WELCOME TO THE

12TH ANNUAL UNDERGRADUATE RESEARCH SPRING SYMPOSIUM AND AWARDS

TUESDAY, APRIL 18, 2017 1:00PM TO 6:00PM

STUDENT CENTER BALLROOM

Georgia Tech Undergraduate Research Opportunities Program

Georgia Tech Center for Academic Enrichment

Abstracts published in this program reflect the individual views of the authors and not necessarily that of the Office of Undergraduate Education or The Georgia Institute of Technology.

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 12th Annual Undergraduate Research Spring Symposium. The research conducted by 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. At Georgia Tech, we strive to develop leaders in all fields and leaders in our global society. The contributions made today and in the future will have an everlasting impact on you and on society.

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!

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Annabel McAtee
Mentor: Dr. David Hu, ME

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Brandon Holt
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Nica de Nijs
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Session B: Computer Science

Student Center Room 320
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Jin Kyoung Kwon
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1:20 pm **Attentive Spatial Transformer Networks for Human Pose Estimation**
Raphael Gontijo Lopes
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1:40 pm **Alternative Interactions for Smartwatches**
Bailey Bercik
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2:00 pm **Transfer through Attention in Deep Reinforcement Learning**
Saurabh Kumar and Farhan Tejani
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Iris Birman
Mentor: Dr. Eric Gilbert, CS

Oral Presentation Sessions

Student Center, 3rd Floor

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Aditya Vishwanath
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Erick Lin
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Brian Kim
Mentor: Dr. Robert Butera, BME

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Liangyu Tao
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Oral Presentation Sessions

Student Center, 3rd Floor

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Maxwell Roberts
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Oral Presentation Sessions

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Student Center Room 301
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Arnold Eng
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Noel Csomay-Shanklin
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Long Qian
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Nikhil Venkatesh
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Ann Johnson
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Oral Presentation Sessions

Student Center, 3rd Floor

Session I: Biological Sciences and Psychology

Student Center Room 320
Moderator: Ms. Recha Reid

3:30 pm **Listening to Stories: Understanding Narrative Persuasion from Rhetorical Persuasion**
Tiffany Ngyuen
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Cahterine Stephens
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Brighton Ancelin
Mentor: Dr. Joshua Weitz, BIOSCI

COLLEGE OF COMPUTING

Oral Presentation
Alternative Interactions for Smartwatches

Bailey Bercik
Gregory Abowd PhD (Computer Science)

Whoosh and TapSkin present alternative interactions to smartwatches. Whoosh utilizes the microphone on the smartwatch to capture non-voice acoustics such as blows, sip-and-puffs, and directional air swipes; this method is evaluated across 8 participants with a 90.5% ten-fold cross validation accuracy. In addition, a passive 3D-printed case that snaps onto the face of the smartwatch allows for expansion of gestures. This expanded gesture set when evaluated across 8 participants has a 91.3% ten-fold cross validation accuracy. TapSkin supports 11 distinct tapping gestures on the skin adjacent to the smartwatch (0 - 9 on the back of the hand and an activation tap on the arm) by using the microphone and inertial sensors on the smartwatch. With a study of 12 participants, this system shows classification accuracies of 90.69 - 97.32% within three gesture families. Both studies highlight possibilities that the interactions provide users.

Oral Presentation
Community Identity on Reddit

Iris Birman
Eric Gilbert, PhD (Computer Science)

This project concerns data collected from various Subreddits, including ones shut down by Reddit itself, and analyzes the data. Some data being analyzed includes the number of times emotions such as sadness or anxiety were present in these subreddits, as analyzed using LIWC libraries. In addition, community feedback to inappropriate comments was analyzed using thread structures. Comments that were deleted from these subreddits for violating community norms were analyzed statistically and textually to better understand community identity and expectations across different subreddit communities.

COLLEGE OF COMPUTING

Poster Presentation # 001
Scheherazade 2.0

Nathan Dass
Mark Riedl, PhD (Computer Science)

Chat bots are slowly becoming integrated in our everyday lives. We can order an Uber through Facebook messenger, ask Siri to set a reminder, start our car with Alexa, ask Google what the weather is like, and much more. However, chat bots only answer the question asked. In their current state, chat bots do not have the capacity to have a personality or hold a normal conversation. There have been attempts to give chat bots personalities through recurrent neural networks or deep learning, but these approaches did not solve the problem. Machine learning has many algorithms and architectures, each with their respective advantages and disadvantages. A new area in machine learning called deep reinforcement learning combines learning from raw input with learning by rewards and punishments. This study is focused on using deep reinforcement learning in the context of story generation for chat bots. The architecture developed in this study utilizes three machine learning models: a forward model to find the next word given the current word, a backward model to validate the context of the previous word given the current word, and a policy model to take into account the reward for choosing a certain word which ensures the chosen word actually makes sense. The goal of this study is to create a machine learning architecture that can be used to create conversational chat bots that have unique personalities, just like an actual person.

Poster Presentation # 002
Efficient Exploration in Reinforcement Learning by Using Expert Behavior to Improve Reward Function

Diptodip Deb
Richard Lipton, PhD (Computer Science)

Reinforcement learning is a form of machine learning in which optimal behaviors for a given task are learned using only a scalar reward function. Designing a reward function is difficult, and can lead to inefficient learning. While there are various methods to increase efficiency of learning, they either do not make use of expert behavior or they require a lot of training data of expert behavior. We propose a method to increase the efficiency of reinforcement learning which learns as much as possible from the expert behavior examples (even if there are only a few) in order to learn a modified reward function that gives more information at the same time as learning the optimal behaviors for the given task.

Poster Presentation # 003
Swarm: Georgia Tech's Inaugural Student Cluster Competition Team

Petros Eskinder
Oded Green, PhD (Computational Science and Engineering)

The purpose of the SWARM project is to construct Georgia Tech's inaugural Student Cluster Competition team. The competition, held during the last two days of the annual Supercomputing (SC) conference, pits undergraduates against each other to (1) design and assemble a compute cluster, and (2) execute real world HPC applications on said clusters. The winner is the team with the highest score over the following domains: 1) completed workload of five applications, 2) best benchmark run, 3) application interviews and 4) general HPC interest interview. From the reports of other university teams, we have learned the importance of intimately understanding each benchmark. Consequently, we present (1) our findings tuning the HPL and HPCG benchmarks on various compute clusters, and (2) the system architecture of the compute cluster we are assembling.

Poster Presentation # 004
Carina: Interactive Million-Node Graph Visualization using Web Browser Technologies

Dezhi Fang, Kshitij Kulkarni, Matthew Keezer and Jake Williams
Polo Chau, PhD (Computational Science & Engineering)

We are working on a scalable, interactive visualization system, called Carina, for people to explore million-node graphs. By using latest web browser technologies, Carina offers fast graph rendering via WebGL, and works across desktop (via Electron) and mobile platforms. Different from most existing graph visualization tools, Carina does not store the full graph in RAM, enabling it to work with graphs with up to 69M edges. We are working to improve and open-source Carina, to offer researchers and practitioners a new, scalable way to explore and visualize large graph datasets.

Oral Presentation
Attentive Spatial Transformer Networks for Human Pose Estimation

Raphael Gontijo Lopes
Stefano Fenu, PhD (Computer Science)

Estimating human pose from raw image data is a task complicated by many factors such as self-occlusion, variation in

appearance from person to person, and the complexity of human pose articulation. This kind of estimation is of great interest to the general activity recognition community at large, but is of special interest to vision scientists working on sign language translation. Many different approaches to this problem have been tried, including Deep Convolutional Neural Networks, which have shown to be effective in many other areas of Computer Vision. In order to deal with these problems, we adopt a class of models, termed Spatial Transformer Networks, that attempt to explicitly estimate transformations of some input image in an affine space. To apply these models to human pose estimation, we first attempt to learn a parts-based model of human articulation in an unsupervised fashion, and then treat the estimation problem as that of estimating the transform from each joint angle in our representation to each joint angle in the target image, yielding an internal representation that attempts to separate the individual appearance of the human from their pose in a given image. My work this semester focused on characterizing the way in which initialization and example selection affects training time for these classes of models, on better quantifying the successes and failures of existing pose estimation techniques, and on exploring alternative network architectures and feature representations that may further improve estimation accuracy going forward.

Poster Presentation # 005
ReVi: Easy and Accurate Reporting of Critical Infrastructure Events for Resiliency Research

Qixuan Hou, Xuran Chen, and Varun Ramachandran
Calton Pu, PhD (Computer Science)

Critical infrastructures, such as roads, bridges, tunnels, power lines, and water main networks are essential elements of a society that enable, sustain, and enhance living conditions of citizens. An important engineering research area studies the technologies to improve the quality of infrastructure systems and their resiliency in face of disasters. However, due to the extensive coverage of modern critical infrastructures and the high cost of dedicated physical sensors to monitor their operations, the data on breakdown events are often incomplete or insufficiently detailed. Therefore, I am proposing ReVi (Re-port & Vi-ew), an easy and accurate reporting application designed for citizen scientists to monitor and document critical infrastructure events for resiliency research. ReVi also has the potential for significant practical impact when used by citizens affected by disasters or repair crew. The goal of ReVi is to enable the creation of higher quantity and quality of data and metadata on critical infrastructures. To support more data creation, ReVi will be used by citizen scientists onsite, to capture the state of infrastructure breakdown events through text, photos, and video. ReVi includes modules that automatically add metadata documentation such as location and environmental data that are important for research use of the data. If successful, ReVi will demonstrate the feasibility of citizen scientists in generating higher quantity and quality of data on critical infrastructures.

Poster Presentation # 006
Execution of Graph Analytics on AMD GPUs

Bhaskar Khaneja
Oded Green PhD (Computational Science & Engineering)

GPUs are not only useful for computer graphics and image processing, but their highly parallel structure also makes them well-suited to analytics where processing of large blocks of data is needed to be done in parallel. The goal of this research is to take code written in cuSTINGER (a streaming graph library) targeting NVIDIA GPUs and convert it into code that can run on AMD GPUs (which are OpenCL-based) and then benchmark performance.

Poster Presentation # 007
Reconstruction of Visual Stimuli After Random Projection

Peter Koplik
Rosa Arriaga, PhD (Interactive Computing)

Humans are able to take massive amounts of data and organize them into concepts that they later recognize and recall. Infants are able to form categorical representations of dogs and cats, for example, from just a few exposures to images of these animals. These images, however, contain a very large amount of information. In order to process massive amounts of information from visual stimuli as quickly as they do, humans must process the stimuli in a manner that reduces the complexity of those stimuli. Previous work in the field of neuroscience has developed models for the processing of high-dimensional natural stimuli through low-dimensional representations and corresponding neural responses. However, these methods are typically computationally expensive and data-dependent. We explore the effectiveness of the random projection method, a biologically plausible, computationally efficient, and data-independent method of dimensionality reduction in categorization and recall of visual stimuli. We observe that a neural network tasked with approximating the original stimulus from the reduced domain generally increases the separation between exemplars of visual categories. This suggests that random projection is useful in the efficient recall and recognition of visual concepts even though they only contain small fractions of the original information from the stimuli. Our findings indicate that the reconstruction of visual stimuli from the random projected domain preserves best the features most typical of that particular category of stimuli.

Oral Presentation
Transfer through Attention in Deep Reinforcement Learning

Saurabh Kumar and Farhan Tejani
Charles Isbell, PhD (Computer Science)

Typical reinforcement learning (RL) agents learn to complete tasks specified by reward functions tailored to their domain. As such, the policies they learn do not generalize even to similar domains. To address this issue, we develop a framework through which a deep RL agent learns to generalize policies from smaller, simpler domains to more complex ones using a recurrent attention mechanism. The task is presented to the agent as an image and a sentence instruction specifying the goal. The attention mechanism guides the agent by designing a sequence of smaller subtasks that the agent has previously learned. The attention "meta-controller" and the underlying RL agent are trained in an alternating fashion. Our experiments show that this transfer speeds up learning in domains with very large state spaces. Furthermore, by alternating the training, the meta-controller learns to focus on areas that are currently solvable by the agent, thus effectively breaking down the state space for transfer.

Oral Presentation
Learning User's Evolving Interests with Combinatorial Contextual Bandits

Jin Kyoung Kwon
Le Song, PhD (Computer Science)

With an immense growth of online content generation and consumption, recommender techniques have received much attention. Traditional techniques such as collaborative filtering, content-based filtering and learning-to-rank methods solve a problem of predicting a fixed set of recommendations given training data. However, they fall short at capturing the dynamic and changing nature of user preferences and at solving cold start problems. Bandit algorithms, especially Contextual Multi-Armed Bandits (CMAB) have shown to deal successfully with dynamicity of user preferences. In CMAB, a learning agent is tasked with minimizing the cumulative regret given side information, so-called context. In a web setting, context is often a user's query or site behaviors that can be captured real-time. The agent, by balancing between the best action given past feedbacks and unknown actions, can deal with "explore-exploit" tradeoff and eventually learn the best action for a given context. While standard (CMAB) can be successful at predicting one best action, it cannot select lists of ranked actions. This is a challenging task because there is an exponential number of combinatorial objects to choose from N objects. This setting is termed Contextual Combinatorial Multi-Armed Bandits (CCMAB). Our paper lies in this CCMAB setting. More precisely, our objective is to utilize existing CMAB algorithms to develop a system that can learn user's evolving interests to help them navigate the environment better. We merge appropriate user behavior models and web techniques to record users' behavioral features and make recommendation predictions real-time.

Poster Presentation # 008
Ranked Sequence Analysis for Player Modeling

Nicholas Liao
Mark Riedl, PhD (Interactive Computing)

We preset a novel approach to player modeling based on a convolutional neural network trained on game event logs. We test our approach over two distinct games, a clone of Super Marios Bros. and Gwario, a human computation version of Super Mario Bros: The Lost Levels. We demonstrate high accuracy in predicting a variety of measures of player experience across these two games. Further we present evidence that our technique derives quality design knowledge and demonstrate the ability to build a more general model.

Oral Presentation
Linearizable Relaxations of Stacks and their Generalizations to Ordered Data Structures

Erick Lin
Byron Boots, PhD (Interactive Computing)

Relaxation is a technique for improving the amortized distributed time complexity in linearizable data structures. We exhibit the first known algorithms implementing linearizable relaxed stacks in a partially synchronous, message-passing system. We proceed to show that relaxed priority queues are reducible to relaxed stacks, meaning that their implementations are equally as fast in terms of amortized performance. Furthermore, restricting these new algorithms to relaxed queues improves on the previously best known upper bounds.

Poster Presentation # 009
Question Answering Agents on Piazza

Marc Marone
Ashok Goel, PhD (Interactive Computing)

Question Answering on Piazza is a challenging task, but has great potential for changing online and offline education. The data is extremely sparse, the language used is very specialized, and near 100% accuracy is demanded. These constraints mean that standard approaches will be ineffective, and perhaps even harmful to the education of students. This project aims to develop new effective techniques for extracting useful information from Piazza data in order to increase the coverage and precision of the question answering agent. The results found here will be tested across various scenarios, with the goal of developing an extensible infrastructure that can be used to quickly train and

deploy a novel question answering agent.

Poster Presentation # 010
Detecting Mosquitos with Convolutional Neural Networks

Lawrence Moore
James Hays, PhD (Computer Science)

Mosquitos are directly responsible for the death of more than a million people each year. Yet the ability to mitigate their deadly impact or even monitor them in the wild to better understand their behavior remains relatively limited. One of the primary reasons for this lack of progress is the difficulty in locating and tracking individual mosquito, leading to only estimates for a population as a whole. To address this problem, this research discusses several approaches using computer vision to detect and track the flight of mosquitos. In particular, we discuss the performance of several convolutional neural network architectures. Once these techniques are refined to give a high enough degree of accuracy, this vision system could be used in conjunction with drones to track and eliminate mosquitos in both an indoor and outdoor setting.

Poster Presentation # 011
Static Exception Checker for Java Programs

Liubov Nikolenko
William Harris, PhD (Computer Science)

Static program analysis is the analysis of computer software without executing its code. This technique is used for verifying certain properties of the given code and finding errors before the run time. The primary advantage of this approach is that it is does not require generating exhaustive test cases and running the program multiple times with different inputs, which can be non-trivial and time consuming. Our paper presents a concretely implemented tool that statically checks the program that can be compiled to Java bytecode for exceptions by representing the given code as a set of Horn Clauses and checking the generated Horn Clause system against assertions that model various exceptions in automatic theorem prover. In particular, we are able to check the given code for custom user constraints, Division by Zero Exception, Array Index Out of Bounds Exception, Null Pointer Exception, and Class Cast Exception.

Poster Presentation # 012
Structured Data and Resource Sharing in Open Source Computational Chemistry

Nicholas Petosa
David Sherrill, PhD (Computational Science & Engineering)

Computational chemists simulate molecular interactions for days to weeks. Researchers share their computational results in open source communities, but resources and disparate and decentralized, hindering the speed of research. The purpose of this research is to demonstrate the effectiveness and feasibility of operating within a DBMS (Data Base Management System) for storing and manipulating resulting chemical datasets. The goal is to offer a centralized, standardized molecular dataset repository to the open source computational chemistry community with full RESTful API support.

Poster Presentation #013
Java Byte Code Safety Verifier and Equivalence Checker

Collin Richards
William Harris, PhD (Computer Science)

Many methods for proving properties about programs have been implemented by reducing the problem of program verification to the solving of a system of Horn clauses. Because of this a number of efficient Horn clause solvers have been implemented, opening the door for rapid development of more software verifiers that would use them as a back-end. We have developed a java-byte code verifier that uses Horn clause techniques to prove safety properties of java programs and we've extended this verifier to prove equivalence properties of java programs.

Poster Presentation # 014
Domain Translation and Adapation

Srijan Sood
Charles Isbell, PhD (Computer Science)

Reinforcement learning is a powerful mechanism for training artificial and real-world agents to perform tasks. Typically, one can define a task for an agent by simply specifying rewards that reflect the agent's performance. However, each time the task changes, one must develop a new reward specification. Our work aims to remove the necessity of designing rewards in tasks consisting of visual inputs. When humans are learning to complete tasks, we often look to other sources for inspiration or instruction. Even if the representation is different from our own, we can adapt our own representation to the task representation. This motivates our own work, where we present tasks to an agent that are from an environment different than its own. We perform domain translation from the goal representation into the agent's representation and show that this allows the agent to successfully complete its task. Further, we explore approaches for transfer learning across similar domains to generalize and improve learning across tasks.

Poster Presentation # 015
Approximate Distance Querying for Streaming Graphs

Alok Tripathy
Oded Green PhD (Computational Science & Engineering)

Applications using graphs as their underlying data representations are ubiquitous. Several examples are the world wide web, social networks such as Facebook and LinkedIn, and various types of infrastructure networks such as power networks and communications networks. In most cases these networks are not static, rather they are constantly changing. In this project, we investigate how the distance between two players of the network changes as it evolves. The distance between two players in a network is the shortest path between these players in the graph. Drastic changes to the these distances might indicate that an important event has occurred. There is existing research done on how pairwise distances change with static graphs, however, in this project we will investigate the changes to these distances for streaming (dynamic) graphs. We will use approximate techniques for estimating pairwise distances of the network. The reason we resort to approximation is that recent studies show that exact methods do not scale for extremely large networks. We also do not compute the distance between every pair of nodes. Rather, our algorithm will take two query players and return the approximate distance between the two. This reduces the amount of unnecessary work done computing distances that are not needed by the user.

Oral Presentation
Examining Low-Cost Virtual Reality for Learning in Diverse Environments

Aditya Vishwanath
Neha Kumar, PhD (Interactive Computing)

We describe our experiences co-designing low-cost Virtual Reality-augmented learning experiences with and for two schools, one in Mumbai, India and another in Georgia, USA, both of which cater to low-income children from neighboring communities. We found that VR was used to demonstrate real-world phenomenon, illustrate abstract concepts, compare and contrast places in the curriculum against virtual landmarks, and to motivate students. Most importantly, VR's representational fidelity appeared to arouse students' curiosity, leading them to ask more questions that reflected a deeper engagement with the topic.

Poster Presentation # 016
MoodLens: EEG-enabled emotional expression glasses

Angela Vujic, Kaela Frazier, Albert Shaw and Beatrice Domingo
Melody Jackson, PhD (Interactive Computing)

MoodLens seeks to help individuals communicate who have lost the ability to speak or use facial muscles due to amyotrophic lateral sclerosis (ALS). It consists of eyeglasses with an outwards-facing fiber optic display controlled by electroencephalography (EEG). The design was created using interviews with individuals with ALS, their family members, and their healthcare practitioners. Here, we present the results and work in progress for three studies: an in-laboratory study testing the visibility, psychological impact, and social acceptability of the display; an in-laboratory study to create the EEG control paradigm; and an in-home user study where individuals with ALS test MoodLens with conversation partners.

Poster Presentation # 017
SMILE: Systems Using the Mind's Latent Expression

Chris Waites, Angela Vujic, and Jatin Nanda
Melody Jackson, PhD (Interactive Computing)

SMILE (Systems Using the Mind's Latent Expression) is using low cost, open source electroencephalography (EEG) hardware to develop a non-invasive real time affect detection system, potentially helping individuals with amyotrophic lateral sclerosis (ALS) express their emotional states through brain-computer interfaces (BCIs). We present a prototype, experimental protocol, data pipeline, and classifier to detect alpha wave activity over the occipital lobe in real-time, with the intention of expanding to other affective phenomena in other regions of the brain. We go on to address the feasibility of achieving similar classification accuracies to that of other, less economically accessible EEG monitoring systems. In particular, we consider how constraints on the number of electrodes of our system affect classification accuracy and how such a system would perform in a real-world, unrestricted environment.

