WELCOME TO THE

10TH ANNUAL UNDERGRADUATE RESEARCH SPRING SYMPOSIUM & AWARDS

WEDNESDAY, APRIL 22, 2015

1:00 PM - 6:00 PM

STUDENT CENTER BALLROOM

Georgia Tech Center for Academic Enrichment

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Abstracts published in this program reflect the individual views of the authors and not necessarily that of the Georgia Institute of Technology.

1:00 pm – 4:30 pm **Oral Presentations**

Session A: Biomedical Engineering
1:00 pm - 2:00 pm, Student Center Room 301

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1:00 pm - 2:00 pm, Student Center Room 319

Session C: Biology, Applied Physiology, & Earth and Atmospheric Sciences
1:00 pm - 2:00 pm, Student Center Room 321

Session D: Electrical and Computer Engineering
1:30 pm - 3:10 pm, Student Center Room 320

Session E: Materials Science and Engineering, Chemical and Biomolecular Engineering, & Aerospace Engineering
1:50 pm - 3:10 pm, Student Center Room 343

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Student Center Ballroom

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Student Center Ballroom

Georgia Tech | Center for Academic Enrichment

Welcome to the Georgia Institute of Technology's 10th Annual Undergraduate Research Spring Symposium. The work of our students and their faculty advisors demonstrates a commitment to not only investigate, but to resolve the issues of today while anticipating the demands of tomorrow. There is no better demonstration of that commitment than the research of our students presented before the Tech community today. At Georgia Tech, we strive to develop leaders in all fields and leaders in our global society. Our students and the faculty that advise them are the core of that pledge.

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

Go Jackets!

Christopher W. Reaves, Ph.D.
Director of Undergraduate Research and Student Innovation
Interim Director of Center for Academic Enrichment

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Moderator: Ms. Kenya Payton

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COLLEGE OF ARCHITECTURE

Oral Presentation
Wish for WASH: Bringing Innovation to Sanitation

Jasmine Burton
Wayne Li, PhD (Industrial Design)

One third of the world lives without access to improved sanitation. Subsequently, 3.4 million people die from water, sanitation and hygiene (WASH)-related diseases annually. Wish for WASH, LLC is a social impact organization that strives to bring innovation to sanitation through culturally specific design, research and education with a current focus on refugees. The SafiChoo 2.0 toilet is the first line of sanitation relief products that features a unique sit-squat toilet seat and a manual bidet that reduces the amount of potable water required for genital cleansing by 60%. The SafiChoo 2.0 toilet offers its users a more hygienic and ergonomic experience than existing crisis relief alternatives. In March 2014, the original co-inventing team won The InVenture Prize Competition enabling them too pilot the original design in the Kakuma refugee camp in tandem with the CDC and the Norwegian Refugee Council under the auspices of Sanivation. Feedback from the pilot enabled the new team to iterate the design into the existing SafiChoo 2.0 toilet. Original co-inventor, Jasmine Burton, founded Wish for WASH, LLC and is currently developing the business model with Vice President of Operations, Katie Isaf with the support of 20 other Georgia Tech undergraduate students. Before scaling globally, Wish for WASH is conducting a nine-month domestic pilot in Decatur, GA with the Global Growers Network, a nonprofit providing garden space for resettled refugees that is in need of a sustainable and waterless toilet. Sanitation is a basic human right; Wish for WASH seeks to normalize toilet talk in order to effectively rectify the sanitation crisis because after all, everybody poops.

Oral Presentation
Tactile Teacher: Enhancing Traditional Piano Lessons with Tactile Instruction

Richard Li; Yingyan (Samantha) Wang
Ellen Do, PhD (Industrial Design)

In the traditional piano lesson setting, the student is asked to imitate the teacher's playing through visual observation of the teacher's fingers and audial observation of the resulting music. Although this has been a proven method, progress may be slow and frustrating because the key component of piano playing tactile sensation is not available for the student to learn from. Thus we seek to augment this process by developing a method of conveying the tactile sensations of the teacher's keystrokes to the student. Our solution is Tactile Teacher, a glove equipped with sensors that detects finger taps on hard surfaces such as the keys on a piano, paired with a student glove that renders the detected sensations with vibration motors. The glove is designed to be extremely minimalistic in order to allow the teacher to play as naturally as possible, using only three piezo vibration sensors and with as much material removed from the glove as possible while still maintaining a firm fit. Tactile Teacher is capable of obtaining over 90% accuracy in identifying single finger taps, and 85% accuracy in identifying taps using pairs of fingers (chords on the piano). In preliminary user studies, new students with no prior exposure to the piano using Tactile Teacher were able to actively learn note sequences on the piano approximately 15% more accurately than students without the glove.

