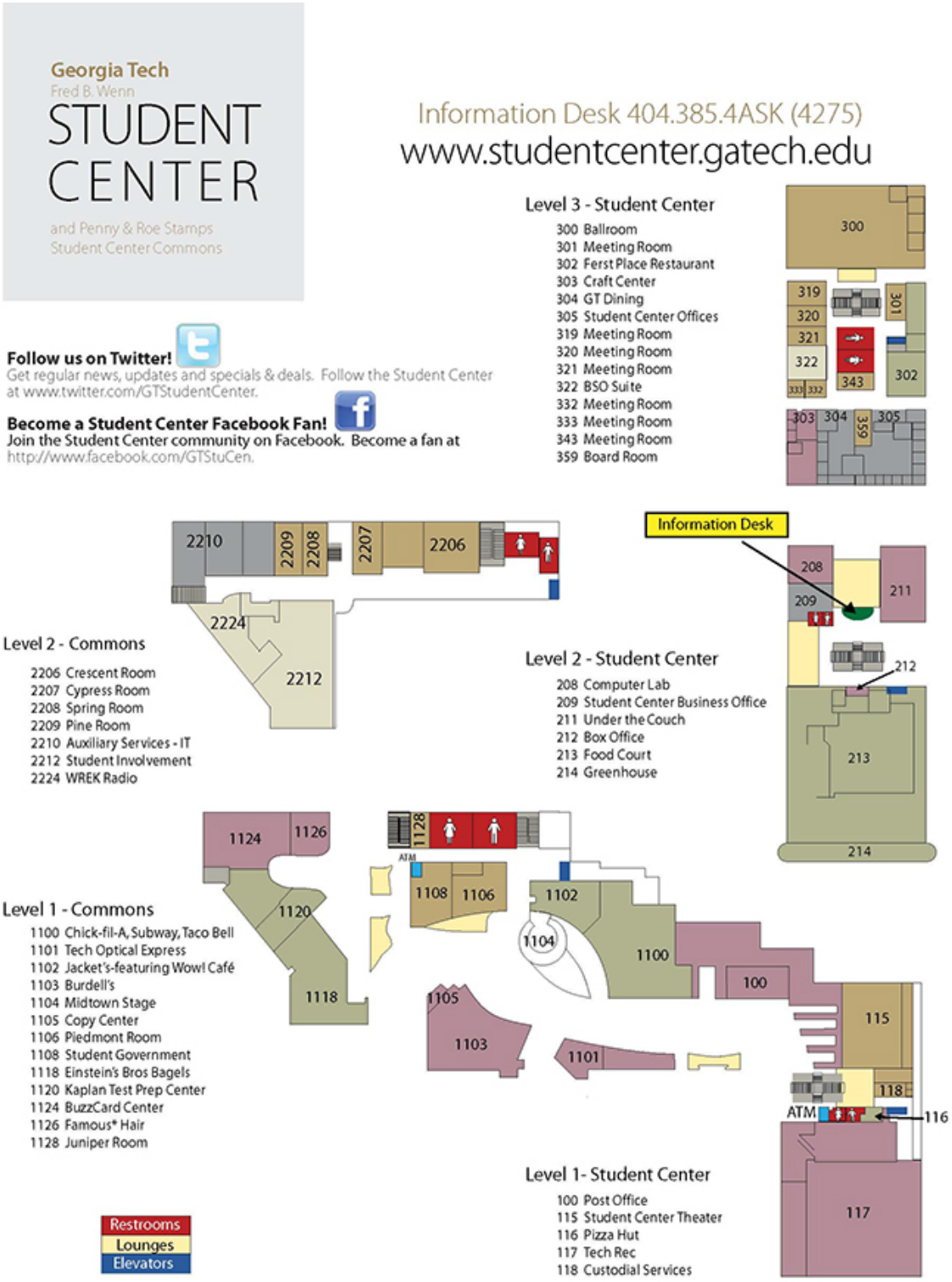
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343 Meeting Room
359 Board Room
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2207 Cypress Room
2208 Spring Room
2209 Pine Room
2210 Auxiliary Services - IT
2212 Student Involvement
2224 WREK Radio
Information Desk
Level 2 - Student Center
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209 Student Center Business Office
211 Under the Couch
212 Box Office
213 Food Court
214 Greenhouse
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1101 Tech Optical Express
1102 Jacket's-featuring Wow! Café
1103 Burdell's
1104 Midtown Stage
1105 Copy Center
1106 Piedmont Room
1108 Student Government
1118 Einstein's Bros Bagels
1120 Kaplan Test Prep Center
1124 BuzzCard Center
1126 Famous* Hair
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