Poster Presentation # 018
Parallel Merge-Sorting Using SIMD

James Watkins
Oded Green PhD (Computational Science & Engineering)

This project explores a new way to implement sorting algorithms using vector instructions, specifically the Intel AVX-512 instruction set. Conventional implementations use the classical Batcher's algorithm. This approach adds significant overhead. Our goal is to eliminate this overhead.

Poster Presentation # 019
Gyrolauncher, the Rotational Space Launcher

Wenxin Zhao, Chima Okechukwu, Wonhee Lee, Yoobin Kim, and Adrian Mungroo
David Smith PhD (Computer Science)

Nowadays launching cargos to space is overly associated with rockets. However, it has heavy dependence on rocket fuels. When it come to a fuel depletion situation, an alternative approach is in great need. The project is to design a space launcher that sends satellites to lower orbits using energy from rotational motion applied from an electric motor instead of using rocket fuels. The goal of the project is to create a design and to construct a prototype demonstrating the motor, truss design, release mechanism, sensor and connection. The feasibility will be evaluated by theoretical calculations and Matlab simulation.
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COLLEGE OF ENGINEERING

Poster Presentation # 020
Persistent Space Situational Awareness Using CubeSats with Passive Optical Sensors

Luke Alexander
Marcus Holzinger, PhD Aerospace Engineering)

The Reconnaissance of Space Objects (RECONSO) Cubesatellite has been under development in the School of Aerospace Engineering for 3 years. This undergraduate thesis will explain the necessity for this mission and give an update as to its development status. The abstract concept of operations for a spacecraft that maximizes its detection of orbital debris is proposed, and the parameters of the system are then limited to the form factor of a low-cost cubesatellite. The performance of the payload hardware is then defined and components are selected for the given design parameters. Supporting flight systems are then defined in order to maximize the probability of success of the mission payload, with trade studies explained for al major pieces of hardware. The implementation of this concept of operations and selected hardware is then explained with updates as to current design efforts at the Georgia Institute of Technology. In conclusion, a path to launch and operation of the RECONSO spacecraft is presented.

Poster Presentation # 060
Preoxidation to improve corrosion resistance of 316L Stainless Steel for Fluoride Cooled High Temperature Reactor

Rebecca Ambrecht
Preet Singh, PhD (Materials Science and Engineering)

Nuclear power reactors are used because they generate clean energy. The next generation reactor objective is focused on safety and improved economics. Fluoride Cooled High Temperature Reactor (FHR) has been selected as one of the solutions because they are safer and have better thermal efficiency at a temperature higher than light water reactors. Slowing down the corrosion rate has been done by creating an alloy with more noble elements such as using Nickel based alloys. However, Nickel based alloys are costly. To reduce capital costs, the austenitic stainless steel 316L (SS316L) has been proposed as a candidate material. For some industrial chemical processes, the surfaces of structural materials are oxidized before use to improve corrosion resistance. However, this pre-oxidized layer may be protective in a molten fluoride environment. To test this hypothesis, SS316L was heated in an air environment for 25 hours at 700 Celsius to grow an oxide layer on the surface. These samples were exposed to a eutectic mixture of LiF, NaF, and KF (FLiNaK) at 700 Celsius for 100 hours. For comparison, freshly-polished SS316L, additional stainless steels and nickel based alloys were also exposed under the same conditions. For these short term test conditions, the pre-oxidized SS316L sample appeared to show less mass loss compared to freshly-polished SS316L.

Oral Presentation
An in vitro "Lymph Node-on-a-Chip" for Evaluating Immune Cell Response to Altered Lymph Node Microenvironments

Ananyaveena Anilkumar
Susan Thomas, PhD (Mechanical Engineering)

Cancer is associated with a high mortality rate due to metastasis, or the spreading of cancer cells to other organs from the primary tumor. A frequent site of cancer metastasis is lymph nodes (LNs) due to their close proximity and direct drainage of fluid, soluble molecules, and cells from the tumor through connecting lymphatic vessels. We hypothesize the remodeling of sentinel LNs associated with melanoma lymphatic drainage alters molecular transport and retention in LNs which may influence the delivery efficacy of immunotherapeutic drugs targeted to LNs. Since molecular size is a significant factor in transport and immunotherapeutic drugs range from small molecules (<5 nm) to large particulate drug carriers (20-500 nm), we sought to establish a flow chamber setup to investigate the size-dependent residence time of molecules within a collagen-loaded channel under controlled flow conditions. A minimum collagen matrix concentration of 1.5 mg/ml showed significant reduction in the amount of 500 and 50 nm spheres transported through the channel, and this was further reduced with higher concentrations of collagen. Alternatively, the amount of 56 and 5 nm dextran transported remained constant with all collagen concentrations tested. Preliminary results indicate that the presence of a semipermeable membrane and collagen matrix may delay the transport of 56 nm dextran in our dual channel device resulting in a longer exposure time, but an overall similar magnitude of transport as without collagen. These results may elucidate the differences between the transport of flexible and rigid drug carriers in the tumor or tumor-draining lymph nodes.

Poster Presentation # 027
Modeling the Effects of Schizophrenia on Working Memory in a MATLAB GUI

Brandon Bumbaca
Eberhard Voit, PhD (Biomedical Engineering)

The MATLAB GUI produced in this project provides researchers and clinicians with an accessible simulation platform. Researchers will be able to use the GUI and the overarching heuristic model which corresponds with it to conduct various simulations

based on different perturbations. The model has proven to both accurately describe neurotransmitter transmission among brain regions associated with working memory and the effects of any perturbation to the system. These effects are visualized in the GUI. With a model already in place and a GUI in which to run the model, the speed at which researchers can conduct simulation-based analysis of the system will greatly increase. Clinicians, such as psychiatrists, can utilize the GUI to give both patients and friends and relatives a better understanding the disease. As computational power and the desire for more robust models increases, implementation of models in GUIs will become more and more important in expediting the process.

Poster Presentation # 066
Unfolding the Origami of Beetle Wings

Zachary Butner
David Hu, PhD (Mechanical Engineering)

Beetles fold their delicate hind wings underneath their fore wings for protection. They unfold these hind wings to take off. In this experimental study, we discover that the unfolding time is proportional to the length of the wing. We hypothesize that this unfolding is driven by the hemo-lymphatic flow inside veins in the wing. We mimic the unfolding action by controlling flow through a folded tube. Our findings reveal the underlying factors of hydraulic-driven origami in the lower limits of size. This study may help the design of soft micro-mechanical systems like micro air vehicles.

Poster Presentation # 067
Effect of filler morphology on polymer nanocomposites using multiscale Models

William Chen, Anuja Anil Kandare and Ivan Chan
Raghuram Pucha, PhD (Mechanical Engineering)

Understanding structure-property interaction and quantifying the molecular and morphological changes that reduce the effectiveness of the reinforcement is a major challenge in the manufacturing of polymer nanocomposites (PNCs). Representative Volume Element (RVE) based Continuum models have been successfully used in literature to understand the mechanical behavior of polymer composites. However, caution should be used when applying continuum-type properties to nano-structured materials. In order to facilitate the development of such composites, relationships between the bulk composite materials and the molecular structure of the polymer, nanotube, and polymer/nanotube interface must be considered. In this poster, the nonlinear material properties of CNTs being obtained from the molecular mechanics models will be presented. Accurate values of macroscopic physical and mechanical properties are crucial in establishing a meaningful link between CNT properties and the properties of (PNCs). Using finite element analysis (FEA), the non-linear material properties of the CNTs from the molecular mechanics models are generated to quantify the effective composite properties. This poster also presents modeling and analysis of cylindrical filler composites using RVE models by introducing a 3D interphase between the filler and matrix. The analysis will be focusing on the study of stress transfer efficiency in the presence of interphase. The knowledge and understanding of the nature and mechanics of load transfer between nanotube and polymer is critical for manufacturing of enhanced carbon nanotube-polymer composites and will enable in tailoring of the interface for specific applications or superior mechanical properties.

Poster Presentation # 068
Fluidized Bed for Black Soldier Fly Larvae

Tony Chirumbole
David Hu, PhD (Mechanical Engineering)

Black soldier fly larvae are of interest to the agriculture industry as sustainable, high protein chicken, fish, and livestock feed. Their body compositions have relatively high levels of protein and fat, 42% and 35% respectively. They are also of interest in food waste management due to their high rate of consumption of organic material. Larvae are usually stored in layers no thicker than six inches and stirred manually to reduce ammonia buildup. Ammonia buildup in layers thicker than six inches kills larvae, causing a bottleneck in production. Storing larvae in a fluidized bed removes the need to stir manually, allowing for thicker layers of larvae. We develop a fluidized bed in which larvae are stirred by air flow from a fan set on a timer. This raising method uses space more efficiently, minimizes manual labor, and can increase the throughput of larvae production.

Poster Presentation # 069
Mammal tails shoo and swat to deter mosquitoes

Kasey Cockerill and Aaron Orquia
David Hu, PhD (Mechanical Engineering)

Biting insects, such as mosquitos and horse flies, can cause significant harm to mammals through loss of resting and feeding time, blood loss, and disease transmission. In this study, we examine one of the primary methods by which mammals deter insects: tail swishing. We filmed and analyzed the tail swishing of elephants, giraffes, zebras, horses, donkeys, and dogs. Using Tracker Video Analysis and Modeling tool as well as MATLAB, we are able to obtain information from mammal videos including amplitude, frequency, and velocity of the tail movements. Mammals swish their tails at a frequency that is 3x greater than that of a gravity driven pendulum in order to prevent flies from landing. A strategy similar to the tail swishing is implemented in the popular "Shoo Away" fan, a product designed to spin at a frequency that deters insects from landing. We are using this fan in combination with the videos we have collected to further elucidate the mechanism by which mammals use their tails as

a protection against biting insects. This study could help us to determine more effective insect repelling methods for mammals and even for humans, which would lead to reduced disease transmission rates.

Oral Presentation
Powered Knee and Ankle Prosthesis

Noel Csomay-Shanklin
Aaron Young PhD (Mechanical Engineering)

I am working with the Exoskeleton and Prosthetic Intelligent Controls (EPIC) lab at Georgia Tech to design and manufacture a robotic powered prosthetic leg. This prosthesis will be one of the few in the Unites States that feature a powered knee and ankle joint, which will be able to aid amputees with transfemoral amputation in level walking, stair ascent, and other community ambulation modes. As opposed to passive prosthetics, our powered prosthetic device will produce active power generation which should reduce the energy expenditure by the user. By the end of March, we will have assembled the device, and will begin working on implementing an effective control regime. A significant pitfall of current powered prosthetic devices, is that when switching between walking modes – such as between walking and climbing stairs – the user must complete an awkward set of gestures for the prosthesis to recognize the desired gait type. Hence, a significant goal of this project is to accurately identify user intent, and configure to allow for smooth transitions between the gait cycle. Finally, instead of following a trajectory based control model, we will implement an impedance based control algorithm, which will smoothly actuate each joint (i.e. knee and ankle) and allow for more comfortable use.

Poster Presentation # 056
An Investigation of Thermal Management of Implantable Neural Interface Devices

Devleena Das, William Xia, and Sean Sain
Ruizhi Chai, PhD (Electrical and Computer Engineering)

With the increase of functionality requirements and complexities of implantable devices, the temperature increase caused by device operations is a growing concern; It is reported that a temperature increase of 1 degree Celsius above the normal body temperature can damage the brain tissue. This research investigates the dynamic thermal management (DTM) of bio-implants with a focus on neural prostheses—electronic devices that substitute damaged motors, sensory or cognitive functionalities of humans. This specific application is representative to include most of the potential causes of thermal dissipation: microchips, electrode arrays, and electromagnetic field caused by telemetry or wireless power transfer. The DTM of neural prostheses is crucial as it allows the system to adjust its status based on a real-time measurements to achieve a trade-off between thermal safety and device performance. To study how the heat sources are generating heat, COMSOL, a finite element software is used to emulate the heat transfer between brain tissue and the neural prosthesis based on Pennes' BioHeat equation. To achieve DTM, two control algorithms are studied: an adaptive control method and a PID control method. While the adaptive control algorithm is based on a simplified linear model of the BioHeat Equation, the PID algorithm uses predetermined PID parameters. Both methods are evaluated by their produced overshoot and the time taken to reach 75% of the reference temperature. These results provide valuable insights regarding DTM in implantable devices and affirm that the designed control method can be applied to achieve real-time thermal management.

Poster Presentation # 070
Design Fixation MRI Research

Kaustav Das
Katherine Fu, PhD (Mechanical Engineering)

The project intersects cognitive science and psychology research to understand the engineering/ design research process behind design fixation- a phenomenon where prior experiences restrict a person to new channels of thought and action. The research is conducted by stationing the human subject in an MRI machine at CABI (Center for Adnanced Brain Imaging). The subject is shown 10 design problems on a computer screen in the MRI machine; he is given 1 minute to read the question and think of a solution, and 30 seconds to recite his solution, which is recorded by a microphone attached above his mouth. 5 of the 10 problems present an example solution with the question, and the recordings are later transcribed to look for instances of design fixation. Signs of design fixation are confirmed when the subject derives parts of the final solution from the example solution. Alongside this, coding schemes are implemented on the scanned brain images and compared with the scripts to determine which parts of the brain were activated during the instances of fixation. The results have shown a positive activation in the right precuneus and middle occipital gyrus (both at the back/ occipital lope of the brain) for problems which had an example solution. These image results were taken from the final 10 seconds of the minute-long reading period of these problems. Currently, codes are being written to compare subjects' scans for each separate problem. Post-scan surveys are also studied to observe trends in how students' backgrounds impact their responses.

Poster Presentation # 061
PLA Composites Containing Acetylated Microcrystalline Cellulose at Varying Degrees of Acetate Substitution

Sherwin Davoud and Su Yong Han
Hamid Garmestani, PhD (Materials Science and Engineering)

Acetylation of microcrystalline cellulose was done with acetic anhydride and acetic acid using sulfuric acid as a catalyst. Samples were collected as a function of time to study the effect of reaction time on the acetylation of microcrystalline cellulose. Characterization of the samples by Scanning Electron Microscopy (SEM) together with image analysis indicates that the particle size increases with increasing reaction time. The FTIR band at 1745 cm-1 confirms the presence of a carbonyl peak due to the acetate functionality. The peak height of the carbonyl group increases with increasing reaction time. Differential Scanning Calorimetry analysis shows a melting peak at 157 oC which further confirms the presence of cellulose acetate (CA) functionality. Modified microcrystalline cellulose with varying degrees of CA substitution was blended with polylactic acid (PLA) to study its effect as a reinforcing agent. Thermal analysis of the composites indicate that CA can act both as a plasticizer and as a nucleating agent. Evaluation of the mechanical properties indicate that the plasticization had no effect on the modulus of rigidity. The results of this study show that cost efficient high performance composites can be produced by the addition of cellulose acetate to PLA via an increases in the modulus of rigidity and a modification of the ductile-brittle behavior.

Oral Presentation
Localized Characterization of an In Vivo Experimental Model of Post-Traumatic Osteoarthritis

Nica de Nijs
Robert Guldberg, PhD (Mechanical Engineering)

Osteoarthritis (OA) is a common chronic joint condition, affecting around 27 million people worldwide. Although mainly described as a disease of the cartilage, OA involves sclerosis of the subchondral bone and inflammation of the synovium. In many cases, osteophytes also form at the end of the joints and are a significant source of pain. The Medial Meniscal Transection (MMT) model is a post-traumatic mechanical model of OA, in which the destabilization of the medial meniscus results in characteristic features of human OA. Although the MMT model is the industry standard for therapeutic preclinical testing, localized expression events have not been characterized. To evaluate prospective tissue engineering and regenerative medicine approaches in OA, a reliable test bed must be established with well-characterized events in the cartilage, synovium, and osteophyte region. Gene expression and immunohistochemical analyses of the articular cartilage and the synovial membrane from the medial tibial plateau in the MMT were compared to that of control tissue at 1 and 3 weeks post-surgery. Our results showed that changes in chondrocytes might precede changes in the extracellular matrix (ECM) in the MMT model. Chondrocyte hypertrophic markers such as collagen 1 and osteopontin were significantly upregulated in the medial cartilage. While surgical effects dominate in the synovium at 1 week, meniscal instability began to have an effect at 3 weeks, when we observed altered expression of osteopontin and matrix metalloproteinases in the synovium. These results were comparable to human OA, and supported by our histological analysis.

Poster Presentation # 021
Optimized Transport Layer Protocol for Communication with Low Earth Orbit Satellites

Baijun Desai
Marcus Holzinger, PhD (Aerospace Engineering)

This paper will investigate methods to communicate data and optimize goodput in high loss, high delay environments such as space and attempt to implement protocols which do not necessarily rely on existing transport protocols. This method could lead to more optimal performance because the protocols may be built from the port level with a LEO environment in mind. Tests will be run on these protocols by introducing propagation delay, packet loss, and bit errors to simulate a LEO environment.

Poster Presentation # 057
Control and Planning of Legged Locomotion

Anushri Dixit
Patricio Vela, PhD (Electrical and Computer Engineering)

The core objective of the research is the synthesis and evaluation of increasingly dynamic quadrupedal locomotion gaits. The gaits include walking, trotting, and hopping. Additionally, obstacle avoidance and path planning using a Kinect will also be analyzed. Inspiration for generation of these gaits is drawn from behaviors found in nature as well as prior contributions in the field of robotic locomotion. A quadrupedal robotic platform was designed and fabricated to support these studies and experiments. A MATLAB simulation was developed to analyze the stability of the various gaits developed by looking at the position of the center of mass within the support polygon.

Poster Presentation # 071
Copper Characterization Analysis

Calvin Ebert
Chaitanya Deo, PhD (Mechanical Engineering)

This study will focus on the characterization of copper samples created using a spark plasma sintering machine. The samples will be created using copper powder of different initial grain sizes as well as varying parameters including sintering temperature and time in the machine. Temperature is currently planned to range from 300 degrees to 800 degrees Celsius by increments of 50 and the time is planned to range from 3 to 10 minutes in increments of 1 minute. The pressure inside the machine will be

identical as well as the cooling, cleaning, polishing, and etching procedures for every sample. Samples will be analyzed for characterization, final grain size, phase, imperfections, hardness.

Oral Presentation
Synthesis and Optimization of Poly(nickel-ethylenetetrathiolate) for High Performance n-Type Thermoelectric Polymers

Arnold Eng
Shannon Yee, PhD (Mechanical Engineering)

Thermoelectric generators directly convert heat into electricity via the Seebeck effect, which creates a voltage in response to an applied temperature gradient. Thermoelectric generators have been limited to niche applications due to their high system costs. Electrically conducting polymers are an attractive class of materials, particularly for low-grade waste heat recovery applications. Furthermore, they are inexpensive owing to their abundance and potential to process from solution via printing techniques, and they have an inherently low thermal conductivity. Thermoelectric polymers are often compared with their power factor which is determined by the electrical conductivity and the Seebeck coefficient. In this work, we investigate the thermoelectric properties of metallo-organic poly[Kx(Ni-ett)], which is one of the highest performing organic n-type TE materials. However, it is produced as a powder that is insoluble in common solvents such as methanol and water; previous attempts to solution process the material have resulted in significantly reduced thermoelectric properties. In this work, we optimize the synthesis of this polymer and fabricate a composite film by suspending poly[Kx(Ni-ett)] in a polyvinylidene fluoride matrix. This is achieved by optimizing the air exposure time and reducing the amount of polymer matrix needed to form a film. The obtained thin-film properties show a room temperature power factor that is seven times higher than that reported in literature and shows excellent stability in air. Additionally, the n-type composite material was used in a TE device based on a novel radial architecture to generate small amounts of power from a temperature gradient.

Poster Presentation # 022
The Application of Plenoptic Cameras in the Analysis of Air Flow Density

Kunal Gangolli and Shravan Hariharan
Narayanan Komerath, PhD (Aerospace Engineering)

Efficient and affordable technology surrounding analyses of airflow field densities have long been sought for applications in aerodynamics. Current technology requires an understanding of complex photography concepts, which is a hindrance to researchers. New technology in the field of plenoptic, or light field, photography has the capability to mitigate some of these challenges. These cameras, unlike typical imaging devices, capture a full three-dimensional image, with the ability to select the focus and depth after image capture through built-in software. This project focuses on the utilization of the LYTRO Illum, a commercial-grade plenoptic camera, that has the faculties to provide a rudimentary analysis of airflow field densities. A holistic approach to achieving an optimal analysis of these field densities requires an initial understanding of static object-oriented imaging, followed by dynamic object-oriented imaging. From this step, deductive analysis of the dynamic objects can be used to map out airflow density in three dimensions. Through this process, the LYTRO Illum, as well as the accompanying desktop software, have been shown to be both easily accessible and transparent to users, with visual aids and previews that provide a context to complex photographic options. This meets the necessity for efficient, variable-depth photography in the aerospace field, as one can focus more on the appearance of the photograph rather than the onerous numbers and settings that hinder researcher's abilities to cost-effectively and productively study aerodynamics.