Poster Presentation # 001
Haptic Mirror Therapy Glove - the Effects of Aesthetics and Construction on Treatment Efficacy

Caitlin Taylor; Benjamin Katz
James Hallam, PhD (Industrial Design)

This research concerns the design and construction of the Haptic Mirror Therapy Gloves– interactive gloves intended to help stroke survivors. These gloves are complex devices, but our study focused on three key areas – custom fit, donning and doffing, and response to aesthetics. Fit matters for the comfort of the stroke survivor, as well as for the accurate placement of the sensors and effectors on the glove. Donning and doffing aids are particularly relevant for people with paretic limbs, as their hands may be in spasm. Finally, aesthetics influence the perception of the gloves by the user. Each of these areas have an impact on the dosage of the therapeutic activity prescribed, and improving them should also improve the overall efficacy of the gloves.

We developed a parametric pattern that can be adjusted by key measurements from the patient's hands. We also researched the current understanding of donning and doffing aids, and developed three different glove variants. Finally, we constructed a semantic taxonomy of wide sample of gloves to develop an understanding of the effect aesthetics have on the perceived function and value of the gloves.

Next, testing involves interviews with Occupational Therapists, to gauge their response to the glove variants and to evaluate the gloves against other therapeutic devices they employ in their practice. These data are recorded through a survey and annotation and coding of interview transcripts. We are also working to make contact with stroke survivors to further provide feed- back about the fit and features of the glove. Through this exploration, we hope to design a better platform for a therapeutic interactive glove, and move one step close to producing a glove fit for a clinical trial.

COLLEGE OF COMPUTING

Poster Presentation # 002
Single Node Large Scale Dense Linear Algebra

Ryan Birmingham
Polo Chau, PhD (Computational Science and Engineering)

Linear algebra is a field with uses across all of academia and industry. While for many fields, sparse algebra can be used sufficiently to solve applicable problems, more often, dense systems must be used to adequately describe and solve systems. We use a single node as a replacement for a cluster environment in order to solve a variety of linear problems, and optimize them to their form. The results suggest that using a single node to solve linear algebra systems is possible for all problems, and feasible for many of these problems. A focus on applications using decompositions, solutions, factorizations, and machine learning is kept..

Poster Presentation # 003
Towards Scalable Graph Computation on Mobile Devices

Yiqi Chen
Polo Chau, PhD (Computational Science and Engineering)

Mobile devices have become increasingly central to our everyday activities, due to their portability, multi-touch capabilities, and ever-improving computational power. Such at- tractive features have spurred research interest in leveraging mobile devices for computation. We explore a novel approach that aims to use a single mobile device to perform scalable graph computation on large graphs that do not fit in the device's limited main memory, opening up the possibility of performing on-device analysis of large datasets, without relying on the cloud. Based on the familiar memory mapping capability provided by today's mobile operating systems, our approach to scale up computation is powerful and intentionally kept simple to maximize its applicability across the iOS and Android platforms. Our experiments demonstrate that an iPad mini can perform fast computation on large real graphs with as many as 272 million edges (Google+ social graph), at a speed that is only a few times slower than a 13" Macbook Pro. Through creating a real world iOS app with this technique, we demonstrate the strong potential application for scalable graph computation on a single mobile device using our approach.

Poster Presentation # 007
Dolphin Drone

David Hendon; Chris Shaw; Justin Le; Gene Hynson; Robbie Hooke
Thad Starner, PhD (Interactive Computing)

Our project aims to create a self-contained submersible drone that reacts to specific whistle patterns by dolphins. This research will test if dolphins in the wild can communicate by replicating whistles. Previous research has shown that dolphins in captivity can make reproducible whistles. The sub is an extension of Dr. Herzing's work using self-contained dolphin translators called CHAT boxes. However, the reaction time of the researcher wearing a translator limits the dolphin's association between the whistle and the object. We have augmented our sub to process sounds underwater and react with either LEDs, tones, or motion, specific to the whistle given by the dolphin. The sub will respond immediately to tones produced by the dolphins such that they can make an immediate connection. The project will be one another step towards understanding dolphin communication in the wild.

Poster Presentation # 004
An Evaluation of Robot Teaching Methods for Constrainted-Keyframe Skills

Andrey Kurenkov
Andrea Thomaz, PhD (Computer Science)

Keyframe-based Learning from Demonstration has been shown to be an effective method for allowing end-users to teach robots skills. We propose a method for using multiple keyframe demonstrations to learn skills as sequences of positional constraints (c-keyframes) which can be planned between for skill execution. We also introduce an interactive GUI which can be used for displaying the learned c-keyframes to the teacher, for altering aspects of the skill after it has been taught, or for specifying a skill directly without providing kinesthetic demonstrations. We compare 3 methods of teaching c-keyframe skills: kinesthetic teaching, GUI teaching, and kinesthetic teaching followed by GUI editing of the learned skill (K-GUI teaching). Based on user evaluation, the K-GUI method of teaching is found to be the most preferred, and the GUI to be the least preferred. Kinesthetic teaching is also shown to result in more robust constraints than GUI teaching, and several use cases of K-GUI teaching are discussed to show how the GUI can be used to improve the results of kinesthetic teaching.

Poster Presentation # 008
A hybrid model for autonomous racing in a slot car dynamical system

Erick Lin
Byron Boots, PhD (Interactive Computing)

Learning from demonstration (LfD) is a recently emerged paradigm in machine learning that is described as an accessible way of programming agents to accomplish specific tasks. As a subset of supervised learning, LfD is often contrasted with reinforcement learning (RL), which involves learning through autonomous exploration rather than human input. This study will involve implementing a learning model in the Anki DRIVE setup that will focus on bootstrapping RL with LfD beforehand to investigate whether a hybrid model exhibits improved performance, introducing obstacle avoidance in light of the task of achieving directed navigation for minimizing lap times, and investigating the possibility of a model that can infer the positions of obstacles based on training data.

Oral Presentation
Algorithmically Bypassing Censorship on Sina Weibo with Nondeterministic Homophone Substitutions

Zhiyuan (Jerry) Lin
Eric Gilbert, PhD (Interactive Computing)

As with traditional media, social media in China exists under the watchful eyes of government censors. However, in limited cases, activists have employed homophones of censored keywords to avoid detection by keyword matching algorithms. In this paper, we show that it is possible to scale this idea up in ways that make it difficult to defend against. Specifically, we present a non-deterministic algorithm for generating homophones that create large numbers of false positives for censors, making it difficult to locate banned conversations. In two experiments, we show that 1) homophone-transformed weibos posted to Sina Weibo remain on-site three times longer than their previously censored counterparts, and 2) native Chinese speakers can recover the original intent behind the homophone-transformed messages, with 99% of our posts understood by the majority of our participants. Finally, we find that coping with homophone transformations is likely to cost the Sina Weibo censorship apparatus an additional 15 hours of human labor per day, per censored keyword. To conclude, we reflect on the opportunities presented by this algorithm to build interactive, client-side tools that promote free speech

Poster Presentation # 009
Modulating the Perceptual Fidelity of Enactive Co-Creative Agents

Sanat Moningi; Kunwar Yashraj Singh
Brian Magerko, PhD (Interactive Computing)

This project provides a theoretical and computational analysis of implementing a creative trajectory monitor in enactive co-creative agents. We implemented the Drawing Apprentice, which is a co-creative agent that collaborates with users in real time abstract drawings; its architecture is based upon the enactive model of creativity (EMC) that formalizes the cognitive science theories of enaction. A critical component in enactive agents, both theoretically and computationally, is the creative trajectory monitor. This mechanism modulates the manner in which agents process and interpret sensory data to help make sense of real time creative interactions. This project will help computational creativity researchers understand why creative trajectory monitors are important in enactive systems and provide some initial techniques for implementing them. Furthermore, the contribution of a creative trajectory monitor in the Drawing Apprentice is the amount of data to extract from the environment and what type of data to extract which would be more meaningful in understand the user's art as well as help the agent contribute novel artifacts on the canvas.