Poster Presentation # 023
Imagination to 6-DOF Loads: Aerodynamics of Arbitrary Shapes

Max Germain and Tyler Hocut
Narayanan Komerath, PhD (Aerospace Engineering)

We wish to understand the aerodynamic forces on bluff bodies in order to predict the dynamics of when various objects are towed by a rotorcraft vehicle. The aerodynamic forces are experimentally obtained for a range of geometric shapes when rotated about each of their respective centers of gravity along all three orthogonal axes. The forces are measured using a stepper motor mounted to a load cell which rotates the model 10 times in order to mitigate any skewing that may occur in a single rotation during testing. Some modifications are made to geometries to investigate possible methods to beneficially alter the aerodynamic effects. All the data collected is used to make predictions on each objects stability when being towed by a rotorcraft using CFD analysis. The information learned about the basic geometries can then be extrapolated by combining them in order to approximate a more complicated geometry in order to make rough predictions instead of having to test a costly scale model. More detailed models have been tested to predict the forces on complex geometries that private entities wish to transport as slung loads. These geometries are also flight tested in order to draw a concrete relation between wind tunnel testing and flight testing.

Poster Presentation # 062
Innolucent Designs

Shawn Gregory, Alex Falcon, Ben Rothschild, Colten Spivey, Nico Grande and Brandon Holt
Mark Losego, PhD (Materials Science and Engineering)

We've created a Limited Liability Company and are researching projects could could be directly viable to improving industry/ standard methods. Our poster will contain three projects detailing our results and non-enabling processings of: A residual antimicrobial for textiles IR Spectroscopy for real-time Blood-Alcohol readings Plastic deposition in wood pores for strengthening.

Poster Presentation # 072
The Taking-Off of Birds

Catherine Grey
David Hu, PhD (Mechanical Engineering)

During take-off, birds extend both their wings and legs. The time of take-off is critical for the birds' survival since it determines their ability to flee from predators. In this experimental study, we are utilizing a high-speed videography to investigate the take-off times from birds at Zoo Atlanta. Our preliminary result indicates that all birds with a mass of 5 g to 5 kg take off in 0.1 seconds, which is independent of body size. Since larger birds have stronger legs and thus more stored energy before they take off, they yield the same take off as smaller massed birds.

Poster Presentation # 028
Evaluation of the Effect of Cyclic Stretch on Aortic Valve Collagen Morphology Using Second Harmonic Generation Microscopy

Priya Gupta
Ajit Yoganathan, PhD (Biomedical Engineering)

Heart disease is the leading cause of death in the United States with aortic valve (AV) stenosis being the most common valvular disease amongst the geriatric population. Previous studies have shown that dysregulation in mechanical stimuli (such as stretch) experienced by the AV can initiate a chain of pathological events, leading to extracellular matrix (ECM) degradation and calcification of AV leaflets. During each cardiac cycle, the AV leaflets experience varying degrees of tensile stretch spatiotemporally induced by the blood pressure. Since collagen is the most abundant component of the ECM and plays a major role in maintaining the structural integrity of the AV leaflets, it is of paramount importance to explore the effect of increased cyclic stretch on the collagen architecture of AV leaflets. In our current study, freshly excised porcine AV leaflets were maintained under static condition or cyclically stretched in a bioreactor for one week. Two different levels of stretch were used: 10% (physiological) and 15% (pathological). After one week, 14 μm sections of each tissue sample were prepared and the collagen fiber network in each section was imaged using second harmonic generation microscopy at an excitation wavelength of 800 nm. The resulting images were analyzed using the open-source software CT-FIRE to calculate different parameters of the collagen fibers, such as fiber length, width, angular orientation, etc. In combination with biomechanical implications, the results can provide insight into the interplay between pathological level of cyclic stretch and structural degradation of AV collagen fibers.

Poster Presentation # 073
The Function Behind Contractions in the Large Intestine

Joseph Haines
David Hu, PhD (Mechanical Engineering)

A digestive organ that links the large and small intestines, called the cecum, exhibits large, periodic contractions in herbivores. We hypothesize that the cecum's gas-filled interior initiates contractions to expel gas that accumulates from anaerobic fermentation. The period of a contraction is the same for both mice and rats at 19 seconds and the gas fraction of the cecum for mice, rats, and pigs is the same at 0.46. These findings will help us to better understand the relationship between fermentation and cecal contractions based on diet.

Oral Presentation
Fc microparticles can modulate the physical extent and magnitude of complement activity

Brandon Holt
Todd Sulchek, PhD (Mechanical Engineering)

The complement system is an integral component of the humoral immune system, and describes a cascade of interacting proteins responsible for the opsonization and lysis of foreign pathogens, in addition to the recruitment of immune cells. Microparticle (MP) biomaterials capable of tuning the local magnitude of serum complement activation could improve complement-mediated cytotoxicity to serum-resistant bacteria or calm an overactive immune response during sepsis. In addition, prior literature shows that MSC viability can be increased by local complement inhibition. We demonstrate that model Fc-functionalized microparticles can be designed to either enhance or diminish the local cytotoxic effect of complement activation in human serum. The particles were formed with either the antibody Fc domains oriented outward from the particle surface or randomly adsorbed in a non-oriented fashion. In the oriented form, complement products were directly sequestered to the particle surface, and they lowered the cytotoxicity of serum and thus decreased the antibiotic effect when compared to serum alone. Conversely, the non-oriented microparticles were found to sequester much lower levels of complement on the microparticle surface, while also extending the distance over which TCC forms and enhancing serum cytotoxicity to bacteria. Together, these two types of complement-modulating particles provide the first biomaterial that can functionally modify the range of complement activation at sites distant from the particle surface. Thus, biomaterials that exploit Fc presentation provide new possibilities to functionally modulate complement activation

to achieve a desired clinical result. Published: Holt, Bellavia, Potter, White, Stowell and Sulchek, Biomaterials Science, 2017, DOI: 10.1039/C6BM00608F.

Poster Presentation # 024
Omnidirectional Space Situational Awareness (OmniSSA)

Lourenço Jara de Carvalho and Eric Avari
Marcus Holzinger, PhD (Aerospace Engineering))

Space Situational Awareness is concerned with accurately determining the state of the objects orbiting Earth, such as satellites, launch vehicle parts, and other debris. The number of these objects has grown steadily over the years, a result of the increasing importance of space-based capabilities in the global economy and security. Avoiding potentially catastrophic incidents, such as collisions that would generate additional debris, requires a continuous increase in observation capabilities to match the growth of these objects. Therefore, lower cost, innovative data gathering techniques must be developed. The Omnidirectional Space Situational Awareness (OmniSSA) array is a proof of concept for the use of commercial, off-the-shelf parts to create a wide survey telescope. OmniSSA consists of three AllSky camera modules in network with a processing computer and storage device, all enclosed in a temperature controlled chassis. OmniSSA harnesses new processing techniques to "stack" images from multiple cameras, providing valuable SSA-supporting data at a relatively low cost. By capturing three images at the exact same time and combining them, the system generates a virtual picture of a larger size than each original. It operates autonomously and continuously, capturing images of most of the hemisphere every thirty seconds. This autonomy, combined with weather proofing and thermal control of the components, allows the system to collect data over long periods in difficult environments, such as Antarctica, where observation conditions are ideal. The OmniSSA array was designed and assembled over the past year, and will soon be tested on campus, before beginning data collection campaigns.

Poster Presentation # 074
The effects of surface modification on osteogenic differentiation

Allie Johnson
Brennan Torstrick, PhD (Mechanical Engineering)

Polyetheretherketone (PEEK) is a thermoplastic polymer with many clinical orthopedic applications. With an elastic modulus similar to bone, PEEK is a preferred implant model due to its reduced risk of stress-shielding that can lead to implant loosening. The limitations of current PEEK devices arise from their poor osseointegration which in a clinical setting may cause implant migration or dislodgement. Recent methods to improve the osseointegration of PEEK have involved surface modification, including the change of surface structure as well as surface chemistry. The purpose of this study is to analyze how the change in surface structure of PEEK affects its osseointegration properties in vitro. Mesenchymal stem cells will be cultured on various PEEK surface structures including surface porous, soda blasted, and smooth injected molded PEEK. These cultures will then be tested for markers of osteogenic differentiation. Based on the optimized surface structure of PEEK, future studies will begin to characterize the optimal surface coating or surface chemistry for PEEK implants so that the inert properties of PEEK may be overcome in the clinical setting by surface modification.

Oral Presentation
In-Situ Water Quality Monitoring for Resource-Constrained Areas

Ann Johnson
Joe Brown, PhD (Civil and Environmental Engineering)

Water-borne pathogens and unsafe water supplies are the cause of death for 1.7 million people every year [1]. Many of these people live in the developing world, where it can be difficult to manage water safety. The World Health Organization mandates that many countries use standardized water quality measurements, and these measurements can take up to 18 hours and require unsustainable equipment and trained operators [2]. Fluorometers provide real-time prediction of both presence and number of thermotolerant (faecal) coliforms (TTCs) in water samples. This makes a fluorimeter an ideal water quality measuring device that would reduce the large amount of time required for water testing by current WHO standards [3]. However, current fluorometers are extremely expensive and not sustainable for in-field use. We present a low-cost fluorometer that will passively and accurately collect real time water quality measurements. Our device measures a fluorescent signal called tryptophan-like fluorescence (TLF), which is produced by bacteria when exposed to light at a specific frequency. This device exploits this phenomenon to deduce the quantity of bacteria in the sample. We hypothesize that this device will have accuracy that matches the current WHO standards for water quality measurements, and will be cheaper, easier to use, and more sustainable than the current methods. [1] WHO, 2002. The World Health Report: 2002: Reducing the Risks, Promoting Healthy Life. [2] WHO, Ed., Guidelines for Drinking-Water Quality, 4th ed. 2011. [3] J. Sorensen, D. Lapworth, B. Marchant, D. Nkhuwa, S. Pedley, M. Stuart, R. Bell, M. Chirwa, J. Kabika, M. Liemisa, and M. Chibesa, "In-situ tryptophan-like fluorescence: A real-time indicator of faecal contamination in drinking water supplies," Water Research, vol. 81, pp. 38-46, 2015.

Poster Presentation # 029
An Examination of the Noninflammatory Role of Astrocytes in Glutamate Excitotoxicity in SOD1 G93A ALS Mouse Model

Kathleen Jordan
Cassie Mitchell, PhD (Biomedical Engineering)

Astrocytes can be found between the vascular and neuronal elements of the central nervous system, where they take up and release molecules in order to maintain a homeostatic microenvironment for optimal neuron growth. Dysregulation of these astrocyte functions can lead to neuronal depolarization, hyperexcitability, excitotoxicity and subsequent neuronal death, characteristic of Amyotrophic Lateral Sclerosis (ALS). We hypothesize that the levels of glutamate and glutamate transporters in astrocytes increase over ALS disease progression and contribute to motor neuron death. Applying inclusion and exclusion criteria to a database comprising findings from over 2,000 papers resulted in data from over 60 papers. Data measuring glutamate concentrations and glutamate transmitter levels from SOD1 G93A (superoxide dismutase-1 glycine 93 to alanine) transgenic ALS mouse models were normalized to wild-type mice and graphed over time. We perform meta-analysis, correlation analysis, and survival analysis to determine the role of astrocytic glutamate regulation in disease progression. We demonstrate that GTL-1, GluR-1, and GluR-2 levels from astrocytes decrease over time. We propose that this trend may be associated with increased extracellular glutamate concentrations and the cellular attempts to maintain homeostasis. The findings of this analysis will give insight into the non-inflammatory role of astrocytes in the pathophysiology of ALS.

Poster Presentation # 075
Controlling Interfacial Properties of Solid-State Lithium Batteries Using Atomic Layer Deposition

Kirit Joshi
Matthew McDowell, PhD (Mechanical Engineering)

The purpose of my research is to use Atomic Layer Deposition (ALD) of thin film materials to control the interfacial chemical, mechanical, and electronic properties of solid electrolyte material in Lithium-ion batteries. The goal of this research is to create stable, high energy batteries.

Poster Presentation # 076
Felines, tongues, and grooming

Kristian Kabbabe Poleo
David Hu, PhD (Mechanical Engineering)

Felines have interesting tongues. Their surface is rough that helps them groom their fur effectively. By studying their grooming techniques and studying their tongues under the microscope it can be seen small spines like cavities that helps them moister and clean their fur while grooming. Studying this property and prototyping mock models, applications of their biology can be found in medical and cosmetic fields.

Poster Presentation # 077
The Formation of Pellet Feces

Candice Kaminski
David Hu, PhD (Mechanical Engineering)

One of the digestive strategies for certain mammals is to excrete feces in a pelleted formation. Animals that produce pellets include rodents, rabbits, and ruminants. In this experimental study, we investigate the gastrointestinal tract and feces of these animals. Animals that produce pelleted feces have a spiral colon, which is longer than that of the animals with cylindrical feces. The pelleted feces have a water concentration of 50-60%, which is much lower than the water concentration of cylindrical feces.

Poster Presentation # 043
Effects of P3HT concentration on solution and electrical properties

Daniel Keane
Martha Grover, PhD (Chemical and Biomolecular Engineering)

The purpose of this research is to optimize organic polymers for application to electronics; specifically, this study analyzes the impact of solution concentration on the properties of treated P3HT. Solutions of Poly(3-hexylthiophene-2,5-diyl), or P3HT, in chloroform are to be treated with short-wave UV radiation and aging. These treated solutions will be tested with UV-vis measurements of both films on individual glass slides and of small amounts of the solutions sandwiched between two glass slides. Furthermore, the electrical properties will be measured by running an electrical charge across a P3HT film deposited onto transistor pathways through the process of blade-coating. Past experiments have examined the effects of changing variables such as the polymer molecular weight, aging time, and treatment method, but little data has been collected on the impact of the polymer concentration in the solution. Solutions of P3HT with molecular weights of both 37 kDa and 95 kDa will be created at a range of concentrations and tested with the previously described methods. Data will be collected for these solutions at different ages, on the scale of a single day to a week after UV treatment. Based on preliminary data gathered up until this point, the aggregate fraction is anticipated to decrease with increased concentration, while the charge mobility will increase.

Poster Presentation # 030
Characterization of Rat Optic Nerve Head Biomechanics through Finite Element Modeling and Sensitivity Analysis of Tissues

Ali Kight
Ross Ethier, PhD (Biomedical Engineering)

Glaucoma, the second leading cause of blindness, is characterized by the death of retinal ganglion cells (RGCs). The pathophysiology of glaucoma is complicated, and the cellular mechanisms behind it are poorly understood. Studies have shown that the optic nerve head (ONH) is the primary site of damage in glaucoma, and elevated intraocular pressure (IOP) is a key risk factor. In fact, a leading hypothesis holds that IOP-induced stress and strain in ONH tissues is a key driver in the pathophysiology of glaucoma. Animal models, specifically rat models, are a useful tool for gaining insight into these complex biomechanics. This research aims to characterize the biomechanics of the rat ONH by building individual-specific rat ONH finite element models and conducting a sensitivity analysis to determine which tissue material properties have the largest effect on intraocular pressure-induced mechanical strain in the ONH. Analysis of the data will include a qualitative look at strain fields and patterns as well as a quantitative look at first and third principle strains in the anterior region of the ONH. A sensitivity analysis on the rat ONH model will vary the material properties of tissues and determine their influence on the overall strain in the optic nerve head under increased IOP. Results from each individual specific model will improve understanding of biomechanics in the rat model of glaucoma, which will ultimately allow us to better understand the link between biomechanics and RGC death.

Oral Presentation
Characterization of Electrodes for Kilohertz Electrical Stimulation

Brian Kim
Robert Butera, PhD (Biomedical Engineering)

Kilohertz electrical stimulation (KES) induces repeatable and reversible conduction block of nerve activity and is a potential therapeutic option for various diseases and disorders resulting from pathological or undesired neurological activity. However successful translation of KES nerve block to clinical applications is stymied by many unknowns such as the relevance of the onset response, acceptable levels of waveform contamination, and optimal electrode characteristics. We investigated the role of electrode geometric surface area and material on the KES nerve block threshold using 20 and 40 kHz current-controlled sinusoidal KES. Electrodes were electrochemically characterized and used to characterize typical KES waveforms and electrode charge characteristics. KES nerve block amplitudes, onset duration, and recovery of normal conduction after delivery of KES were evaluated for effective KES nerve block. Results from this investigation demonstrate that increasing electrode geometric surface area provides for a more efficient KES nerve block, while material change shows no significant change. Reductions in block threshold by increased electrode surface area were found to be KES frequency dependent, with block thresholds and average power consumption reduced by >2x with 20 kHz KES waveforms and >3x for 40 kHz KES waveforms.

Poster Presentation # 031
Morphology Change of Optic Nerve Sheath in Idiopathic Intracranial Hypertension Patients (pre- and post- CSF drainage)

Chansu Kim
John Oshinski, PhD (Biomedical Engineering)

Idiopathic Intracranial Hypertension (IIH) is a syndrome which leads headache, vomiting and sometimes irreversible vision loss. CSF pressure in intracranial space triggers the morphology change in optic nerve sheath (ONS) and optic nerve (ON). Currently, the root of abnormal CSF pressure is clinically and scientifically unknown. IIH patients can be treated by manually draining CSF out to decrease the pressure. Previous studies have indicated that there is a correlation between pressure difference in CSF and ONS diameter (ONSD). ONSD measurement was conducted by looking at examination of magnetic resonance (MR) imaging. However, this method does not measure the dimension of the ONS at multiple locations and did not look at change in ONSD due to CSF drainage. The purpose of this study is to identify and analyze the diameter change of ONS and ON between pre- and post-CSF drainage by using qualitative and quantitative MR imaging techniques. We believe that this study will further provide qualitative and quantitative information about whether the appearance including ON diameter and ONSD will return to normal after conducting surgery.

Poster Presentation # 032
Data enabled design of multi-factorial disease treatment paradigms: a case study of Amyotrophic Lateral Sclerosis

Tyler Kittel
Cassie Mitchell, PhD (Biomedical Engineering)

Amyotrophic lateral sclerosis (ALS) is a debilitating motor neuron disease with no cure; the only FDA-approved treatment, riluzole, extends survival by two months on average. The various treatments for the SOD1 G93A mouse model can be categorized as pertaining to apoptosis, axonal transport, chemistry, energetics, excitability, inflammation, oxidative stress, proteomics, or systemic approaches. A meta-analysis was performed to determine whether certain treatment categories may be more effective than others at various time points throughout disease duration. Quantifiable treatment results extracted from over 230 published studies testing various treatments on the high copy B6SJL-Tg mouse model

were normalized to their nontransgenic control to yield over 6,000 paired data points. Prior to analysis, these values were divided into 7 different time bins. An ANOVA analysis demonstrated significant results in 4 stages: inflammation and systemic treatments were most effective in early life (1-64 days), excitability treatments were superior at disease onset (101-112 days), treatments targeting axonal transport were exceedingly effective just after onset (113-122 days), and apoptosis treatments yielded better results as the mice began to die (141+ days). In addition, polytherapy treatments were significantly more effective than monotherapy treatments during the diseased stages, especially in extending the survival. These findings support the notion that ALS is a complicated neurodegenerative disease requiring an equally complex treatment procedure. Such a regimen would combine multiple treatments targeting different molecular mechanisms, selected on the basis of disease stage. Further research pursuing this stage-oriented treatment approach will be necessary to refine the results of this analysis.

Poster Presentation # 033
Measuring Stem Cell Factor and C-X-C Motif Chemokine Ligand 12 Expression in a Bone-Marrow-on-a-Chip Device

Anagha Krishnan
Krishnendu Roy, PhD (Biomedical Engineering)

Bone-marrow-on-a-chip devices are artificial bone marrow structures constructed from stromal cells such as MSCs, osteoblasts, and endothelial cells. These devices retain natural bone marrow structure and function and can be maintained in culture, allowing them to serve as models for bone marrow processes, particularly hematopoietic stem cell (HSC) mobilization. HSCs are stem cells that give rise to all other blood cells, including both the myeloid and lymphoid cell lineages. HSC mobilization is the process of moving stem cells from the bone marrow to the peripheral blood for easier collection and storage during stem cell transplantation. HSC mobilization is governed primarily by the expression of two proteins: stem cell factor (SCF) and C-X-C Motif Chemokine Ligand 12 (CXCL12). In this study, I will measure SCF and CXCL12 expression by different stromal cells and under different flow conditions via fluorescence microscopy. This work will allow for a better understanding of whether bone-marrow-on-a-chip devices are accurate models of HSC mobilization. This, in turn, will lead to better collection in patients who fail to mobilize sufficient stem cells via conventional harvesting methods.

Poster Presentation # 078
Lymphatic Smooth Muscle Cell Atomic Force Microscopy

Morgan Labrie
Todd Sulchek, PhD (Mechanical Engineering)

Since its creation, there have been countless studies utilizing AFM to characterize various structural features of cells. Previous research conducted utilizing AFM suggests many different ways of altering the stiffness and structure of a cell by using varying softening and stiffening medias, plating on different surfaces, and varying degrees of stimulation. Lymphatic cells have never been characterized using AFM, and the responsive properties they possess in response to the stimuli mentioned before are unknown. The research being conducted here works to characterize properties of healthy and wounded (cells adjacent to an incision) lymphatic cells. This structural data could potentially lead to a greater understanding of the mechanics of lymphedema development and to possible treatments of lymphedema for the future.