Poster Presentation # 006
Understanding Noisy Big Data Streams

Thurston Sandberg
Matthew Wolf, PhD (Computer Science)

In today's world, there is an increasing need for applications to deal with large amounts of data. So much so that we have begun to delineate and organize classifications of "Big Data" that help us break down and understand it. Colloquially this is considered the five V's. Currently, the "V" with the most attention is Volume, or dealing with and processing a massive amount of data. However, there are many interesting avenues of exploration within the other four V's Velocity, Variety, Veracity, and Value. In this work, we have focused on Veracity and Value of a high Velocity data stream as observed in an Internet of Things (IoT) space. We looked into placing ambient sensors in high foot traffic areas in order to determine the type of traffic taking place. This involved combining multiple types of sensors, such as motion detecting, accelerometer, and microphone, collecting data that give rise to a higher abstraction idea such as "person walking", "person biking", "dog walking", etc. We controlled these streams of sensor data through the EVPath middleware network overlay that allows for flexible and intelligent communication of multiple sources of data. EVPath enables endpoints capable of computation to work on the data before it is aggregated in a master node; to wit, Intel Galileo boards can run full Linux distributions capable of crunching numbers in addition to data collection. This combination of sensor data collection and

processing across multiple nodes allows for distributed intelligent detection of patterns within streams of data that showcase unique handling of multiple V's of Big Data that gives rise to distinct behavior detection.

Oral Presentation
Community Driven Mapping of Place Names

Ana Smith
Jacob Eisenstein, PhD (Interactive Computing)

Location names (toponyms) are a vital part of everyday life, enabling efficient navigation and community branding. Moreover, toponyms convey implicit information about the locations which they describe and about the social groups who use the toponyms. "Spaghetti Junction" rather accurately describes the intertwined bridges of the Tom Moreland Interchange near Atlanta. Suppose a group of people tends to favor the name "Spaghetti Junction"; then that group is more likely to consist of metroAtlanta locals rather than people living elsewhere in the United States. A significant amount of information can be associated with colloquial toponyms, and formally identifying colloquialisms may lead to a richer understanding of regions and communities.
We propose a system for mapping colloquial toponyms to geocoordinates by using a social network, in this case Twitter. Tweets are first collected from a specified region with the help of the geocoordinatefiltering features of Twitter's API. To obtain a list of regional toponyms, a broader list of toponyms is filtered. The result is a set of mapped and unmapped toponyms where a mapped toponym is one which can be located in a gazetteer (i.e., a location to geocoordinate dictionary). Using these toponyms and other data, a hybrid social network is constructed. Nodes in the network represent toponyms and users; some nodes also contain additional information such as the geocoordinates, either estimated during runtime or produced by a gazetteer. Edges between nodes represent users mentioning toponyms or other users. The location of unmapped colloquial toponyms are then estimated using properties of the network..

Poster Presentation # 005
Talking to Dolphins, A Pattern Recognition Approach to Analysis of Unknown Language

Pavleen Thukral
Thad Starner, PhD (Computer Science)

We expand research of dolphin animal vocalizations. Marine mammalogists commonly study a specific sound type known as the whistle found in dolphin communication. However, one of the main problems arises from noisy underwater environments. Often waves and splash noises will partially distort the whistle making analysis or ex- traction difficult. Another problem is discovering fundamental units that allow research of the composition of whistles. We propose a method for whistle extraction from noisy underwater recordings using a probabilistic approach. Furthermore, we investigate discovery algorithms for fundamental units using a mixture of hidden Markov models. We also fundamentally enhance this research by adding in visual ques of dolphin posture, and groupings. We observe how certain dolphin behaviors provide contextual clues about intent and presence of certain whistles. We also provide an algorithm for dolphin identification using the spots on the bellies of wild spotted dolphins. Using these three approaches we provide a cohesive system to study and understand dolphin cognition. We evaluate our findings with a marine mammalogist on data collected in the field.

Oral Presentation
Finding Meaning in Text: Parsing Sentences to Semantic Dependency Graphs Using Word Embeddings

Yijie Wang
Jacob Eisenstein, PhD (Computer Science)