Poster Presentation # 079
The Effect of Chyme Density on Segmental Contraction in the Small Intestinet

Morgan LaMarca
David Hu, PhD (Mechanical Engineering)

The physical processes that govern the digestion of food and the transportation of nutrients through the wall of the gastrointestinal tract have a substantial influence on the rate of their absorption of nutrients and water. The two fundamental patterns of motility, propulsion and mixing, drive the flow and digestion of chyme along the gastrointestinal tract. While peristalsis is the principle muscle contraction for propulsive motility, segmentation is responsible for mixing motility and consists of segmental rings of contraction that chop and mix chyme. Previous studies have shown how the contraction frequencies alter in response to different types of food. We propose that the pattern of segmental contraction varies in response to the different compositions of intraluminal contents as well. As the composition of ingesta alters and it becomes less dense, segmental contraction frequency may increase as a response. The small intestine may alter the contraction frequency in response to different compositions of intraluminal contents in order to minimize energy loss. Our innovative invasive in vivo observational technique will allow us to quantify the density and gas fraction gradients throughout the small intestine, and compare that to the observed frequency and amplitude of segmental contractions in the small intestine of male Sprague-Dawley rats. Every year, billions of dollars are spent diagnosing and treating gastrointestinal infections, malnutrition, or a variety of other health issues. Understanding and comparing essential patterns of motility across patients can improve medical diagnostics as well as the manufacturing of food supplements and pharmaceutical medications.

Oral Presentation
Effect of Extracellular Matrix Strain on Myofibroblastic Differentiation

Jacqueline Larouche
Philip Santangelo, PhD (Biomedical Engineering)

Fibronectin (Fn) is an abundant glycoprotein in the extracellular matrix (ECM) and is comprised of three types of tandem repeats. Type three repeats are only stabilized by hydrogen bonding and are particularly sensitive to force-mediated unfolding. Cells engage Fn through integrins, which, along with other components of focal adhesion complexes, couple the actin cytoskeleton to Fn fibers. Computer simulations suggests that translocation apart of the 9th and 10th type III repeats activates a differential affinity for the avB3 integrin over the a5B1 integrin, termed an 'integrin switch'. We hypothesize that this conformational change drives myofibroblastic differentiation, leading to fibrotic progression. Our lab created an antibody (H5) that recognizes an epitope in the 9th type III repeat that is exposed when Fn experiences strain. H5 has been validated on strained fibers and conformationally stabilized fragments, but this conformation change has not been detected in more physiologically relevant environments. To recapitulate the heterogeneous orientation of Fn fibers in native ECM, I generated decellularized ECM on elastic membranes, allowing me to model the effect of matrix strain on Fn conformation. Results show that H5 binds significantly more to strained matrices compared to relaxed controls ($P<0.01$). Furthermore, cells that only express the a5B1 integrin adhere significantly less to strained matrices ($P<0.05$), whereas avB3 expressing cells adhere equally to strained and relaxed matrices. These results indicate that the integrin switch happens in anisotropic, Fn-rich ECM, and affects early cell-matrix interactions. Future studies will focus on downstream effects of the integrin switch on myofibroblastic differentiation.

Poster Presentation # 034
Investigation of Immunomodulation on Myofibroblast Activation: Implications for Skeletal Muscle Repair

Matthew Lawler
Edward Botchwey, PhD (Biomedical Engineering)

Incomplete skeletal muscle healing after traumatic injury is a major clinical burden, comprising 50-70% of combat injuries. Autologous tissue repair is the main form of treatment, which requires multiple surgeries and has limited clinical success. Therefore, there is a need for therapeutic methods that promote muscle repair at the site of injury. Macrophages are highly involved in this process, and generally exhibit either an inflammatory (M1) phenotype, promoting cell debris clearance, or an anti-inflammatory (M2) phenotype, promoting muscle regeneration, although there is plasticity in these phenotypes for injury repair in vivo. Type I collagen is also crucial to the skeletal muscle repair process, and is deposited by myofibroblasts which differentiate from fibroblasts in the presence of transforming growth factor-beta (TGF-beta) among other pathways. However, persistent myofibroblast activity can lead to fibrosis. While it is clear that macrophages and myofibroblasts are involved in the skeletal muscle healing process, the interplay between these two populations has not been thoroughly investigated. In vitro experiments of M1, M2a, and M2c macrophage phenotypes with 10T1/2 fibroblasts were conducted, with 10T1/2s incubated in macrophage-conditioned media for 72 hours. Expression of alpha-smooth muscle actin (alpha-SMA), an indicator of myofibroblast activation, was probed via immunofluorescence. Through confocal microscopy and image intensity analysis, it was determined that fibroblast interaction with M1 soluble factors lead to significantly higher levels of normalized alpha-SMA expression within fibroblasts compared to control. Experimentation is underway to determine the significance of contact dependency as well as using media conditioned with different seeding densities of macrophages.

Poster Presentation # 080
Immobilization of Plasma Cells using Janus Particles for Antibody Collection

Ye Lim Lee, Tanvi Suresh, and So-Yun Han
Todd Sulchek, PhD (Mechanical Engineering)

When a plasma B cell recognizes a pathogen, it releases large quantities of antibodies as an immune response. The main objective of the study is to create and optimize the Janus particle, a bifunctional microbead with two spatially and chemically defined hemispheres. One side of the particle targets and binds plasma cells while the other side contains protein G that collects specific antibodies that are secreted. Experiments were conducted to determine the best combination of particle size, reagent type, and reagent concentration that would result the greatest amount of antibodies collected. Moreover, the study was carried out with hybridoma cells to determine whether the Janus particle can bind to the plasma B cell and collect antibody with another hemisphere.

Poster Presentation # 035
Developing a PEG-based Bioink to 3D Print Aortic Valves

Siyi Li
Michael Davis, PhD (Biomedical Engineering)

Heart valve disease is an increasing clinical burden associated with high morbidity and mortality, typically treated by valve replacement. For children, current valve implants are not ideal as they are not small enough in size and fail to grow. Tissue engineering using 3D bioprinting can address this issue by incorporating cell-laden biomaterials into a scaffold capable of growth and biological integration. Despite advances, there is a

lack of suitable bioinks for 3D bioprinting. This study aims to develop a polyethylene glycol (PEG)-based bioink for printing aortic valve scaffolds. To identify a biomaterial with printable properties, we conducted several benchtop tests using different weight-to-volume ratios and combinations of PEG-diacrylate, PEG-amine, PEG-succinimidyl valerate, sodium alginate, and Pluronic F127. The gelation properties of each hydrogel formulation was tested and the printability was determined by benchtop extrusion using a 0.2 mm needle. The shape fidelity of formulations that exhibited benchtop printability were determined by 3D printing with the EnvisionTec Bioplotter. While different combinations of PEG mixtures alone were not suitable for 3D printing, we identified a mixture of 5% w/v PEGDA and 40% w/v Pluronic F127 as 3D printable at 24°C, 0.5 bar pressure, 10 mm/s print speed, and strands 0.2 mm apart. Cylindrical scaffolds of 0.6 mm diameter were printed for 5 layers and cured by white light for 3 minutes. These scaffolds maintained shape and structure after soaking in PBS. The results of this study suggest that the combination of PEG-diacrylate and Pluronic F127 is a suitable bioink formulation for 3D printing.

Poster Presentation # 044
Protein Nanocarrier for Targeted 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 would enable modulation of intracellular signaling mechanisms and protein-protein interactions involved in various disorders. This study utilized protein engineering techniques to develop a novel protein nanocarrier that is capable of delivering functional antibodies to the intracellular environment. Each nanocarrier contains six SPAB antibody-binding domains, and is therefore capable of delivering up to six antibodies. The interaction between the SPAB domain of the nanocarrier and the heavy chain constant region of the antibody is noncovalent, thus allowing the nanocarrier to bind different functional antibodies with the same affinity. We successfully expressed the protein monomers, assembled the functional nanocarrier, and investigated its antibody-delivery properties. Results of cellular studies using HeLa, MCF-7, as well as SK-BR-3 cancer cell lines indicate significant delivery of fluorescent antibody as compared to soluble antibody, as measured by fluorescent microscopy and flow cytometry. Ongoing experiments seek to achieve specific targeting capability of our nanocarrier design through addition of targeting antibodies and to demonstrate the potential of this nanocarrier to deliver therapeutic antibodies to cancer cells. In addition to efficient cellular uptake, the highly biocompatible and modular nature of our nanocarrier makes it ideal for expanding the scope of antibody-based therapeutics to the intracellular environment.

Poster Presentation # 081
Nasal Cavity Airflow

Joyce Magill
David Hu, PhD (Mechanical Engineering)

During inhalation, the rate at which air enters each nostril is different(1). This difference is caused by the swelling of blood vessels in one side of the nasal cavity, and not the other. The swelling constricts the airway, thereby increasing the flow rate in this nostril. The purpose of this variation is likely to allow a wider range of odorants to be detected by receptors in the olfactory epithelium(1). High sorption odorants are captured by olfactory epithelia more effectively at high flow rates, whereas low sorption odorants are absorbed better at low airflow rates(2). To date, two other animals have been tested for such a phenomenon: rabbits and rats. Both demonstrated similar changes in airflow pattern(3). Determining the mixing patterns and parameters of air external to the nose may be applied to sensor and filtration technologies. The purpose of this project is to determine the impact of varying inhalation rates of nostrils on the air external to the nose and to determine any relationships among body mass, nostril area, breathing frequency, and inhalation velocity. This is achieved through three steps. First, frequency, mass, and nostril size data are collected for a number of mammals ranging from rats to elephants. Next, inhalation rates for individual nostrils are collected and analyzed for these species. Finally, airflow rates and nostril dimensions are used to investigate airflow patterns external to the nose using physical and computer models. This explores a possible correlation between nostril size and flow rate to optimize mixing. 1. Sobel N, Khan RM, Saltman A, Sullivan EV, Gabrieli JDE. Olfaction: The world smells different to each nostril. Nature. 11/04/print 1999;402(6757):35-35. 2. Mozell MM, Kent PF, Murphy SJ. The effect of flow rate upon the magnitude of the olfactory response differs for different odorants. Chemical Senses. 1991;16(6):631-649. 3. Bojsen-Moller F, Fahrenkrug J. Nasal swell-bodies and cyclic changes in the air passage of the rat and rabbit nose. Journal of anatomy. 1971;110(Pt 1):25.

Oral Presentation
Object Segmentation with Posterior Feedback Matching

Sivabalan Manivasagam
Chris Rozell, PhD (Electrical and Computer Engineering)

One of the central tenets of being human is being able to communicate with each other. Individuals with motor neuron disabilities such as ALS, or brain injury such as a tetraplegia or stroke are unable to fully communicate and interact with the rest of us. One important communication task is the ability to specify regions or segmentations in an image. This study proposes an information theoretically optimal approach to the task of object segmentation from an image using only noisy binary inputs. We

apply a posterior matching algorithm derived from feedback information theory with a binary symmetric channel to the image segmentation task. We develop a user-friendly lexicon of ordered dictionary strings for image segmentation. We apply our method to large image segmentation datasets and compare our method to another binary input image segmentation algorithm. We analyze the algorithm's ability to specify segments over varying number of inputs and its robustness to input noise. We demonstrate that the posterior feedback matching algorithm is an effective approach for complex tasks such as image segmentation. This new information-theory based approach can potentially be applied to other tasks such as control of a robotic arm, creating new motor control for these individuals and for their reintegration into society.

Poster Presentation # 082
Cat tongues

Andrea Martinez
David Hu, PhD (Mechanical Engineering)

Felines have very peculiar tongues. They have a tough surface, that when studied, it has been identified is due to the claw like papillae made from keratine (same compound as human nails). By studying the relationship between the soft tissue of the tongue and the hard papillae composition, it is possible to understand the vital functions the tongues provide for the cats. Ideally, this study between the soft tissue and hard elements could be implemented medical devices.

Oral Presentation
Elephant trunk can adjust contact force and sweeping trajectory in response to differing surfaces

Annabel McAtee
David Hu, PhD (Mechanical Engineering)

The elephant can use its trunk to sweep and collect food from a range of textured surfaces. This sweeping behavior is facilitated by hairs on the trunk tip which act like the bristles of a broom. Here we report that the elephant can adjust the sweeping trajectories and contact force for a better grasp on corrugated boards. The trajectory of the elephant trunk sweeping was measured as the trunk scoops bran dust off of a corrugated board placed at three angles of 0, 45 and 90 degrees. Analysis of positional data drawn from video evidence demonstrated that the elephant adjusts its sweeping trajectory in order to better align with the corrugations and thus collect more food with each scoop. In addition, we discovered that the elephant increases the force when the corrugations are at an angle that varies from the comfortable sweeping trajectory. The elephant uses increased contact force to compensate for the difficulties in sweeping caused by the suboptimal directions of the corrugations. We illustrated this mechanism by LuGre model and theoretical prediction of remaining food amount matches well with the experimental results. This work may inspire robotic applications involving the leveling or grading of uneven surfaces, common in many industries such as construction or landscaping.

Poster Presentation # 053
Optimization of Point Absorber Design in Ocean Wave Energy Conversion

Taylor McKie
Kevin Haas, PhD (Civil and Environmental Engineering)

The purpose of this study is to analyze the factors that affect the efficiency of a wave energy conversion device and design an optimal point absorber float geometry considering the various factors. Factors to be analyzed in the study include damping system design, resonance, float geometry, and the kinematics of the device. This study will utilize Fusion 360, Nemoh, and Wec-Sim to achieve the objectives. Fusion 360 will be used to design point absorber float geometries. Nemoh will be used to simulate the hydrodynamic response of each float design. Wec-Sim will be used to vary the wave conditions and calculate the efficiencies of the various designs based off of the response generated in Nemoh. From this, trends will be observed and an optimal geometry can be determined. The results of this study can be used to further optimize point absorber systems and provide solutions to minimize the difficulty of extracting energy from ocean waves.

Poster Presentation # 058
Human Walking Gait

Siddharth Mehta
Patricio Vela, PhD (Electrical and Computer Engineering)

My research explores the mimicry of the human walking gait on on Bioloid GP Humanoid Robot. While diverse solutions to this problem exist, our solution incorporates the utilization of Optragen: A Toolbox for optimal trajectory generation. Optragen solves the optimal trajectory giving a certain set of constraints and cost function. Compared to other methods, Optragen is a much more robust solution for robot motion planning as it can not only generate trajectories for the human walking gait but also ones which can avoid obstacles.

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 CFD 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.

Poster Presentation # 045
Droplet microfluidic module for behavioral screen of Caenorhabditis elegans

Marija Milisavljevic
Hang Lu, PhD (Chemical and Biomolecular Engineering)

Caenorhabditis elegans (C. elegans) nematode is an attractive model organism to study the link between chemosensory behavior and genetics. However, the screening of worm behaviors in response to chemical stimuli proves challenging because use of traditional, manual methods is slow and labor-intensive. With numerous behaviors and stimuli (and combinations of stimuli) to screen for, along with various genotypes to consider, high-throughput screening methods are integral to the progress of animal behavior and genetics research. To address screening challenges, the Lu lab has developed a droplet microfluidic platform that enables high-throughput screening of worm behavior. Animals are encapsulated in individual droplets and merged with stimuli droplets in the device; subsequent behavior is analyzed. Previously, worms were stimulated by the addition of a stimuli reagent (or multiple reagents) to the worm's initial chemical environment. However, because the removal of the worm's original medium can also affect behavior, we seek to develop a microfluidic unit that completely exchanges the worm's initial droplet with that of the stimulus droplet. My work is focused on exploring the optimal geometry of the device channels, integrating on-chip valves, and varying the capillary number of the water-oil emulsion system. Upon completion, this liquid replacer unit will complete the range of capabilities of the droplet platform, creating a versatile tool for C. elegans research on behavior.

Poster Presentation # 036
Investigating the effects of sustained attention on motor cortex excitability

Arsh Momin and Alex Chen
Michael Borich, PhD (Biomedical Engineering)

Studies show that transcranial magnetic stimulation (TMS)-based measures of cortical excitability are variable and influenced by multiple factors[1]. Previous work has shown brain-state dependent effects on TMS-evoked responses; however, it remains unknown how brain-state may affect the inherent variability of MEPs[2]. Frontal eye field activation has been shown to be a significant factor in maintaining consistent attention, which is linked to cortical excitability[3,4]. The objective is to evaluate the impact of different visual attention paradigms on motor cortical excitability. Each participant (18-35y) completed two visits, one week apart. The motor cortex (M1) hotspot for the first dorsal interosseous (FDI) muscle was identified using neuronavigated TMS and the resting motor threshold (RMT) was established. Electroencephalography (EEG) was collected using a 32-channel DC amplifier. Electromyography (EMG) data were collected with a 16-channel amplifier. TMS-based measures of general corticomotor excitability (MEP peak-to-peak amplitude), intracortical facilitation (ICF, interstimulus interval (ISI): 12ms), and short interval intracortical inhibition (SICI, ISI: 2ms) were collected during three attention conditions. In condition 1, no visual stimulus (VS) was presented. A version of the Eriksen Flanker Task was used for the VS for conditions 2 and 3[5]. Preliminary data suggests that increasing visual attention demand may reduce MEP variability and potentially increase test-retest reliability without substantially influencing MEP amplitude. Additional data collection and analysis will further clarify the effect of visual attention on motor cortical excitability. Future studies measuring corticomotor excitability may benefit from improved standardization of attentional demands during TMS-based assessments. 1. Nicolo P, Ptak P, Guggiseberg AG. Variability of behavioural responses to transcranial magnetic stimulation: Origins and predictors. Neuropsychologia. 2015; 74: 137. 2. Huber R, Mäki H, et al. Human Cortical Excitability Increases with Time Awake. Cerebral Cortex. 2013; 23(2): 332; 3. Esterman M, Liu G, et al. Frontal eye field involvement in sustaining visual attention: Evidence from transcranial magnetic stimulation. NeuroImage. 2015; 111: 542. 4. Conte, A. Francesca G. Attention influences the excitability of cortical motor areas in healthy humans. Experimental Brain Research. 2007; 182: 109. 5. Eriksen, BA, Eriksen, CW. Effects of noise letters upon the identification of a target letter in a nonsearch task. Perception & Psychophysics. 1974; 16: 143–149.

Poster Presentation # 063
Manufacturing of Dual Layer Filtration Membranes

Lucas Muller and DoHyun Kwon
Tequila Harris, PhD (Materials Science and Engineering)

As part of the Polymer Thin Film Processing (PTFP) Group, this research investigates the relationship between fluidic properties of polymer solutions and the processing parameters associated with the casting of water filtration membranes using slot die extrusion. The motivation for this work is to improve the quality of water filtration and explore solutions to problems related to water scarcity and sanitation. The research focuses primarily on manufacturing multi-layer cellulose acetate membranes via single slot die casting. Compared to conventional nanofiltration membranes that are limited in permeate flux and rejection of substances in water, double layered water filtration membranes have higher flux and better rejection, while also gaining improved mechanical strength. Works on this project consists of the design and fabrication of new tooling based on results from analyzing the viscous flows through the system. Preparation of experiments that characterize the coating bead under different condition allows for the generation of a range of operating parameters for manufacturing defect-free membranes. These membranes can be tested for permeate flux, as well as for performance degradation over time due to accumulation of substances on the film.

Poster Presentation # 046
Automated Analysis of Fiber Growth Kinetics in Semiconducting Polymer Thin Films

Kaylie Naghshpour
Martha Grover, PhD (Chemical and Biomolecular Engineering)

Solution processable organic electronic materials are being commercialized for use in photovoltaic cells, organic light-emitting diodes, and flexible displays, among other applications. As the production of these materials is scaled up, organic electronics will increasingly offer a lower cost, easily processable alternative to inorganic electronics. In order to manufacture organic electronics at a large scale, their microstructure must be quantified and controlled. To explore how this structure evolves during processing, a poly(3-hexylthiophene) (P3HT)-based organic field effect transistor system was studied. P3HT forms polymer fibers that enhance charge transport. However, the mechanism and kinetics of fiber growth have not yet been fully explored, partially because fiber growth is difficult to monitor in a solution. In this study, we track the growth of P3HT nanofibers in chloroform by depositing them in a thin film over a 48-hour period. The length distribution of fibers in the film was analyzed using an automated image analysis software program. The exact kinetic constants for fiber growth can then be extracted for various solution conditions. The methods introduced here are not only applicable to P3HT fibers, but to any fiber system. By providing researchers and materials engineers with greater knowledge of the fiber growth kinetics, there will be more control of the manufacturing process of organic electronics.

Poster Presentation # 054
The Assessment of a Laccase-Single Wall Carbon Nanotube Hybrids As Cathodic Catalysts in Microbial Fuel Cells

Andrew Pan
Spyros Pavlostathis, PhD (Civil and Environmental Engineering)

Microbial fuel cells (MFC) are batteries utilizing bacterial oxidation of organic substrates in the anodic chamber to generate an electrical current. However, current generation is highly dependent on cathodic reduction of oxygen to water. Several catalysts have been utilized for this reaction, the most prominent of them being platinum. However, platinum comes with high economic and environmental costs in its usage. This study aimed to assess the efficacy of utilizing a novel enzyme-carbon nanotube system as an alternative catalyst to platinum. The enzyme of choice, laccase, was physically adsorbed into single-wall carbon nanotubes(SWNT) that was doped with 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulphonic acid). After binding, the laccase-SWNT was immobilized onto carbon felt using 1% Triton-100x as a surfactant. SWNT-bound enzyme activity was confirmed following nanotube-enzyme adsorption, and the catalytic potential was assessed with cyclic voltammetry. Current output was constantly monitored over a 48 hour time span using a potentiostat. The same tests were run with a platinum-based cathode, and results showed that the laccase-SWNT system performance was comparable to the platinum system.

Poster Presentation # 083
Development of an EPIC-μCT method for analyzing proteoglycan content in neocartilage constructs

Kaley Parchinski
Robert Guldberg, PhD (Mechanical Engineering)

Osteoarthritis (OA), characterized by debilitating joint pain, is a degenerative disease caused by the breakdown of cartilage in joints and adjacent bone. It is the most common type of arthritis, affecting 10-12% of the US adult population, and currently has no cure (Lawrence, et al.). Cartilage contains specialized molecules called proteoglycans (PGs). PGs are vital suppliers of swelling pressure that enable cartilage to withstand compressional forces applied by adjacent bones. A decrease in cartilage PG content can signal the subsequent onset of osteoarthritis. Current methods of OA therapy evaluation are destructive, however due to the degenerative nature of OA the longitudinal evaluation of therapies is crucial. EPIC- μCT (equilibrium partitioning of ionic

contrasting agent – microcomputed tomography), is a volumetric, non-destructive method that uses a contrast agent (Hexabrix 320 30%) to yield an equilibrium distribution that is inversely proportional to the density of PGs (Palmer, et al.). An EPIC-μCT method for analyzing proteoglycan content in neocartilage constructs would allow for the longitudinal evaluation of novel osteoarthritis therapies. To develop this model, neocartilage constructs were created from bovine chondrocytes and cultured to 21 days in serum-free media. PG content was then assessed at 7, 14, and 21 days using the EPIC-uCT method. Results have shown that constructs were not affected by longitudinal scanning and reached equilibration in Hexabrix after 30 minutes of incubation. A negative correlation was also found to exist between neocartilage PG content and Xray attenuation. Current research is being conducted to quantify the longitudinal degradation of PG content.

Poster Presentation # 026
Aerodynamics and Airborne Deployment of Flexible Fabrics

Sahaj Patel and Vishnu Rajendran
Narayanan Komerath, PhD (Aerospace Engineering)

This project is focused on studying, via observation and data collection, the behavior of a flexible fabric sheet attached to a rigid flying wing. By testing multiple configurations of a thin fabric sheet trailing a fixed structure in a wind tunnel, this project aims to remove inefficiencies in the flight of a fabric sheet, including excessive oscillation along the sheet that causes physical damage. Further research in this project will consider methods to deploy the fabric while in flight, using methods such as unrolling the sheet from an internal compartment in the airfoil mid-flight or unfolding a frame containing the sheet. The initial wind tunnel experiment involved an individual cambered wing with a span of seven feet with a piece of one mil thick Mylar attached to the leading edge of the wing. The first test used a piece of Mylar with a span of twenty-eight inches and a chord length of twelve inches. The second test used the same span but also had a chord length of twenty-eight inches. Both tests were run with an airflow velocity of twenty miles per hour. As the chord increased, the sheet demonstrated extreme span-wide oscillations, similar to flag flapping instability, which eventually ripped portions of the sheet. Current work is seeking to keep the sheet under tension to minimize these oscillations and achieve laminar airflow above and below the sheet. The findings of this project will mainly apply to the flight of banners or flexible structures behind airplanes.

Poster Presentation # 084
Low Temperature Scalable Hydrogen Production from Natural Gas Feedstock Using CHAMP-SORB Approach

Yuzhe Peng
Andrei Fedorov, PhD (Mechanical Engineering)

Hydrogen production from natural gas feedstock via the steam-methane reforming (SMR) process is a mature industrial technology; yet miniaturizing this process for distributed production has proven problematic. Reaction temperatures exceeding 900°C are traditionally employed in large-scale SMR reactors to overcome the thermodynamic limitations, while distributed smaller-scale hydrogen generation requires operating temperature below 500°C to reduce material cost and preheating energy requirements. Furthermore, conventional SMR systems utilizing sequential unit operation approach produce a large footprint as well as reduced performance with decreasing size due to the impact of system losses and cost of balance-of-plant components. Additionally, industrial SMR processes frequently operate at H2O to CH4 ratios approaching 6:1 (far exceeding the stoichiometric ratio of 2:1) to enhance CH4 conversion and to minimize catalyst coking at the cost of excess energy expense and reduced volumetric H2 yield density. This project is focused on the experimental validation of the CHAMP-SORB concept. It is advancement of the CO2/H2 Active Membrane Piston (CHAMP) variable volume, batch-membrane reactor concept to overcome the SMR process scale-down limitation. A combined reaction-separation approach, it not only utilizes the removal of H2 and CO2 from the reactor in situ to shift equilibrium toward greater fuel conversion and H2 yield at much lower temperature, but also incorporates sorbent regeneration steps in the CHAMP operating cycle, thereby preventing eventual saturation of the sorbent after repeated cyclic operation. The residence time and thermodynamic state in the CHAMP reactor are actively controlled to achieve enhanced rate and completion of reaction and separation.

Poster Presentation # 085
Measuring and Modeling the Local Mechanobiology of Regenerating Bone

Kishan Pithadia
Robert Guldberg, PhD (Mechanical Engineering)

Large bone defects with insufficient vascularization require clinical intervention for healing. These critically-sized injuries are caused by trauma, tumor removal, or congenital deformities. Bone is a dynamic "mechanostat" that develops and remodels its structure according to mechanical demands. While it is documented that controlled loading can enhance regeneration and vascular maturation of large bone defects, excessive load transfer can actually prevent healing, and the optimal amount of loading is poorly understood. To further understanding of the precise mechanisms of such healing, a computational method was developed to correlate local bone regeneration over time with mechanical measures estimated by finite element models. Computerized tomography scans acquired at different time points throughout healing are first registered using three implanted fiducial markers for a rough registration, followed by a simplex minimization method to precisely overlay the two scans, enabling quantification of local bone growth over time within the defect. Local stress and strain values are then measured using

finite element models. Computationally, bone volume scans and finite element models are divided into specified sub-volumes to account for voxel-level image registration errors, allowing for an efficient means to measure correlations at a regional level. This method of finding correlations between finite element models and tissue compositional changes allows for characterization of the adaptation of regenerating bone to mechanical loads in a parametric fashion.

Poster Presentation # 064
The Effects of Polycrystalline Silicon Photovoltaic Cells On Unmanned Aerial Vehicle Performance

Ponthus Pyronneau
Hamid Garmestani, PhD (Materials Science and Engineering)

The objective of this study was to investigate the differences in performance between monocrystalline silicon and monocrystalline silicon photovoltaic cells in addition to the effects on the performance of solar powered unmanned aerial vehicles. This was accomplished by casting both monocrystalline and polycrystalline silicon solar cells optimized for the specific test drone of the study and then observing the differences in electrical and mechanical performance. Performance parameters that were examined in depth included endurance, range, power to weight ratio, lift to weight ratio as well as power differences between both types of photovoltaic cells. In addition, examination of how much absorption of solar radiation occurred within the actual cells, and observation of any other optical phenomenon were performed. The cells were further characterized by examining the correlation between the solar cell microstructure and observed performance. The results of this study will potentially benefit the fields of materials science, aerospace, and electrical engineering by confirming that a cheaper means of fabricating solar cells will yield relatively higher performance data.

Oral Presentation
Synthesis of stretchable conductive material by silver nanowire

Long Qian
C.P. Wong, PhD (Materials Science and Engineering)

In recent years, the stretchable conductive materials have gained extensive interest of researchers. In comparison with the normal rigid conductors, stretchable conductive materials have high conductivity and large strain endurance. One of the most commonly used method to produce stretchable conductive materials is by filling carbon nanotubes(CNT) into the polymers. However, it is very hard to obtain uniform dispersion of CNT in the polymer matrix. The nonuniform dispersion may results in an extremely low conductivity. Our research introduces a new method of producing stretchable conductive materials by using silver nanowire instead of CNT and polyurethane as polymer. Silver nanoparticles have much higher conductivity so the resulting composite is expected to have a higher conductivity than that of the conventional CNT method.

Poster Presentation # 086
Hydrodynamic

David Raji
Mostafa Ghiaasiaan, PhD (Mechanical Engineering)

Projects undertaken revolved primarily around the experimentation and analysis of various models of heat exchangers. The heat exchanger models used all involved a helically coiled tube inside of a cylinder. Varying flow rates for both the fuel and coolant as well as different model designs served as the variables of change in experimentation. The projects have involved different fluids and different phases of flow, including ongoing work on two-phase flow experiments using liquid nitrogen (utilized primarily as a proxy for liquid natural gas). We are currently in the beginning stages of looking into developing correlations between aforementioned variables such as the flow rate and the pressure drop across the helical coil for the fuel fluid.

Poster Presentation # 037
Quantification of Microvessel Fragments from Primary Isolation using 3-D Confocal Microscopy

Matthew Rather
Nick Willett, PhD (Biomedical Engineering)

Skeletal development and fracture repair includes the coordination of multiple events such as migration, differentiation, and activation of multiple cell types and tissues. The development of a microvasculature and microcirculation is critical for the homeostasis and regeneration of living bone, without which, the tissue would simply degenerate and die. Seeding constructs with micro-scale blood vessel fragments have shown success in promoting the formation of an interconnected vascular network that can integrate with host vasculature when implanted. This project seeks to characterize the distribution of various cell types within the stromal vascular fraction (SVF), to understand their relative importance in the revascularization process in vitro, and to assess their structural fates within the vascular networks they form. A series of flow cytometry, enrichment-depletion studies, immunohistochemistry staining and confocal microscopy will be done to identify relevant cell subpopulations in the SVF, determine the relative importance of each cell type in neovascularization, and correlate cell types observed in the SVF to their structural roles, respectively. With confocal analysis through Amira and ImageJ, vessels placed within each seeding construct were quantified by volume contraints, anthropometry, and vessel density. After implementation of these seeding

constructs in vivo, quantification of bone regeneration will be compared back to these constraints to draw further conclusions about the effects of vessel growth and bone regeneration within a defect.

Poster Presentation # 047
Throughput optimization of a behavior-based screening platform of C. elegans

Alicia Robang
Hang Lu, PhD (Chemical and Biomolecular Engineering)

The nematode Caenorhabditis elegans (C. elegans) is often used as a model organism to gain fundamental knowledge of biology throughout the animal kingdom and to model human diseases. Although C. elegans is a relatively simple organism, approximately 55% of its genome has functional counterparts in humans. In addition, they can be cultured inexpensively, and are easy to observe and manipulate genetically due to their transparent bodies. Traditional screening methods involves using a pipette to manually add the stimulus on a moving worm, resulting in a time-consuming and labor intensive process. Recently, a variety of microfluidic platforms have been manufactured to simplify the imaging and increase the throughput of screens. We have developed a platform where each worm is isolated in a nanoliter-sized droplet to assess the behavior of C. elegans in response to a stimulus. Through on-chip valves and chambers, encapsulated worms are transported to different areas on the device by changing the direction of flow streams. Currently, our platform is able to encapsulate, stimulate and observe 30-second long behavior in worms at a rate of 40 worms per hour. The focus of my work is to find and test methods to triple this number by simultaneously encapsulating worms and observing behavior, redesigning the microfluidic device and improving the system's worm supply. Such methods to increase the throughput would produce a more robust platform to be widely used for behavioral and genetic studies.

Poster Presentation # 059
Cell Phone Adoption v. Residential Electricity Systems in Developing Countries

Suraj Sehgal
Valerie Thomas, PhD (Industrial and Systems Engineering)

This project is examining and comparing the rise of cell phone adoption and residential electricity systems in developing countries, specifically Rwanda, Uganda, and Kenya. First, it establishes overall trends of increasing electrification rates and cell phone subscriptions over the past decade. Second, it highlights the discrepancy between current high cell phone ownership versus lower national electrification rates among countries in Sub-Saharan Africa. Third, it presents cost comparisons of cell phone ownership versus solar home systems, comparing the costs of various financing options. Finally, it studies the various factors that have caused the adoption of cell phones and residential solar systems to differ in these specific countries, looking into what may lead to the future success and growth of solar home systems.

Poster Presentation # 087
Weightlifting by the Elephant Trunk

David Shumate
David Hu, PhD (Mechanical Engineering)

The purpose of this research is to analyze the bio-mechanical mechanism of the elephant trunk. The elephant's trunk, or proboscis, is utilized in breathing, smelling, touching, grasping, and communication. The bio-mechanical mechanism of the elephant trunk makes it an adaptable, effective tool in a variety of tasks. There is a lack of research on the detailed mechanism of the elephant trunk, which this research aims to address. The mechanism of the elephant trunk will be studied using a smith weight machine attached to a reward system, which the elephant will manipulate under close observation. Input variables include the load mass, the load height, the horizontal distance, the shape of the load, and the direction of force. Data will be captured using a displacement sensor and high speed cameras. The data will be processed into position, velocity, and acceleration graphs. The close study of the elephant's interactions with the smith machine will yield insight into the bio-mechanics of its trunk. The anticipated outcomes of this research are the identification of different bio-mechanical strategies associated with different tasks. The findings may be translated to the field of soft robotics.

Poster Presentation # 048
Gas Separations with Zeolitic Imadazolate Framework Mixed Matrix Membranes

Nathan Sidhu
Ryan Lively, PhD (Chemical and Biomolecular Engineering)

Mixed matrix membranes (MMMs) are an alternative and superior separation technology that takes advantage of the attractive separation characteristics of a discrete phase and the excellent processability of a continuous phase, such as a polymer matrix. Zeolitic imidazolate frameworks (ZIFs) are a subclass of metal organic frameworks that offer superb thermo-chemical stability, as well as favorable adsorption and diffusion properties, and have shown potential to be the discrete filler in MMMs. In this work, this subclass of micro-porous materials were incorporated in MMMs and studied to determine their permeability and selectivity through isochoric permeation and pressure decay systems. We believe the interaction between the ZIF crystal fillers and the polymer matrix plays a major role in the separation performance of as-made MMMs. A series of ZIFs

(ZIF-7, 8, and 11) with relatively different crystal framework flexibility were incorporated into a commercially available Matrimid® polymer matrix, to allow for systemic examination of the interplay between the polymer and the crystals and any subsequent performance changes. Permeability and solubility of CO2, N2, and CH4 were measured using permeation and pressure decay systems to determine the performance of the polymer matrix. These experiments revealed that the addition of the ZIF crystals increased the permeability of the polymer, which indicates an enhancement of the as-made membrane productivity. Furthermore, each ZIF crystal uniquely impacted the membrane separation performance.

Poster Presentation # 088
Carbon Fiber SMC

Arjun Singh
Kyriaki Kalaitzidou, PhD (Mechanical Engineering)

As the aviation, automotive and marine industries continue to grow, companies are looking into new ways of reducing the weight of product components while also aiming to increase the material strength. The goal of this project is to utilize expired/ out-of-freezer pre-preg carbon fiber from the aerospace industry in the Sheet Molding Compound (SMC) process and produce composites that provide equivalent or better properties than the materials being currently used in the industry. In this research, SMC plates are made on the SMC production line using unidirectional carbon fiber tape. The tape is cut into 1-2" using the SMC cutting blade and is sandwiched between 2 separate carrier films, producing a SMC sheet which is rolled on to a roller for further use. The produced sheets are then cured into plates using a hot press. After curing, test samples for the impact and flexural tests are cut from the plate using the waterjet and are tested.

Poster Presentation # 038
A Study of Chondrogenesis in Bioreactor Culture

Madeline Smerchansky
Krishnendu Roy, PhD (Biomedical Engineering)

The mechanical properties of scaffolds used to encapsulate stem cells are widely known to help direct the differentiation of those stem cells down different lineages. When studying chondrogenesis, the ability of the scaffold to withstand force is important as joints are expected to bear loads after implantation. The goal of the project is to study how differing perfusion and compression conditions influence mesenchymal stem cell (MSC) chondrogenesis. We hypothesize that sinusoidal dynamic compressive stimuli along with perfusion bioreactor culture of hydrogel-MSC constructs further enhance zonal cartilage differentiation. Using the C9-x CartiGen perfusion bioreactor, cyclic compression from -0.5 N to 0.5 N with 10% strain was applied to the hydrogel constructs at a frequency of 1 Hz and sinusoidal loading for 4 hours/day with a perfusion rate of 0.5mL/min. These constructs were loaded with MSCs and cultured statically and without perfusion for one week prior to loading into the bioreactor. After week 1 the constructs were subjected to a sinusoidal compressive force for two weeks. At week 3, they were removed from the bioreactor and data were collected on collagen I, II and X gene expression. The preliminary collagen data collected from three different scaffolds suggests that chondrogenic response to dynamic compression depends on scaffold condition. Perfusion bioreactor culture coupled with sinusoidal dynamic loading provides a more accurate model of the articular cartilage environment when compared to static culture due to loading at joints. The investigation of alternate bioreactor culture conditions will provide valuable insight into the optimum conditions for differentiation.

Poster Presentation # 039
Meta-Analysis of Biomarker Presence in Preclinical TBI Case Studies

Connor Sofia
Michelle LaPlaca, PhD (Biomedical Engineering)

This study examines the relationship between protein biomarkers in cerebrospinal fluid before and after traumatic brain injury (TBI) in rodents in order to determine which biomarker, if any, holds a higher significance in determining TBI as a diagnostic tool. By examining several hundred papers to determine an overall power value for each biomarker, this study hopes to identify in a more holistic manner a suitable diagnostic biomarker.

Oral Presentation
Matter Transport by Elephant Trunks

Dhanusha Subramani
David Hu, PhD (Mechanical Engineering)

Most mammal arms (or arm-like appendages) with rigid skeletons can rely on a small quantity of muscles and skeletal joints to reduce degrees of freedom that need to be controlled. However, the elephant trunk - rather than its legs - is elongated and specialized to become the elephant's most important and versatile appendage, especially in sweeping, scooping, and grabbing food. An elephant trunk is boneless and therefore, contains no skeletal joints that can aid in precision control; the trunk is simply made of muscular tissue. However, elephants are still able to pick up the smallest of foods such as a grain of rice with the same precision and delicacy as a large log. In our study, we show that when the African elephant uses its boneless trunk to grab granules and cubes, it employs a vertebrate-like strategy that mammals with rigid skeletons employ. The downward "pushing" force increases when grabbing smaller particles in order to get a more precise hold of the granular material. The elephant is able to control the amount of contact force exerted

by changing the joint position as the food size differs, so the vertical section of the trunk elongates when it grabs the food. This indicates that an articulated or segmented-like limb may allow the elephant to make up for the lack of bones by using its muscles to achieve optimal and precise success in grasping objects. The findings of our work will be used to inspire ways to control soft robotic actuators.

Oral Presentation
Excitatory-inhibitory dynamics during transient deep brain stimulation of the subcallosal cingulate

Liangyu Tao
Robert Butera, PhD (Biomedical Engineering)

Deep brain stimulation (DBS) is a promising investigational treatment for patients with treatment resistant depression (TRD). However, the mechanism by which stimulation modulates network level pathological activities in white matter pathways involved in DBS have not been clearly established. Local field potential recordings of the SCC in TRD patients implanted with DBS have shown the emergence of chirps, a rapid change in frequency over time, following specific stimulation conditions. These chirps are reproducible responses in the SCC that may uncover neural circuit interactions impacted by DBS, and be used as a metric to assess stimulation. Understanding why and how stimulation causes this electrophysiological behavior in the SCC network is an important step in increasing the efficiency and success rate of treatment for patients with TRD. Here we analyze a simulated neuron population of mutually connecting subpopulations of excitatory-inhibitory neurons in response to DBS stimulation. We propose mechanisms on how two neuron populations that are connected via excitatory subpopulations can generate chirps based on excitatory-inhibitory balance and the connectivity between them. Finally, we propose a network, informed by the patient data, of connecting neuron populations, each composed of connecting subpopulations of excitatory-inhibitory neurons, to study the network level impact of stimulation on the activity of the SCC. Our network model showed the emergence of chirps by decreasing the connectivity between regions of the brain. These results suggest that DBS in the SCC modulates white matter communication within the SCC network and requires measurements of downstream regions to fully understand the network.

Poster Presentation # 065
Surface Bioengineering on a Triboelectric Nanogenerator (TENG) Device

Linda Tian
Zhong Lin Wang, PhD (Materials Science and Engineering)

The purpose of this study is to create a biocompatible, antibacterial, wearable, self-powering triboelectric nanogenerator (TENG) device. As one of the most promising new forefronts in biomedical engineering, creating self-powered biomedical devices that are both biocompatible and antimicrobial is of extreme significance due to their broad range of applications in both clinical and healthcare-industry settings. Using alginate, a biocompatible polysaccharide derived from brown seaweed (Phaeophyceae), and silver nanoparticles, which have antibacterial properties, we create a self-powering triboelectric nanogenerator (TENG) that is both biocompatible and antimicrobial. An antimicrobial, biocompatible, wearable TENG device also allows for prolonged wear of the device without fear of developing a dermal infection or skin irritation. We create biopolymer films of varying thicknesses, from different concentrations of silver nanoparticles, alginic acid, water, and glycerol for the fabrication of the triboelectrification layer of the TENG. In order to characterize the performance of the TENG device, we use a linear motor to control the separation distance between nodes of the TENG. The linear motor ensures that the distance between the two TENG nodes is held constant throughout the experimental trial. We then take measurements of voltage and current for each of the biopolymer films. This antimicrobial TENG project is practical, important, and urgently needed. Findings from this work are also applicable to creating coatings for implantable medical devices.