Finding meaning in text is a hard linguistic task, complicated by semantic and syntactic ambiguity in natural language. To solve the problem, semantic dependency graph is proposed. Semantic dependency is essentially a categorized relation between two words, such as the verb-object relation (e.g. the relation from "beats" to "UGA" in "Georgia Tech beats UGA."); semantic dependency graph is a collection of all such relations within a text, in the form of a directed graph.
Recently, word embedding as a way of capturing word meaning has gained popularity within computational linguistics. Word embedding is essentially representing words as vectors, to allow knowledge sharing across related words. It can capture some non-trivial relations among words, such as woman-man relation (i.e. vector-wise [woman] – [man] ≈ [queen] – [king] ≈ [madam] – [sir] ≈ [aunt] – [uncle]). Word embedding is trained on large collections of unlabeled text, leveraging the large amount of text available online.
In this project, we propose to incorporate word embedding into the machine learning algorithm that parses sentences into semantic dependency graphs. Specifically, we propose to formulate semantic dependency relation as an additive operation within a subspace of the word embedding vector space. Inference of the graph structure, an NP-hard problem, is accomplished by an approximation algorithm called Alternating Directions Dual Decomposition (AD3). Hinge loss and gradient methods are used to optimize the model on the labeled dataset, together with word embeddings pre-trained on a larger unlabeled dataset. The project is meaningful in linguistic study, and would have broad practical applications to semantics-driven machine translation, question answering and text summarization.

COLLEGE OF ENGINEERING

Oral Presentation
Evaluating Metrics for Phase Amplitude Coupling in the Brain

Rehman Ali
Robert Butera, PhD (Biomedical Engineering)

Phase-amplitude coupling (PAC) is theorized to play a fundamental physiological role in neural oscillations of the brain. PAC has been demonstrated to play a role in the alleviation of Parkinson's disease by deep brain stimulation (DBS), and is currently being investigated in the alleviation of treatment-resistant depression (TRD) at Emory School of Medicine. In order to investigate PAC in local field potential (LFP) recordings around the brain, a toolbox of PAC metrics currently in use is being assembled to tackle the problem of evaluating PAC in these signals with relative ease and reproducibility. The goal of this research is to evaluate six different metrics, five of which are currently in use amongst computational neuroscientists in this field and one of which is entirely novel. In addition to investigating the efficacy of these metrics, the signal processing used to decompose these LFPs into the pertinent frequency bands is also assessed. These issues will be addressed in terms of typical signal processing considerations such as amplitude modulation, band-pass filter bandwidth, envelope and phase extraction, etc. More atypical signal processing techniques common in neuroscience such as the continuous wavelet transform will be investigated in detail as well. This work highlights the importance of certain signal processing and statistical methods in evaluating PAC as well underlying tradeoffs and limitations in their efficacy.

Poster Presentation # 054
Analysis of colon cancer metastasis using a microfluidic-based cell adhesion chromatography system

Ananyaveena Anilkumar
Susan Thomas, PhD (Mechanical Engineering)

Selectins, cell adhesion molecules that facilitate interactions between circulating cells with other blood or vascular endothelial cells in the fluid flow environment of the circulatory system, also significantly contribute to the process of hematogenous cancer metastasis. We aim to understand the adhesive behavior of tumor cells with selectins using a modified parallel plate flow chamber that recapitulates the shear flow environment of the circulation. To accomplish this, cancer cells were perfused through a microfluidic device with a planar selectin-functionalized substrate. Residence time distribution experiments were performed with cell elution time used as a proxy for the overall time-averaged cell adhesivity to the substrate and can be juxtaposed with the instantaneous interaction behavior measured via videomicroscopy, yielding a new metric of adhesion persistence. By implementing this system, we found that a bimodal dependency of adhesion persistence with rolling velocity exists for cell adhesion to Land P- but not E-selectin. Furthermore, we quantified the relationship between the velocity at which cells moved through the chamber and the time elapsed before the cells arrived in the field of view. We devised a mathematical model for this relationship, which may be helpful in further analysis of selectin-mediated cancer cell adhesion. We also conducted particle rotation experiments with half functionalized Janus particles as a proxy for cells with videomicroscopy to understand rolling behavior of cancer cells. The data from these experiments is currently being used for high content analysis of cancer metastasis and the role of selectin-mediated cellular adhesion in this process.