Poster Presentation # 049
Investigating Doped Mesoporous ZSM-5 Catalyst for Cascade Catalysis

David Umo
Ryan Lively, PhD (Chemical and Biomolecular Engineering)

The petrochemical industry faces two prevalent challenges that it seeks to address. The first of which is minimizing the emission of CO2 and other greenhouse gases into the atmosphere in order to reduce the effects of global warming. While also addressing the second challenge of finding energetically efficient and cost-effective ways to produce lighter, more valuable hydrocarbons. As a result, it comes as no surprise that zeolites are used largely in the petrochemical industry because they function both as adsorbents and catalysts in carbon-carbon bond breaking reactions. This summer, I worked with a specific type of zeolite known as ZSM-5. ZSM-5 is a microporous zeolite with pore diameters less than two nanometers. The pore sizes of the ZSM-5 catalysts I synthesized this summer ranged from 0.5 to 0.6 nanometers. The crystal structure of the ZSM-5 catalysts was also analyzed by x-ray diffraction, and the result from the analysis matched that of a typical ZSM-5. In this project it is also important to note that the silica to heteroatom mole ratio was kept fixed at 250 to 1. Consequently, the acidity of the ZSM-5 catalysts was varied by varying the heteroatoms: Tin, Aluminum and Boron.

Poster Presentation # 040
Abdominal Aorta Displacement and Strain Analysis Using Spiral Cine DENSE MRI

Melissa Valdman
John Oshinski, PhD (Biomedical Engineering)

The risk of aortic aneurysm rupture is presently predicted based on the aneurysm's diameter. Surgical intervention is recommended if the diameter of an abdominal aortic aneurysm is greater than 5.5 cm. But while this is an adequate predictor of aneurysm rupture, there are still many aneurysms that rupture with smaller diameters and aneurysms that can grow to larger diameters with no indication rupture. Understanding the mechanics of the aorta can help diagnose and predict the path of cardiovascular pathologies as well as help understand the biological components that may be responsible for these properties. Volunteers with healthy aortas were scanned by cine DENSE MRI to identify the displacement and strain of the abdominal aortic wall and see how these measurements differ based on the circumferential position. The images are analyzed using MATLAB code which requires some manual steps. Because the aortic wall is so small, and the MRI images do not have the highest resolution, there is a lot of room for human error. Although nothing can be done about the MRI resolution, there are a few techniques incorporated into the code to increase the accuracy of the data. The goal is to decrease the number of manual steps in the analysis by automating those steps in the code. The healthy patient's DENSE MRI scans will them be analyzed using the new MATLAB code, providing more accurate displacement and strain results.

Poster Presentation # 041
Exosome-mediated Differentiation of Adipose-derived Mesenchymal Stem Cells to Trabecular Meshwork Cells

Richard Vannatta
Ross Ethier, PhD (Biomedical Engineering)

Glaucoma is the second leading cause of blindness and affects over 70 million people worldwide. Intraocular pressure (IOP), a well-established risk factor for glaucoma, is primarily regulated by aqueous humor outflow through drainage tissues, specifically the trabecular meshwork (TM). In primary open angle glaucoma, TM cellularity is significantly decreased in comparison to age-matched healthy eyes, presumably limiting the TM's ability to regulate IOP. It is hypothesized that regenerating TM cellularity in a glaucomatous eye would lead to proper IOP and aqueous outflow regulation, preventing further vision loss associated with glaucoma. Towards this, we are investigating the use of stem cells to restore TM cellularity and function. Recently, we used co-culture techniques to differentiate adipose-derived stem cells (ASC) into TM cells; however, the results were inconsistent. A more effective and consistent method of differentiation is thus required. To improve differentiation, TM cell-derived exosomes, secreted extracellular vesicles, are being investigated to determine their role in ASC differentiation. This project will investigate the application of paracrine signaling and exosome secretome of TM cells as a mechanism to efficiently differentiate ASC to TM cells, expanding knowledge about paracrine signaling, the TM, and glaucoma treatment options.

Oral Presentation
Circulation Control Study for High-Lift/Low-Drag Aircraft Properties

Nikhil Venkatesh
Lakshmi Sankar, PhD (Aerospace Engineering)

Today, modern commercial aviation is a dynamic sector which poses great challenges for engineers. With more and more consumers using air transport, aircraft manufacturers and airlines face additional challenges to meet environmental regulations and aircraft operation restrictions. Noise pollution from aircraft due to the vortex shedding effect is a great source of concern for airport authorities. A research study (Englar et al, 2005) elucidate that compared to conventional high-lift systems, circulation control wings (CCW) achieve comparable high-lift coefficients during take-off and landing regimes whilst having minimum drag. Study of effects of 2-D steady and pulsed jets have revealed that vortex sheets at trailing edges which are principal sources of noise can be eliminated. CCW are also advantageous as they have little or no moving parts and allow aircraft to operate at high angle of attack and with the cushion of low stall speed during takeoff and landing scenarios. The aircraft sector is looking towards innovative engineering especially in the field of experimental aerodynamics to cope with environmental regulations, improving efficiency yet still bettering performance and passenger comfort. Works Cited: Englar, Robert J., Smith, Marilyn J., Kelley, Sean M. and Rover, Richard C. III., "Development of Circulation Control Technology for Application to Advanced subsonic Transport Aircraft", AIAA Paper 93-0644, presented at AIAA Aerospace Sciences Meeting, January, 1993.

Poster Presentation # 050
Synthesis of self-assembled protein-inorganic supraparticles and immobilization of RgpA for Tumor Necrosis Factor-a degradation

Melanee Wang
Julie Champion, PhD (Chemical and Biomolecular Engineering)

An immobilized enzyme is an enzyme bound to an insoluble material which can improve stability and reactivity in a heterogeneous support rather than a homogeneous solution, which is useful for therapeutic applications. Porous, spherical supraparticles are formed from protein-inorganic flower-shaped nanoparticle subunits and are a suitable material for enzyme immobilization. These calcium phosphate nanoparticle subunits self-assemble when rotated in a small glass vial and

are synthesized by calcium chloride and phosphate-buffered saline in the presence of a tri-block co-polypeptide ZR-C10-ZR. This protein contains an artificial random coil block (C10). The combination of this block with a ZR leucine zipper domain produces affinity binding sites for its dimerization partner ZE, which are utilized for enzyme immobilization. The particles were synthesized in many different ways, including varied mixture volume, rotational speed, and calcium concentration. Particles were imaged using bright field microscopy and confocal laser scanning microscopy. Image analysis methods, such as the Sobel method and Canny method, were used to compare size of particles, number per volume, and other particle characteristics. Supraparticles were demonstrated to bind both GFP-ZE and mCherry-ZE and the specific loading capacity was determined using isothermal titration calorimetry. The supraparticles were then used to immobilize RgpA-ZE, a protease which targets the pro-inflammatory cytokine TNF- alpha. The activity of supraparticles loaded with RgpA-ZE was compared to the soluble RgpA.

Poster Presentation # 089
Modeling Optical Properties for Exposure Controlled Projection Lithography (ECPL)

Jenny Wang
Amit Jariwala, PhD (Mechanical Engineering)

Exposure controlled projection lithography (ECPL) is an additive manufacturing process in which liquid photopolymer resins are cross-linked and solidified with UV light patterned by a dynamic mask. This procedure has promising applications in the fabrication of micro-optic lenses. COMSOL software package was used to theoretically model and simulate the progression of curing. The model characterizes the exposure of UV light to the resin chamber, as well as the chemical reactions that produce the solid polymers. A process-planning method has been developed to actualize the fabrication process using the simulations. Additionally, a real-time in-situ measurement method, the interferometric curing monitoring (ICM) system, has been implemented to monitor the ECPL fabrication. The ICM system uses the principles of interference optics to measure small changes in the refractive index of the curing sample. A correlation has been observed between the ICM signals and the height of the cured sample. However, there has been no work conducted to investigate how the curing process affects the interferometric signals. Developing an understanding of the connection between the progression of polymerization and the observed ICM signals will help establish a more accurate model to estimate the cured part dimensions during the polymerization process. The model could then be used to devise a feedback-controlled system to fabricate more precise and accurate parts using ECPL. This work aims to develop a theoretical basis for the relationship between the ICM signals and the measured cured height.

Poster Presentation # 042
The Use of G-quadruplexes to Improve Cellular Internalization of 16-Helix Bundle DNA Nanostructures

Kristin Weiss
Yonggang Ke, PhD (Biomedical Engineering)

In recent years, a variety of nanoparticles have been used for therapeutic delivery. Several recent studies have focused on self-assembled DNA nanostructures with monodisperse size, shape, and surface chemistry. The purpose of this project is to study the effect of coating 16-Helix Bundle (16 HB) DNA nanostructures with G-quadruplexes in order to increase cellular internalization. Previous research has shown that cells uptake DNA with a large concentration of guanine at a higher rate than concentrations of any of the other nucleotides. Additional research has been shown that the use G-quarduplex, which are nucleic acid strands with large concentrations of guanine that form tertiary structures in the presence of potassium, coated on the outside of gold nanoparticles increase cellular internalization as opposed to non-coated nanoparticles. The goal of this project is to use this knowledge of G-quadruplexes and their cellular internalization properties to increase the cellular internalization of the 16-HB DNA nanostructures.

Poster Presentation # 051
Understanding intramolecular catalytic cooperativity in enzyme-inspired silica-supported organocatalysts for C-C bond forming re

Jingwei Xie
Christopher Jones, PhD (Chemical and Biomolecular Engineering)

Carbon-carbon coupling reactions are essential steps in pharmaceutical synthesis as well as certain transformations of biomass toward chemicals and fuels. Inspired by enzymatic catalysis, heterogeneous organocatalysts can utilize multiple functionalities, such as acids and bases, to achieve precise catalytic function including highly controlled selectivity. Mesoporous silica provides a weakly acidic solid phase with high surface area to allow for good dispersion of catalytic functional groups. Grafted on the silica surface, basic secondary amines with alcohol groups connected with different alkyl linker lengths (ethyl to pentyl) can cooperatively catalyze aldol condensation intramolecularly or with the assistance of the acidic surface. This project studies how the linker length between the basic and acidic functional groups affects the intramolecular cooperativity relative to the well-studied amine-silanol acid-base catalytic mechanism. In addition to the two-step functionalization method used to functionalize the silica supports, a capping agent was used on a portion of the materials to remove the silanol groups in order to demonstrate the activity of exclusively intramolecular catalytic function. Nitrogen physisorption, infrared spectroscopy, thermogravimetric analysis and elemental analysis were

performed to characterize the functionalities. Batch liquid-phase kinetics studies utilizing these catalysts in acid-base catalyzed aldol condensation reaction of 4-nitrobenzaldehyde and acetone were performed to determine relative activities and site-specific rates of catalysts with various linker lengths. Experimental data have shown that longer linker length between the amine and alcohol moieties on the catalytic amines improves conversion and confirms the presence of intramolecular activity.

Poster Presentation # 090
Blood-Brain Barrier on a Chip

Jiwon Yom
YongTae Kim, PhD (Mechanical Engineering)

A blood-brain barrier (BBB) is a biochemical, physical barrier found in the brain vasculature that only allows selective transport of molecules in order to protect the brain from potential damages. Due to its complex structure of cellular arrangement, there is a lack of a physiologically relevant BBB model that could be used to test the efficacy of drugs that treat brain cancers, such as glioblastoma multiforme. Therefore, this study aims to introduce an in vitro BBB model on a microfluidic platform that captures the dynamic nature of BBB which leads to changes in permeability of the BBB. The proposed BBB model, or BBB on a chip, incorporates human primary cells that comprise the human BBB, including human brain microvascular endothelial cells (HBMECs), human brain vascular pericytes (HBVPs), and normal human astrocytes (NHAs). To validate the proposed BBB model, this study tests for permeability of different combinations of the primary brain cells (HBMEC monoculture, HBMEC+HBVP co-culture, HBMEC+HBVP+NHA tri-culture) to observe the effect of cellular composition on permeability.

Poster Presentation # 055
The Effects of Freezing and Thawing on the Rock Strength of Limestone

Nick Young
Haiying Huang, PhD (Civil and Environmental Engineering)

There is a freezer warehousing complex completely underground in the shell of a quarry. Inside the complex, there are a series of freezer rooms that have exposed limestone, directly subjected to the conditions within. The facility does not know the impact of low temperatures on the characteristics of their surrounding structure. The objective of this research is to provide a basic analysis of the limestone's rock strength due to different durations and cycles of freezing and thawing through uni-axial compression testing as well as Brazilian tensile strength testing. The results of this analysis will be used to judge the need for further, more comprehensive testing and modeling of the site to holistically understand any possible risks.

Poster Presentation # 091
Particle Filtration Inspired by Flower's Stigma

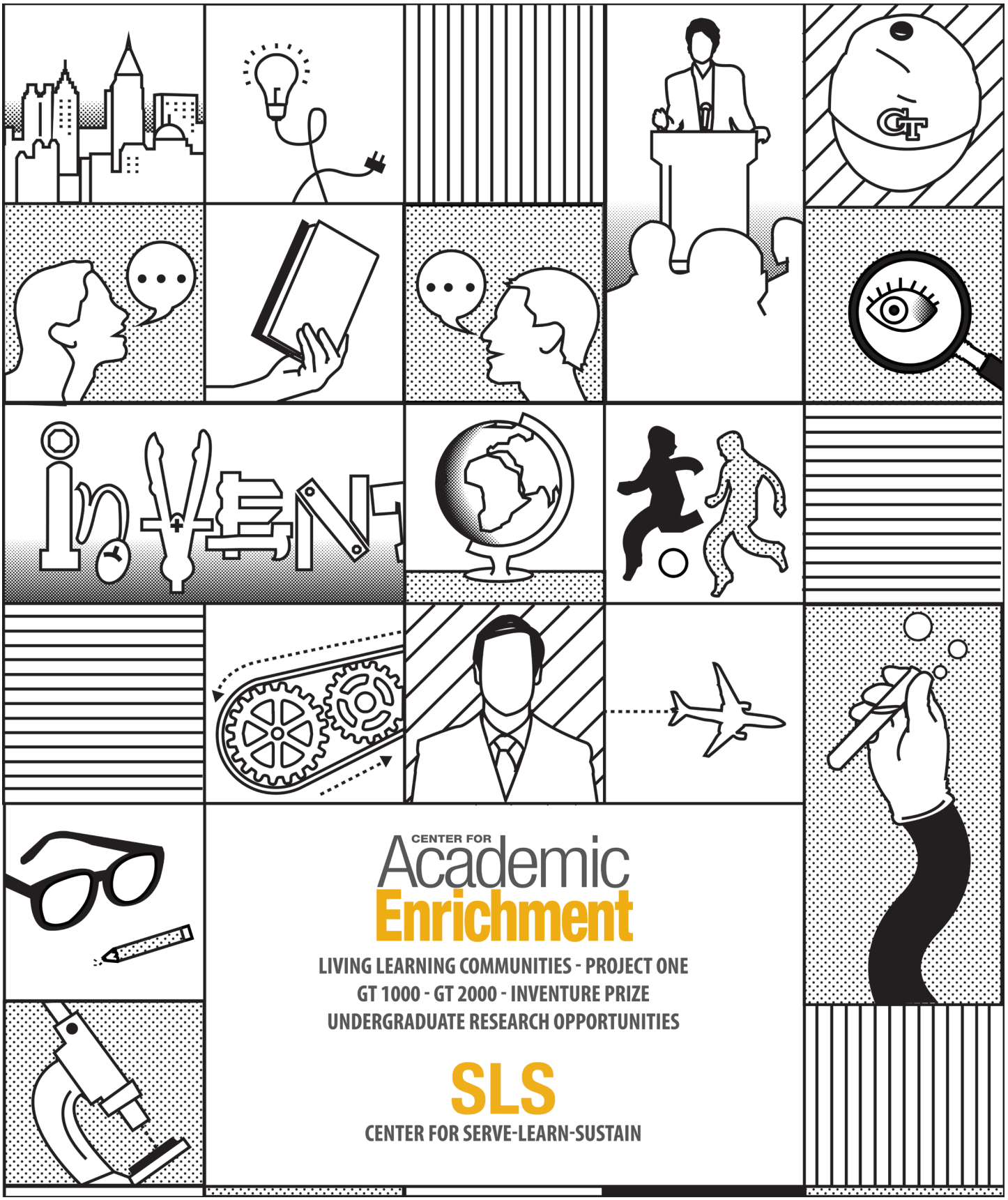
Yi Zhou
David Hu, PhD (Mechanical Engineering)

Every spring, the pollination season, pollen has brought huge inconvenience to our life in Atlanta. On March 29th, the pollen count reaches 4,107 pollen per cubic meter of air, which is the highest of this year; and the all-time highest record in Atlanta is 9,369 pollen per cubic meter of air, occurred on March 20th, 2012. Although the pollen may be health-threatening to human beings, it is the key element in a plant's reproduction. To receive the pollen, some plants take advantage of insects' interaction with flowers, while others utilize media such as wind. Therefore, plants' pollen capture structures highly effect success of pollination. The goal of this research project is to implement fluid dynamics techniques, inspired by plants' pollination-related structure and material characteristic, to create a filter which optimizes the efficiency of collecting pollen particles in the air. I am focusing on the interaction between wet stigma and dry pollen. The stigma is wet due to the coating of stigmatic fluid which adheres pollens to the stigma and is most composed of oil, sugar and amino acid [4]. Figure 2 displays a typical stigma with pollen it collects. Inspired by the stigmatic fluid, I hypothesize that beside the angle of stigma against wind, the coating fluid of certain viscosity increases the pollen collection efficiency of the stigma.

Poster Presentation # 052
Optimization of Silylation Reaction on Cellulose Nanocrystals for Improved Particle Hydrophobicity

Han Zong and Shraeyas Margan
Elsa Reichmanis, PhD (Chemical and Biomolecular Engineering)

Cellulose nanocrystals (CNCs) are rod-like renewable nanoparticles made from the acid hydrolysis of plant fibers. These high-aspect-ratio particles have an abundance of hydroxyl groups on their surface, which allows them to be functionalized by a variety of chemistries. The goal of this research is to study the silylation of CNCs and optimize the reaction conditions to achieve the desired particle hydrophobicity for our application: organic electronics. Thermogravimetric analysis (TGA) and Fourier Transform Infrared Spectroscopy (FTIR) will be used to monitor the presence of new surface groups and the extent of reaction (i.e. grafting density). Once this reaction has been understood and optimized, the newly hydrophobic particles will be dispersed in organic solvents and mixed with semiconducting polymers for use in organic field-effect transistors.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Poster Presentation # 092
Comparing miRNA expression in prostate and ovarian cancer

Amber Akbar
John McDonald, PhD (Biological Sciences)

MicroRNAs such as miR-429 have been shown to induce mesenchymal-to-epithelial transition (MET) in metastatic ovarian cancer cell lines. The project will explore the expression of different microRNAs in prostate and cancer cell lines and evaluate their ability to induce MET. Different miRNAs will be tested in mesenchymal-like cancer cell lines, PC3 and HEY, for prostate and ovarian cancers. After evaluating the ability of the different miRNAs to induce MET, gene expression data will be analyzed to isolate genes of interest that are knocked down by a specific miRNA in both cancer cell lines, which would help move the field closer to understanding which miRNAs can broadly be applied to treat different cancers. After identifying these genes, recapitulation with siRNA would be done to affirm that the miRNA actually knocks down the gene of interest.

Poster Presentation # 093
Evolution of Cross-Feeding in a Simple Bacterial Community:

Ashley Alexander
Frank Rosenzweig, PhD (Biological Sciences)

Under favorable conditions a microbial population founded by a single clone can rapidly increase in size and in genetic diversity. Understanding the mechanisms by which clonal diversity is produced and maintained will improve our understanding of how clones evolve, communicate, and coexist in cancer and infectious disease, as well as how simple microbial communities evolve in extreme environments here on earth and possibly elsewhere in the solar system. We seek to further investigate the nature of how a stable cross-feeding community of E. coli clones arose from a single common ancestor. The experiments in which this result were observed were founded by ancestors that differ from typical "wild type" E. coli. We now know that they carried mutations that result in high-affinity but inefficient glucose metabolism when glucose is limiting. We hypothesize that such mutations predispose certain genotypes to evolve into stable cross-feeding communities. We have also generated theory showing how subtle differences in availability of limiting resource favor or disfavor evolution of cross-feeding. We will test this hypothesis and these theoretical predictions by genetically manipulating wild type E coli strain K12 and evolving it at different resource levels. The results of this project will reveal which genetic and ecological conditions predispose certain bacterial genotypes to evolve stable communities rather than a single evolved clone. Through her work on this project Petit Scholar, Ashley Alexander, will hone skills in site-directed mutagenesis, metabolic analyses, and experimental evolution.

Oral Presentation
Unraveling the Rat's Nest: Techniques for Analyzing Large Networks from Raw Data

Brighton Ancelin
Joshua Weitz, PhD (Biological Sciences)

While conducting research in the Weitz Group, I've learned a good deal about network science, data acquisition, and the importance of being able to comprehend and use real world network data for simulation purposes. Many problems in our world can be modeled fairly well under the paradigm of networks, such as how a disease might spread through a population, how to take a Google search and find the right page, how to build a computationally fast computer server, and how you might be able use your friends' friends to meet Taylor Swift. A network paradigm allows the researcher to describe situations in the simple terms of individual entities communicating with other individual entities, a model that at its core is very easy to understand. Networks can be examined in many ways, and it's through looking at them in these different ways that we as researchers can begin to make sense of large data sets and compare them in ways that just aren't possible otherwise. Many techniques have been developed for randomly generating networks with specific aspects, but there is still great value in being able to find and use real world data to develop one's networks. Simulation on real world networks can add a certain volume of validity to a researcher's findings or hypotheses that simulation on randomly generated networks just can't. Knowing how to analyze a network is one thing, but knowing how to find and properly import a real world network from raw data is another thing altogether.