Poster Presentation # 038
Video-based Robust Heart Rate Detection

Varol Aydemir
Ghassen Al-Regib, PhD (Electrical and Computer Engineering)

The current standard in clinical measurements to measure heart rate is electrocardiogram (ECG). In ECG, there are special equipment and leads connected to human body. For long-term screening of the heart rate for patients, this may be a source of discomfort. In this study, human heart rate is going to be measured in real-time using an of-the-shelf webcam camera and results are going to be compared with ECG ground truth data. This will enable low-cost, non-invasive and long-term screening of human heart rate. Recent studies have shown that using photoplethysmographic imaging, blood volume pulse (BVP) signal can be extracted from a video. Consequently, various physiological parameters can be calculated using BVP signal. Recent studies also have shown that each heartbeat causes imperceptible motion in the human body. This imperceptible motion can be captured using a simple camera and as a result some physiological parameters like heart rate and heart rate variability can be extracted from this signal. Although considerable developments achieved, there are still some problems related to motion artifacts. In our research, we try to combine these two approaches. We also try to measure the effects of different video parameters on the accuracy of these algorithms. Finally, we aim to develop more motion-tolerant algorithm.

Oral Presentation
Speech Therapy with the Tongue Tracking System

Shurjo Banerjee
Maysam Ghovanloo, PhD (Electrical and Computer Engineering)

Speech and language therapist pathologists (SLPs) rely primarily on auditory feedback from their patients to treat and diagnose speech impediments. The Georgia Tech Bionics Lab is currently in the process of creating the Tongue Tracking System (TTS), a machine which when completed, will provide tracking information about tongue motion during speech. TTS involves placing a small magnet on the patient's tongue using a dental adhesive and tracking it within the oral cavity using an array of magnetic sensors. This information about tongue trajectory, when provided to patients and SLPs will potentially provide a low cost and efficient avenue for improved speech therapy and a greater understanding in the treatment of speech impediments.

Oral Presentation
Fuel Composition Effects on Turbulent Flame Speed

Aaron Blacker; Pedro Maddens Toscano; Shawn Reginauld; Maxwell Curtis
Tim Lieuwen, PhD (Aerospace Engineering)

With increasing concern of the environmental impact of burning fossil fuels, such as coal and natural gas, for power generation, potential future fuels derived from biofeedstock have emerged. These fuels, when gasified to be used as a substitute for natural gas, are referred to as synthesis gas, or "Syngas". Syngas fuels are typically composed primarily of H2 and CO, and may also contain smaller amounts of CH4, N2, CO2, H2O, and other higher order hydrocarbons. However, the specific composition depends upon the fuel source and processing technique, leading to substantial variability in composition. The turbulent flame speed is an important parameter through which the fuel composition exerts influences on many important combustor development issues, such as thermal loading, blow-off limits, flashback limits, and combustion instability. The laminar flame speed, SL, is a thermo-physical property of a fuel-oxidizer mixture that describes the speed at which a laminar flame front propagates into a reactive mixture. For a given mixture, it is a function of pressure, temperature and flame stretch rate. The turbulent flame speed, ST, while having an analogous definition for the average propagation speed of a turbulent front, does not uniquely depend on the mixture's thermal and chemical properties. As with turbulence itself, ST is a function of the flow within which the flame resides; i.e., it is a function of laminar flame speed, turbulence intensity, turbulence length scales, etc. Correlations of turbulent flame speed of the form ST = SL × f (u '), where u' denotes the root mean square (RMS) turbulence fluctuation, have been obtained from numerous studies. However, u' and SL alone do not capture many important characteristics of ST, a point that has been made repeatedly in the literature as fuel composition is also known to significantly influence the turbulent flame speed.
Currently, research has been conducted by Georgia Tech on a wide range of Hydrogen/Carbon Monoxide blends. However, this composition may not entirely accurately represent that actual fuels being used. For that reason, three and four component fuels including various blends of Hydrogen, Carbon Monoxide, Nitrogen, and Natural Gas are being investigated. The turbulent flame speed measurements of these more complex fuels will be compared to the simpler two component fuels. This will allow us to determine if the complex fuels can be accurately represented by data of simpler fuels. This would be advantageous as obtaining data with two-component fuels is both simpler and more cost effective, resulting in more extensive studies being able to be conducted. Ultimately, our presentation will present preliminary results comparing the four component fuels to the two component fuels and the measured turbulent flame speeds.

Poster Presentation # 055
Functionally-targeted Patch Clamping In-vivo

Christopher Capocasale
Craig Forest, PhD (Mechanical Engineering)

The ability to quickly and easily target functional regions on the brain surface with current in-vivo electrophysiology methods (e.g., Patch Clamping) would enable new types of neuroscience experiments. Specifically, we are interested in using this tool to record from synaptically connected neurons in the anatomically well-studied whisker (vibrissae) pathway of the mouse. A method using Intrinsic Optical Signal Imaging to visualize neural activity in combination with machine vision methods for accurate electrode placement is presented. To verify the physiological significance of visualized neural activity, it's the optical center of activity is compared to the anatomical representation of the corresponding whisker barrel. Additionally, the mechanical accuracy and repeatability of electrode placement is characterized using an independent metrology system. Finally, the efficacy of this targeting method will be demonstrated experimentally in the anesthetized mouse.