Poster Presentation # 099
Chemoreception of Marine Chemical Defenses

Zinka Bartolek
Julia Kubanek, PhD (Chemistry and Biochemistry)

Many sessile and soft-bodied marine organisms use chemical defenses to protect from predation, colonization by bacteria and overgrowth by neighboring organisms. Marine sponge Erylus formosus protects from predation by concentrating aversive triterpene glycosides such as formoside in its tissue. It has been shown that live zebrafish reject foods laced with formoside and proposed that this aversive response is mediated by chemoreceptors. Recently, RAMP-like triterpene glycoside receptor (RL-TGR), a co-receptor involved in triterpene glycoside signaling has been identified in zebrafish. However,

the mechanism and scope of function of RL-TGR is not fully understood. To further our understanding of chemoreception, it is important to determine the scope of function of RL-TGR and triterpene glycoside based defenses. Triterpene glycosides formoside, thornasteroside A and nodososide were purified from sponge E. formosus and sea stars Acanthaster planci and Linckia laevigata via high performance liquid chromatography (HPLC), nuclear magnetic resonance (NMR) and mass spectrometry (MS). The response of RL-TGR to these compounds was assessed by measuring cAMP levels in human embryonic kidney (HEK293) cells transfected with mammalian expression vector containing wild-type RL-TGR. Previously, RL-TGR showed a positive response to naturally occurring concentrations of formoside, and further testing is underway to determine the response of RL-TGR to thornasteroside A and nodososide. Understanding the scope of triterpene glycoside defenses in marine environments adds to the knowledge of community organization, feeding behaviors, species distribution and ecological speciation. This study will help us understand both the chemical and behavioral ecology of marine environments.

Poster Presentation # 108
Bayeswave Analysis Study on Recovering Waveform Complexity through Reconstructions

Brian Day
Deirdre Shoemaker, PhD (Physics)

With the field of gravitational wave astronomy becoming a means to observe the universe in a new way, it is important that the data obtained from the Laser Interferometer Gravitational-wave Observatory (LIGO) detectors can be properly analyzed. Bayeswave Analysis is one tool to process the data collected from the detectors that offers analysis on a potential event that is not biased to expect a signal in the data due to it being a minimal assumption analysis and can be used to determine if the event is a signal, a glitch, or noise. Through the analysis, Bayeswave uses evidence values obtained from comparing signal, glitch, and noise models to determine what the event most likely is and produces reconstructions of both signal and glitch models which can be used to further understand the event in the data. Although Bayeswave has shown to be able to accurately reconstruct simple waveforms, its ability to accurately reconstruct waveforms from more complex system is not known. Therefore, this study is to determine if Bayeswave can accurately reconstruct known injected signals with varied initial parameter complexity. The ability for Bayeswave to reconstruct the more complex injected waveforms is gauged by analyzing the median overlap between the reconstruction and the injection as a function of signal-to-noise ratio (SNR), the strain and frequency data as functions of time, and the residual of the reconstruction waveform when it is subtracted from the injected waveform as a function of time.

Poster Presentation # 110
The effect of context on an individual's emotional responses when viewing affective animal videos

Sunya Fareed
Eric Schumacher, PhD (Psychology)

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 # 100
Development of Thiabicyclo[3.3.1]nonane-Based Polycations for Mediated Transfection

Mark Garren
M.G. Finn, PhD (Chemistry and Biochemistry)

Polycation-mediated DNA/RNA transfection is a non-immunogenic and non-pathogenic alternative to viral vectors that requires fine-tuning of material properties to maximize efficacy at minimal cytotoxicity. Previous work has shown promise in the development of polycationic materials from polymerization of 2,6-dichloro-9-thiabicyclo[3.3.1]nonane (BCN) with dipyridine analogues for siRNA transfection in GFP-HeLa cells. Synthesis of monomers with terminal alkyne groups by reductive amination has led to the ability to modify polymers via copper-catalyzed-azide-alkyne cycloaddition (CuAAC) with a variety of functional groups to test for biocompatibility. By developing an activity series based on the hydrophilicity/hydrophobicity of the functional groups, we are able to acquire a better understanding of structure-activity relationships in order to optimize transfection efficacy.. Based off of previous synthetic work, we tested a series of polymers on GFP-HeLa (for GFP knockout), HeLa, Chinese Hamster Ovarian (CHO) and Human Embryonic

Kidney (HEK) cells (for expression of GFP and red plasmids). Transfection efficacy and polymer cytotoxicity were quantified via flow cytometry, fluorescence readings, and MTT assay. These results, combined with synthesis of additional polymers, show promise for tying functional group specificity to varied cell lines to optimize for transfection efficacy.

Poster Presentation # 101
Gold Nanoparticles: Bioimaging, Efficacy, and Toxicity in Biological Systems, Towards Clinical Trials

Sarah Ghalayini, Cecily Ritch, Arusha Siddiqa, Cassidy Tobin and Tessneem Belhadj Yahya
Mostafa El-Sayed, PhD (Chemistry and Biochemistry)

While cancer remains one of the leading causes of death worldwide, the current mainstream treatments-including surgery, radiotherapy, and chemotherapy, all have serious drawbacks as they are either unsuccessful or cause damage to healthy tissues. It is, therefore, urgent for new approaches to the treatment of cancer to be developed and applied. Plasmonic photothermal therapy (PPTT) takes advantage of the interesting physical and chemical properties of gold nanoparticles (AuNPs) in order to either convert the light energy into localized heat resulting in cancer cell death, or scatter the light to help with the diagnosis of the illness. This study of the efficacy and toxicity of gold nanoparticles involved the synthesis of homogeneous batches of different sized AuNPs through ionic reduction techniques, that were then conjugated them with ligands to enable the selective targeting of cancer cells. We also studied the cellular uptake of AuNPs by cancer cells through transmission electron microscopy (TEM), dark and light field imaging analysis, and observed that the AuNPs were clustered inside the cell when the AuNPs were conjugated with select ligand peptides. Even so, the detailed mechanisms of the interactions between the nanoparticles and biological systems involving toxicity, efficacy, and molecular changes are still largely unknown. To this end we have Surface Enhanced Raman Spectroscopy (SERS) to detect time-dependent changes in the vibration frequencies and intensities of the molecules. In conclusion, this study of the interactions of AuNPs with biological systems has demonstrated that the AuNPs modified with biocompatible peptides are effective and safe for cancer diagnosis and treatment, and provides a good framework for the translation of this approach to future studies.

Poster Presentation # 094
The Effect of Dehydration on Executive Functions: A Meta- Analysis

Hayley Keadey
Melinday Millard- Stafford, PhD (Biological Sciences)

Dehydration (DEH) is believed to impair cognitive function with higher level processing (e.g., executive control, working memory) disproportionately affected. Purpose: To complete a systematic literature review and meta-analysis examining if DEH impairs cognitive tasks requiring executive functions. Methods: Pubmed, Web of Science, EBSCO, Scopus, PsychInfo, and Sport Discus were searched using keywords: *hydration, water loss, weight loss, hypovol*, sweat loss, cognition, and other specific cognitive function terms. Thirteen studies were identified, providing data on 200 human subjects with DEH levels ranging from 1.2 to 4.7 % body mass loss. Methods to induce DEH, control conditions, outcome variables, and executive function tasks varied between studies. Effect sizes (ES) were calculated using standardized mean differences and a random effects meta-analysis was utilized. Results: Five of 13 studies reported DEH impaired ($p < 0.05$) executive functions (either reduced accuracy or increased reaction time). The overall ES of DEH impairment on executive functions was small (ES = - 0.31), but non-significant ($p = 0.14$; 95% CI [- 0.74, 0.12]) and exhibited a high degree of heterogeneity among effects ($I2 = 82.5\%$). The ES did not differ when isolating reaction time and accuracy. Conclusion: In contrast to narrative reviews, a meta-analysis indicates DEH does not significantly impair higher level cognitive processing when assessed by tests of executive functions. This is likely a result of inconsistencies across studies.

Oral Presentation
Physical Regulation of Cell Adhesion Strength by Cell-surface Bound Hyaluronan Polymers

Rebecca Keate
Jennifer Curtis, PhD (Physics)

Cell adhesion occurs at the extracellular matrix (ECM) and is critical in coordinating tissue development, maintenance, and repair. Hyaluronan (HA) is a dense polysaccharide that forms the pericellular matrix (PCM) and plays a large role in several cellular processes. Because HA is negatively charged as well as dense, it is believed to repulse cells from surfaces. Levels of HA are correlated to events such as tissue modeling and tumor metastasis, which indicate HA removal, synthesis, and position, all play a critical role in these processes. By investigating the effects of HA in cell adhesion, much can be learned about the mechanics of cell-cell interactions. Experiments have been performed on a spinning disk apparatus, which applies a consistent shear stress to a circular cell sample, to quantify the adhesive strength of individual cells. After observing the dispersion of cells in relation to relative radial position on a circular coverslip following an applied shear force, the adhesive strength of the cell can be computed. By spinning the cells in different conditions, the adhesive impacts of individual physiological features can be quantified. Experiments have been done thus far that isolate the effect of HA on a cell's adhesive properties. Data has shown a significant increase in adhesive strength following the removal of HA with the enzyme hyaluronidase, which demonstrates that HA plays a crucial role in modulating adhesive cell activity.

Poster Presentation # 107
Characterizing the Subsidence and the Stability of the Western Flank of Arenal

Morgan Kemmerlin
Andreq Newman, PhD (Earth and Atmospheric Sciences)

Arenal, a stratovolcano, in Costa Rica had been continuously active since its eruption in 1968 with pyroclastic flows and lava continuously effusing for nearly the next forty years. It has been inactive since 2010. Volcanoes are built of steep slopes of poorly consolidated rock, the western flank of Arenal, in particular, is composed of loosely placed boulders. This flank has been observed to be subsiding at a rate of approximately 70 mm per year with larger subsidence on the flank than at the foot. This rate of deformation is higher than with gravity-driven volcanic deformation. It is unknown whether the subsidence is stabilizing or destabilizing the slope. An unstable slope on the edifice could lead to flank collapse and a landslide which could be extremely hazardous to the local towns and the dam. The goal of the research is to, first, temporally characterize the subsidence. It is currently unknown if the flank is subsiding in one large, continuous block, or if it is slumping in smaller blocks. The background motion of the tectonic plates and the effects of the 2012 Nicoya Earthquake has already been removed from the data of the motion at Arenal. Work is currently being conducted to characterize the subsidence of the western flank. Once the motion is characterized, then a hazards analysis will be conducted to determine the stability of the flank, the probability of a landslide, the extent of said landslide and the possible effects on the local region.

Poster Presentation # 102
Thermal Stabilization of the Olfactomedin Domain of Myocilin: Insights into the Evolution of the 5-bladed -propeller

Michelle Kwon
Raquel Lieberman, PhD (Chemistry and Biochemistry)

Olfactomedin (OLF) domain-containing proteins, first identified in relation to bullfrog olfactory chemoreception, are part of a superfamily of proteins implicated in many important biological functions and human diseases. The myocilin OLF domain (mOLF), one of the best studied, is closely associated with the ocular disease glaucoma. Nearly 100 myocilin mutations have been reported in glaucoma patients; >90% are missense mutations within mOLF. Disease-associated mutant myocilins are destabilized and aggregation prone, leading to toxicity and death of cells that maintain the anatomical trabecular meshwork extracellular matrix in the eye. The Lieberman lab solved the crystal structures of OLF domains from myocilin and gliomedin (gOLF), a peripheral nervous system OLF domain. While both are similar five-bladed -propellers, only mOLF contains a stabilizing calcium ion. Remarkably, gOLF is ~20 °C more stable than mOLF, even though it doesn't have a calcium ion and is phylogenetically more primitive. The goal of this project was to use insights from mOLF and gOLF to create a thermostable mOLF. Surprisingly, mutagenesis of a calcium-coordinating aspartate (D478) to alanine abolished calcium binding but increased mOLF thermal stability to near gOLF levels. Addition of D478A to the destabilized, glaucoma-associated variant D380A rescued thermal stability to that of wild-type mOLF. Structures of thermostable mOLF variants reveal unexpected changes in tertiary structure compared to wild-type mOLF, which were confirmed by solution biophysical measurements. The findings from this study expand our understanding of the structure-stability relationship of mOLF and provide further insight into the evolution of the OLF -propeller.

Poster Presentation # 109
Model Selection in Gravitational Wave Astronomy

Kate Napier
Deirdre Shoemaker, PhD (Physics)

Physics As a new era of gravitational wave astrophysics begins, we want to know as much as possible about the sources that create these ripples in the fabric of spacetime. This requires us to have accurate waveform models. At Georgia Tech, we solve Albert Einstein's equations of general relativity numerically in order to study binary black hole systems. However, the computational cost of creating one numerical relativity simulation is high. I am utilizing a tool from linear algebra called principal component analysis to try to characterize gravitational waves in a way that maintains high levels of accuracy but that is less computationally expensive.

Oral Presentation
Listening to Stories: Understanding Narrative Persuasion from Rhetorical Persuasion

Tiffany Nguyen
Eric Schumacher, PhD (Psychology)

Researchers have theorized narratives' ability to transport individuals cause them to have their opinions and even behavior changed to become more narrative-consistent. This result is based on the interpretation that from devoting most of your cognitive and emotional processes to the narrative you become more "distanced" from reality and leave you more susceptible to being persuaded. The literature has shown when strong arguments were presented the medial prefrontal cortex regions of interest exhibited more robust activity, such as in the ventromedial and dorsomedial. The underlying processes behind these brain activation patterns are consistent with the idea that persuasive messages affect a change in the individual's

mental state (Falk et al., 2010). Our research on the neural encoding of weak or strong arguments without and within a narrative structure would provide new information on how the persuasiveness of arguments are affect when are presented within narratives. The basis of our research was based on the behavioral finding that weak arguments were considered more persuasive when enfolded in a larger narrative context. Our preliminary fMRI findings also showed greater activity in medial prefrontal cortex regions of interest consistent with Falk and colleagues' (2010) found trends that supported the behavioral finding. However, with 21 participants' data we have found trends, including less activity in regions of interest, which support the possibility of emotional appeal as a confound in the literature on persuasion.

Oral Presentation
Low Dimensional Antiferromagnetism in Transition Metal Hydrazinium Sulfates

Sai Naga Manoj Paladugu
Martin Mourigal, PhD (Physics)

A purely one-dimensional chain of atomic-scale magnetic moments, or spins, cannot develop long-range order at any finite temperature. Nonetheless, such systems can show extremely complex magnetic excitations that are not yet fully understood. In my work, I have synthesized three iso-structural compounds, Cu(N2H5)2(SO4)2, Ni(N2H5)2(SO4)2, and Co(N2H5)2(SO4)2, which behave like one dimensional chains of spins, with the moments localized on the transition metal ions Copper, Nickel, and Cobalt. These ions carry spin quantum numbers of 1/2, 1, and 3/2, respectively. In order to characterize the magnetic properties of these compounds, I have performed x-ray diffraction measurements to determine their crystallographic structure, as well as thermodynamic measurements of their heat capacity, isothermal magnetization, and magnetic susceptibility at temperatures below twenty Kelvin, and applied magnetic fields ranging from zero to fourteen Teslas. By comparing how these thermodynamic properties vary between these compounds, I am able to make qualitative assertions on the nature of magnetic excitations to be investigated in future neutron scattering experiments.

Poster Presentation # 095
Coevolution in Replicate Lineages of Bacteria and their Lytic Bacteriophages

Caelan Radford
Eric Gaucher, PhD (Biological Sciences)

Bacteriophages are gaining renewed Western medicine interest as a potential therapeutic for antibiotic resistant bacteria. One challenge facing bacteriophage use as a tool of medicine is the evolution of resistance in bacteria to strains of phage to which they are exposed. Previous studies have investigated the coevolution of bacteria and lytic bacteriophages and observed an increase in bacteriophage virulence along with an increase in bacterial resistance over the course of many serial passages. Evolved phages can then be used on the original population of host bacteria and experience a lower rate of resistance. However, the bacteria still become resistant after one exposure. In this study, we use many replicates of coevolving bacteria and bacteriophages to investigate the consistency of their phenotypic coevolution. Combinations of bacteriophages from different replicates and future passages in the experiment were exposed to bacteria from earlier passages to determine how consistent the course of the bacteria/bacteriophage coevolution is. Combinations containing phages from different numbers of replicates were tested to determine if many or few replicates were required to obtain phages which underwent the same phenotypic coevolutionary pathway as the phages and bacteria in the replicate the bacteria tested against were obtained from. Data is not yet fully collected; data collection and analysis is expected to continue for the next month.

Poster Presentation # 111
Symptomatic Differences Between Sexual and Nonsexual PTSD

Veronica Rubinsztain
Mark Wheeler, PhD (Psychology)

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 # 103
Assessing the Role of Ribosomal RNA in Protein Folding and Evolution through FRET

Celeste Runnels
Loren Williams, PhD (Chemistry and Biochemistry)

The rRNA and rProteins that make up the ribosome contain a molecular record of biopolymers tracing back to the origin of life. From the core to the surface, this precise chronicle progresses from ancient, universally conserved structures to modern expansion segments and surface proteins. This layered structure is the result of the ribosome evolving by accretion, in which small RNAs and peptides were added onto the surface of the existing structure, leading to gradual growth in size and complexity. This accretion model implies not only that the RNA and protein segments within the ribosome are fossils of the most ancient iterations of these biopolymers, but also that RNA was intimately involved in guiding the evolution of proteins (and vice versa) with the ribosome serving as a cradle for this early co-evolution. This model of rRNA-protein interaction as an underlying force driving protein evolution predicts that rRNA has the intrinsic capability to chaperone protein folding. To test this prediction, we investigate the rRNA interactions of fragments of ribosomal proteins uL23 and uL22, which both contain -hairpin structures penetrating deep into core of the ribosome. We have created protein constructs consisting of two green fluorescent protein (GFP) variants linked to each end of these ribosomal -hairpin sequences so that their folding competency in the presence of rRNA can be assessed via FRET. The ability of the -hairpin segments of these rProteins to fold in the presence of rRNA could have roots in the ancient interactions of rProteins and rRNA as evolutionary co-chaperones.

Poster Presentation # 096
Rotifer Growth Under Astaxanthin Enrichment

Emma Siegfried
Terry Snell, PhD (Biological Sciences)

Rotifers and astaxanthin both play an important part in the aquaculture industry. Rotifers are used as a substitute for copepods, the main source of food for larval fish in natural systems, due to the ease with which they can be cultured. Astaxanthin is a carotenoid and antioxidant which brightens the coloring of fish and improves fish health. Rotifers are believed to be a method through which astaxanthin can be bioencapsulated and fed to larval fish, thus they receive the compound earlier in their life history. As a result, it is important to understand the effect of astaxanthin on rotifers themselves. This experiment uses a multitude of different protocols to determine how different concentrations of different astaxanthin compounds effects rotifers on both the individual and population levels. Reproductive tables and fluorescent imaging were used to assess the health of individual rotifers; population density measurements in mass cultures were used to assess rotifer population health. The reproductive ability of rotifers was significantly different from a control under multiple different astaxanthin treatments, as well as created a higher stable population density in the mass cultures. The fluorescent imaging showed that the rotifers reached peak astaxanthin concentration, within the rotifer gut, after 3 hours and fell back to similar concentration levels as the control within 24 hours. These results all point to the fact that astaxanthin helps to increase rotifer health and fitness, and as a result, these rotifers could be used as a vector for astaxanthin to larval fish.

Oral Presentation
The Impact of Client Biases on Behavioral Treatment of Autism

Catherine Stephens
M.J. Marr, PhD (Psychology)

Consistent interactions between a client (autistic child) and all his/her therapists are key for successful behavioral treatment for the client's problem behaviors. Unlike clinical psychotherapy, in behavioral treatment, the client does not have just one therapist, but many over the course of the day, all following the same treatment protocol. This study investigates how therapists differences in race, gender, and interactive techniques may result in increased problem behavior and decreased treatment effectiveness. Data will be collected from two stages of treatment of clients at the Marcus Autism Center Severe Behavior Day Treatment program. Therapist/client pairs will be categorized based on whether the therapist and client are different genders and/or races. Functional analysis: For each client/therapist pair, the average problem behavior occurrences in FA sessions involving that specific pair will be compared to the average problem behavior occurrence across all FA session with that client. Treatment: Change of problem behavior occurrences between consecutive sessions conducted by target therapist compared to the average change between all sessions conducted that day. In addition, specific therapist behaviors during sessions will also be recorded and compared to the change in problem behaviors. If race/gender differences are not found to have an effect in behavioral treatment, such as they have in clinical psychotherapy, this raises the question of why behavior treatment is not affected by these biases. If differences are found, then further consideration should go into pairing therapists and clients and comparing the scores collecting in session with different therapists.

Poster Presentation # 097
Chemical X Induces Beta Cell Regeneration in Danio Rerio

Oludamilola Taiwo
Chong Shin, PhD (Biological Sciences)

The purpose of this experiment is to distinguish Chemical X as a specific inducer of pancreas beta cell regeneration in Danio Rerio (zebrafish). Diabetes is a result of the lack of insulin-producing beta cells in the pancreas. Dani Rerio is commonly used as a diabetic animal model due to the ease of inducing transparency and pancreas ablation in zebrafish larvae. The experiment involves collecting a specific genetic line of zebrafish larvae and ablating their pancreas cells three days after birth. The next phase involves treating the ablated zebrafish with Chemical X, screening the fish two days later for regeneration, and producing confocal images of the regenerated beta cells. The expected outcome of this experiment is that Chemical X allows for the proliferation and neogenesis of only pancreas beta cells. These findings could be used in identifying a novel signal pathway for beta cell regeneration.

Poster Presentation # 104
Synthesis and Properties of YbZrF7; An Anion Excess ReO3-Type Material

John Ticknor
Angus Wilkinson, PhD (Chemistry and Biochemistry)

The vast majority of materials expand upon heating, while a select rare few contract upon heating. This unusual behavior is described as negative thermal expansion, and its potential applications are numerous. In past research, a significant number of these rhenium trioxide type fluoride materials have exhibited long range thermal expansion. This effect has been attributed to the tilted rocking of the rhenium trioxide octahedra which shift the metal centers inward upon thermal excitation, thereby inducing a reduction in volume relative to a temperature increase. The motivation in studying YbZrF7 involves the possibility of anion (fluoride) excess being incorporated into the ReO3 type structure in such a way that the rocking motion of the polyhedra framework would be rigidified, thereby limiting and/or controlling the extent of possible negative thermal expansion for the solid. Cubic YbZrF7 was successfully synthesized, characterized by x-ray powder diffraction, and studied via x-ray synchrotron under variable temperature and pressure conditions as a means to gauge its true behavior. Concurrently, models have been developed to understand the material's behavior at a chemical and mechanistic level. The two most striking findings regarding the material include a near zero coefficient of thermal expansion at room temperature along with an abrupt amorphization at modest pressures of approximately 0.9 GPa.

Poster Presentation # 105
Fibronectin's Integrin Binding Domain Has Downstream Changes on Fibroblast Phenotype

Jane Watts
Haylee Bachman, PhD (Chemistry and Biochemistry)

Fibronectin (Fn) is a protein found in the extracellular matrix (ECM) of eukaryotic cells. Of particular interest is Fn that is present in tissues that are under some sort of environmental stress which ultimately leads to the formation of scar tissue in human lungs. There are two recombinant versions of fibronectin's integrin binding domain which consists of ninth and tenth type III domain repeats that are studied in Dr. Thomas Barker's Bioengineering lab: the "relaxed" 9*10 type conformation which is the result of a leucine to proline mutation, and the "strained" conformation in which a 4-glycine linker is inserted between the ninth and tenth type repeats (4G). Fn's integrin binding is what produces downstream ECM changes. The overall goal of this research is to understand how normal human lung cell growth is affected by the presence of Fn fragments 9*10 and 4G, as well as full length fibronectin fragments. For the first part of this project, fast protein liquid chromatography (FPLC) was used in order to purify fibronectin fragments from recombinant E. coli cultures. These fragments can then be used to explore the biochemical cues influence on normal human lung cells. This is done by utilizing microscopy techniques to image cells and cell proliferation assays such as the CyQUANT direct assay to quantify the lung cell's responses to growth in the presence of the different fibronectin fragments. From this, it can be determined how these ECM proteins produce downstream effects that eventually lead to fibrosis of human lungs.

Poster Presentation # 098
Microbe-Microbe Interactions in the Cystic Fibrosis Lung Microbiome

Rachelle Wiese
Sam Brown, PhD (Biological Sciences)

Establishing an artificial microbial community to mimic the cystic fibrosis lung microbiome by culturing keystone species of pathogens recognized to play a major role in the pathogenesis of inflammation and lung function degradation over time. Relevant keystone strains of bacteria will be grown in monocultures and cocultures in environments that simulate the CF lung in order to observe the microbe-microbe interactions and the inhibitory or synergistic effects they have on one another. Optimizing the management of the CF lung is my aim throughout this research project.

Poster Presentation # 106
Synthesis of Lysine Demethylase (KDM) Inhibitors for Selective Tumor Targeting

Yuan Xu
Adegboyega Oyelere, PhD (Chemistry and Biochemistry)

Cancer and many diseases are results of epigenetic misregulation. (1) One of many epigenetic modifications is regulating gene expression by methylating the lysine residues of the histone proteins. (2) Histone methyltransferase (HMT) and histone lysine demethylase (KDM) catalyst the methylation and demethylation through chromatin modification. (3) KDMs are iron(II)-dependent oxygenases that contain a conserved catalytic Jumonji C (JmiC) domain. There are two major KDM families: a) the flavin-dependent monoamine oxidases LSD1 (KDM1A) and LSD2 (KDM1B0, and b) the Fe(II)- dependent oxygenases that contain a conserved catalytic Jumonji C (JmjC) domain (KDM2–KDM7). (4) For this project, we are employing a specific pharmacophoric model consisting of a surface recognition cap group which interacts with the surface of the active site channel, a linker that resides in the hydrophobic tunnel of the active site connecting the cap to the metal binding group (MBG) that chelates the iron ion (Fe2+) in the heart of the enzyme (Figure 1). An imbalance in HMT and KDM activities is linked to the development of wide variety of human cancers and other diseases. We are making this compound to find a protein inhibitor for this class of enzymes.

Oral Presentation
Computational Chemistry, Together

Michael Zott
David Sherrill, PhD (Chemistry and Biochemistry)

Computational chemistry is a growing field in the chemistry arena due to its low financial cost and low environmental impact as well as its ability to help guide chemical insight that is difficult to elucidate experimentally. The scope of the size of systems studied ranges from tens to millions of atoms. For small systems, the Schrödinger equation is approximated according to the principles of quantum mechanics (QM) for accurate results; however, larger systems are treated using the classical equations of motion for molecular dynamics (MD) simulations in order to yield a faster albeit less accurate answer (the biggest point id try to make here rather than size is time, QM takes single snapshots while MM is capable of effectively integrating over time. Id try to discuss this instead of the size discussion). In general, the practitioners of QM and MM only perform QM or MM calculations — not both. In order to translate from chemical simulations to chemical properties, it is desirable to combine the accuracy of single energy calculations provided by QM with the ensemble picture provided by MM. Here, streamlined QM□MM calculations using a newly developed interface between the software packages Psi4 (QM) and OpenMM (MM) are used to study a conformationally flexible N-arylimide system in chloroform solvent. These systems are known to exhibit strong solvent effects — previous computational efforts with implicit solvent models have been carried out (might be easier to say gas phase simulations), but no computational results have matched the relative populations of available conformational states reported experimentally. By performing explicit solvent dynamics calculations enabled by MM sampling, accurate QM energies are then obtained and important chloroform-solvent intermolecular interactions are determined. Finally, a more theoretically sound estimate of conformational populations is obtained.

IVAN ALLEN COLLEGE OF LIBERAL ARTS

Poster Presentation # 119
Key Phrase Analysis for Abstracts and Titles of the Transmissions Study of Published Knowledge About Women, Science, and Engineering

Sarah Bartel
Mary Frank Fox, PhD (Public Policy)

This poster is a dimension of the Study of Transmissions of Published Knowledge About Women, Science and Engineering (Mary Frank Fox, PI, NSF Award HRD-1015877). The overall project is the first comprehensive study of such published knowledge (1965-2010), and the transmission of this knowledge from producers to consumers. In this overall project, the published articles (knowledge) are identified with unique methods of identification and inclusion. This poster focuses specifically on identification and use of frequently occurring terms, categorized as themes or phrases, appearing in articles that 1) reflect references to "gender" compared to "sex" or 2) occur in the titles and abstracts of articles (N= 3414) over time. The poster focuses on "gender" and "sex" for two reasons: 1) The use of these terms has evolved in publications, reflecting an increasing social usage and emphases on issues of "socially" constructed masculinity/femininity ("gender"), compared to biological distinctions between women and men ("sex"). 2) The use of these terms has a bearing on broad understanding of women in science and engineering (the overall project's given focus). Analysis here presents findings on 1) use of these terms ("gender," "sex"), and 2) other underlying themes appearing in phrases (such as the theme "difference" and the associated phrases such as "gender difference" or "studies difference"). Key commonalities appearing in titles and abstracts have implications for understanding patterns of use of terms among specific broad clusters of fields, over time, and the citation frequencies (and thus, impacts) for articles containing several identified key themes and phrases.

Poster Presentation # 116
The Sweating Sickness: Political and Social Impacts

Hannah Corpe
John Tone, PhD (History and Sociology)

From 1485 to 1551, a disease ravaged England, the exact causes of which are still unknown. The most notable symptoms include sudden onset, delirium, fever, headache, and the copious sweating that provided the diseases' name- the English Sweating Sickness, or Sudor anglicus. Concurrently with the five outbreaks, England was also going through political and social upheavals. In my research, I will prove that although the disease is most notable for striking in England, it in fact was found in several other places. This is significant because of how the disease was viewed by contemporaries- as a punishment from God for sins exclusively limited to the English people- which has impacted and restricted our understanding of the disease. I will use primary source documents, as well as existing analyses in published, accredited articles and journal entries to explore the discourse surrounding the sweat and the cultural, social, and political climate in England at the time. The implications of my research include furthering our understanding of the sweating sickness as a disease by synthesizing information from outbreaks of the disease in other places with our knowledge of provable outbreaks of the disease in England. This will not only provide a more complete understanding of the disease as a whole but will also lend itself to more entirely appreciating the impacts of the social and political environment of England at the time on the recording and comprehending of the disease.

Oral Presentation
Conjuring

Lucy Groves
John Tone, PhD (History and Sociology)

Secret supernatural powers are hidden in the mountains of North Georgia. This research project is a documentary film that focuses on men and women who possess the gift of spiritual healing for various medical conditions. Personal interviews with these healers and the healed record for the first time the details of this secretive tradition. Stories of conjuring warts or poison oak, along with drawing fire and stopping blood, reveal generations of communities relying on their neighbors for help when doctors and hospitals were far away. In this year-long research project inspired by childhood encounters with old-time healers through grandparents living in rural North Georgia, I made inroads with individuals who for years have protected their practices in order to shield them from the outside world. Known only by word of mouth, this dying art is at risk of going extinct in the modern world without any historical record of its existence, so this documentary and the interviews themselves are pivotal artifacts for American history. Whether one believes in the validity of the healing or not, the communities where it thrives fully accept it and have put their lives in its hands for over 200 years.

Poster Presentation # 112
Factors Explaining Life Satisfaction Across Countries

Jong Rak Koh, Tim Lee, and Julien Dennes
Shatakshee Dhongde, PhD (Economics)

The factors explaining the happiness level at large scale are still unclear and debated. In our research, we explore a potential causal relationship between wealth and life satisfaction at the

national level, examining the age-old question, "Does money buy happiness?" Using the Gallup Global Wellbeing Poll data on self-reported life satisfaction and the World Bank database, we study the extent to which wealth, measured by GDP per capita, influences the average level of happiness in 146 countries. For our initial experiment, the simple regression model highlights a significant relationship between GDP per capita and self-reported indices of happiness. We continue to explore the causal relationship as we try to challenge the initial model by assessing if GDP per capita can act as a proxy for other factors (e.g. political freedom, access to healthcare, education, et cetera).

Poster Presentation # 113
Population Density of Major US Cities and its Impact on Productivity

Wendy Martinez
Shatakshee Dhongde, PhD (Economics)

This research project analyzes the correlation between population density and productivity. Analysis will include a myriad of economic development factors, including education and transportation.

Poster Presentation # 114
Manufacturing and GDP: Proof of Movement of Standardized Processses

Athena Matute
Shatakshee Dhongde, PhD (Economics)

Since the early 2000's there has been a decline in the share of labor in manufacturing in most developed countries around the world. Using World Bank data sets that include information on rich, middle, and poor nations, we test the theory that as a manufacturing process becomes more standardized and requires less skill to produce the process is moved to middle income nations. Statistics on wages, infant mortality, education and GDP are used to qualify the economic status of the nation as well as the abilities of the labor force. The evidence collected suggests that manufacturing moves away from countries with very low and very high GDP and moves toward countries that fall into the developing category.

Oral Presentation
The History of Greenlandic Colonialism and its Effects on Modern Mental Health

Kaley Parchinski
John Tone, PhD (History and Sociology)

Recent economic and political changes in the Arctic have led to the highest suicide rates in the world. In Greenland, the problem is particularly acute: almost 87 per 100,000 people commit suicide every year in the capital city of Nuuk (Bjerregaard, et. al., 2015). Community activists, health workers, and government agents are aware of the problem and work to prevent suicide (Redvers, et. al., 2015). However, some underlying causes of suicide are not easily overcome. Under the Home Rule Act of 1979, Greenland enjoys limited self government as part of Denmark, but Danish colonialism still shapes economic and political life and contributes to the high rate of suicide.

Oral Presentation
Mr. Smith Goes to Washington

Maxwell Roberts
Margaret Kosal, PhD (International Affairs)

This study is based on three premises. First, that the American procurement system is currently producing avoidable negative outcomes. Second, that these negative outcomes are driven, not by technological, strategic, or economic conditions, but by flaws in the institutional structure of the defense procurement process which cause actors in that process (actors being here defined broadly as groups bound together by common interests, rather than individuals) to act in ways that are rational for their own limited institutional goals but are overall detrimental to national security and the efficiency of the procurement process. Thirdly, that the remedies to these institutional flaws have already been proposed, but that these institutions, for the same reason they subvert the procurement process to serve their own ends, are resistant to reform. This study seeks to demonstrate negative outcomes in the procurement process, explore examples of attempted reform, identify the reasons for the success or failure of those reforms, and to find ways to generalize those lessons into policy recommendations for not just reforming defense procurement but actually forcing reform to be initiated and sustained.

Poster Presentation # 115
Determinants of Diabetes Risk in Low and Middle Income Countries

Anupama Sekar
Shatakshee Dhongde, PhD (Economics)

Diabetes, commonly thought of as an "affluent" disease, is steadily affecting a large part of the developing world. Many modern day lifestyle changes are contributing to this shift, mostly related to sedentary professional and personal lives, access to more fat, sugar, and oil - filled food, and increased population and poverty levels. Diabetes, which this paper focuses on, is part of a group of non-communicable diseases which not only affects individual health and families, but takes a toll on output and economic growth in national economies. While plenty of improved technology makes modern treatment very successful for patients, it is incredibly difficult for the people who need it most, to access and afford it. This paper examines the effects of

income levels of various developing countries and the according incidence of diabetes. It is aimed to further study the impact of "affluence" on the spreading of the disease, as well as under- vs. over-nutrition, in the context of LMICs, through regression analysis. The increasing incidence at both ends of the spectrum warrants further research, which can help target effective policy and nutrition programs.

Poster Presentation # 117
Sexual Orientation Conversion Therapy: A Modern Practice

Kathryn Stauduhar
Amy D'Unger, PhD (History and Sociology)

The topic of sexual conversion therapy has become a political talking point in recent years, but has had a place in US history since the creation of eugenics and the development of modern psychology. This paper explores the creation of eugenics, the development of modern psychology, and founding of ex-gay ministries in relation to the practice of changing a person's sexual orientation. Specifically this paper analyzes the work of Eugen Steinach, Freud, and conversion therapy techniques. While some techniques like aversion therapy, which is used effectively to treat other mental health disorders, it will be scrutinized in the context of treating homosexuality. Furthermore, it discusses the social institutions that hindered gay people in the United States, how they prevented social progress, and how they are still implemented today. Because the rhetoric surrounding human sexuality is so complicated, this paper utilizes original source material and synthesizes it with modern statistics to analyze said social institutions. The Stonewall riots triggered the beginning of the Gay Rights movement and brought the the topic of homosexuality into the media, and into American homes. This exposure raised questions about homosexuality, its validity, and the validity of trying change sexual orientation. The American Psychiatric Association changing their stance on the diagnosis of homosexuality as a mental disorder drastically changed the validity of institutionalized medical conversion therapy. The slow acceptance of homosexual relationships among members of the medical and psychological community, beginning with the removal of homosexuality as a mental disorder from the DSM, allowed for the religious community to take over the business of conversion therapy, where they remain protected by a variety of religious freedom laws.

Poster Presentation # 118
Reconstructing Atlanta: Newly Discovered Stories of Post-slavery Atlanta

Yonatan Weinberg and Ali Yildrim
Douglas Flamming, PhD (History and Sociology)

Ali Yildrim and I are researching the years immediately following reconstruction in Atlanta with newly compiled databases. This research is for a History and Sociology symposium arranged by Dr. Douglas Flamming. We are searching online newspaper collections and ancestry databases to assemble new characterizations of people, like former slavetraders, and to discover little-known intentions behind the missionaries starting schools for freedmen. Some of the documents we have discovered include Johnson's presidential pardon for A.K. Seago, an Atlanta slavetrader, as well as his tax documents. We even located his former business in the heart of downtown atlanta and superimposed it onto the wings restaurant currently there. We also found the annual report of the Freedman's Aid organization that founded Clark University, highlighting its competitive, religious motivations. They explicitly said that a prominent rationale for educating freedmen was that they would combat Romanist (Catholic) religious ideology and promote their Protestantism.

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Ancelin, Brighton	I	4:10 PM	SC 320
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Bercik, Bailey	B	1:40 PM	SC 320
Birman, Iris	B	2:20 PM	SC 320
Csomay-Shanklin, Noel	G	3:30 PM	SC 301
de Nijs, Nica	A	1:40 PM	SC 301
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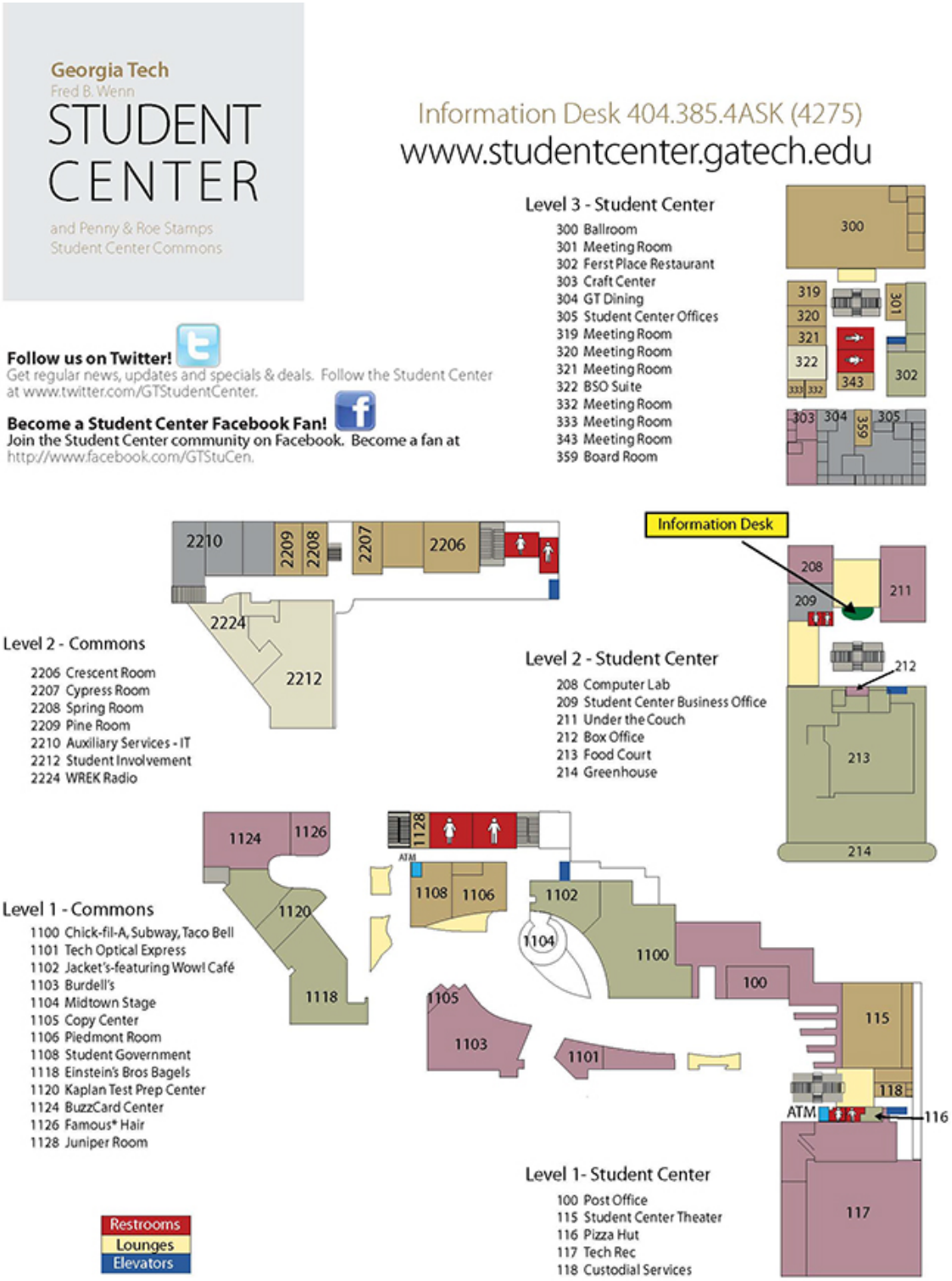
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320 Meeting Room
321 Meeting Room
322 BSO Suite
332 Meeting Room
333 Meeting Room
343 Meeting Room
359 Board Room
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2207 Cypress Room
2208 Spring Room
2209 Pine Room
2210 Auxiliary Services - IT
2212 Student Involvement
2224 WREK Radio
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Level 2 - Student Center
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209 Student Center Business Office
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212 Box Office
213 Food Court
214 Greenhouse
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1102 Jacket's-featuring Wow! Café
1103 Burdell's
1104 Midtown Stage
1105 Copy Center
1106 Piedmont Room
1108 Student Government
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1126 Famous* Hair
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