Oral Presentation
Effect of Exercise on the Bifurcated Y-graft Fontan Connection—The Importance of Left Pulmonary Artery Stenosis

Jaci Carithers
Ajit Yoganathan, PhD (Biomedical Engineering)

Background: The Fontan procedure is a palliative surgery for single ventricle congenital defects. It improves patient outcomes in the short-term; however, long-term morbidities such as pulmonary arteriovenous malformations and decreased exercise capacity still persist. The bifurcated Y-graft is a novel

modification that splits inferior vena cava flow between the pulmonary arteries to avoid flow collision. This study aims to comparatively evaluate the hemodynamic performance of the largest Y-graft cohort to date with an age-matched traditional total cavopulmonary connection (TCPC) cohort under resting and simulated exercise conditions.
Methods: Patient-specific Fontan anatomies and flows were reconstructed from cardiac magnetic resonance images, including 22 Y-grafts and 22 traditional TCPCs. Computational fluid dynamics modeling was performed for each patient using three flow conditions for the inferior vena cava: resting, moderate exercise (2x resting flow) and vigorous exercise (3x resting flow). The connection's hemodynamic performance was assessed by evaluating the connection power loss and by computing the inferior vena cava flow split (hepatic flow distribution) to both lungs.
Results: The Y-graft and traditional TCPC both showed a non-linear increase in power loss from resting to vigorous exercise conditions, however the Y-graft experienced a steeper increase. Hepatic flow distribution was relatively maintained between the conditions for both cohorts, yet the traditional TCPC had a higher factor of variance. Among patients with marked power loss increase, all shared the common feature of left pulmonary artery stenosis.
Conclusion: The Y-graft experienced a steeper increase in power loss compared to the traditional TCPC, however the prevalence of LPA stenosis in the Y-graft cohort may be the reason. The traditional TCPC had an increased factor of variation for hepatic flow distribution, lending support for the Y-graft's ability to maintain hepatic flow distribution.

Poster Presentation # 056
Porous polymer monolith fabrication in a poly(dimethylsiloxane) microfluidic device to study quorum sensing between bacterial populations

David Caro
Craig Forest, PhD (Mechanical Engineering)

Gram-negative bacterial populations use quorum sensing as a method of inter-cellular communication. This process allows one population to transmit a signaling molecule to another population, triggering regulatory gene expression in the receiving population. In order to better understand and model these signaling pathways in bacteria, a detailed method is presented in this work for the creation of a new microfluidic device that houses two distinct groups of bacteria separated by a porous polymer monolith. The microfluidic device is composed of poly(dimethylsiloxane) (PDMS). Because PDMS is permeable to oxygen, it allows the bacteria to function in a controllable environment that closely mimics true conditions. However, the oxygen permeability also poses a challenge to the in situ fabrication of a porous polymer because the oxygen inhibits free-radical polymerization2. In order to allow polymerization within the microchannels of the PDMS device, the surface of these microchannels must first be chemically modified with a photoinitiator that does not inhibit polymerization. Then, a surface modification solution is introduced to the microchannels, followed by UV exposure at 365 nm, which is defined to a specific area by a chrome-plated photomask. The surface-modification solution alongside the introduction of a photoinitiator allows the porous polymer to be intertwined with the walls of the PDMS. It is then that the porous monolith can be polymerized within the PDMS device. The monolith is structured with pores that are of large enough diameter to allow the transmission of these bacterial signaling molecules from one population to another, and small enough in diameter to prevent the transmission of bacterial cells. By coupling the growth of two separate populations of bacteria in a microfluidic device with the formation of a porous polymer monolith, the transmission of signaling molecules can be studied effectively.

Poster Presentation # 057
High Throughput Method of Characterizing Structural Materials

Andrew Castillo
Surya Kalidindi, PhD (Mechanical Engineering)

This poster presents the development and validation of a high throughput method for characterizing structural materials. The method focuses on structure, processing and mechanical property relationships in an aluminum alloy (6061) for different aging temperatures. Relationships from traditional methods were established and used to verify the results of the high throughput method. Optical and electron microscopy were used to characterize the microstructure for both methods. In the high throughput method, a steady state thermal gradient was used to achieve regions of different aging temperatures in one sample. Mechanical properties from these samples were then determined from instrumented indentation which involved converting the load-displacement data into stress-strain curves. This method provides material, time, and cost savings for materials characterization due to the reduction of samples to a single sample and high throughput nature of indentation testing.

Poster Presentation # 058
Finite Element Analysis of Changes in Lymph Node Stiffness Underlying Cancer Metastasis

James Caudill
Susan Thomas, PhD (Mechanical Engineering)

Whenever you are sick, you might have noticed your lymph nodes getting swollen and stiff. These physical property changes in lymph nodes in many disease states relate to internal changes in the cells, matrix composition, fluid flow, and fluid pressure. This same stiffening of the lymph nodes also occurs in tumor draining lymph nodes according to preliminary evidence in the literature. Measuring this stiffness can help our understanding of disease progression as well as provide an early indication of metastasis in

cancer. Therefore, we want to explore if the stiffening in tumor draining lymph nodes is due to cellular or fluid changes and if these changes are practical indications of metastasis by utilizing finite element analysis software (FEA).
The FEA model measures forces produced by performing an indentation test to compress the lymph node. The model has been created under the assumption that Hertz Contact applies between the soft lymph node and the harder steel indenter. The FEA software breaks up the geometry of the model into discrete shapes (tetragons).
These shapes or elements can then be assigned material properties such as a modulus of elasticity, shear modulus, and density. A stiffer modulus of elasticity can be assigned to certain elements to represent "cancer" cells in the lymph node. The indenter then displaces to produce a 10% strain on the lymph node and the program can calculate the resulting forces, stresses, and strains. The current model used is a 2D axisymmetric model, which allows for fast calculations.
Our results have shown that the location of stiffer elements change the forces that are measured at 10% strain depending on location and configuration. Clusters of these stiffer cells have been placed at the top, bottom, center, and outside of the lymph node. A random distribution of stiffer cells as well as a shell was also created and tested. The percentage of stiffer cells was also varied from 10%-100% for each configuration. These current results are insightful in that there is a significant stiffness change only after 50% of the lymph node is metastasized by stiffer "cells". This points to other changes happening within the lymph node to produce the stiffer effects seen. A future 3D model is currently being built. This model will be more accurate, and will incorporate hydrostatic fluid elements as well as viscoelastic materials added to better model the in vivo lymph node environment and changes occurring with cancer progression.

Poster Presentation # 059
Effects of HIV-1 Infection on Bone Growth in HIV-1 Transgenic Rats

Alexandra Cavallaro
Robert Guldberg, PhD (Mechanical Engineering)

Background: Human immunodeficiency virus (HIV) affects 1.1 millions people in the US, yet not much is known about the specific effects of HIV on the bone remodeling process.
Motivation: Little is known about the growth patterns of the skeleton in individuals infected with HIV. In previous studies, children infected with HIV-1 have low bone density and display the negative effects of bone remodeling.
Materials & Methods: All procedures were approved by the Institutional Animal Care and Use Committee of Georgia Institute of Technology. Female HIV-1 rats and control wild type (WT) rats were purchased from Harlan Laboratories. Tg rats were scanned using a vivaCT system from Scanco Medical, at 5, 7, and 9 months of age. 1 mm region of the femoral middiaphysis was scanned and evaluated for cortical bone parameters.
Results: Across all ages, the HIV group had significantly lower values for all cortical bone parameters except average mineralization compared to the WT group.

Poster Presentation # 060
3D Models for Soft Tissue Analysis

Miles Chan; Vikram Krishnaswamy
Raghuram Pucha, PhD (Mechanical Engineering)

Smooth muscle tissue, a biological material, is an important part of any vascular system and the study of its mechanical properties has applications in organs including intestines, blood vessels, digestive tract, and uterus [1]. Examined in cross section, a smooth muscle shows roughly circular muscle cells, each with a central nucleus. In longitudinal sections, the smooth muscle appears as elongated, tapering, and spindle-shaped [2].
Representative element-based (RVE) 3D models of biological soft tissue will be presented in this poster for determining soft tissue mechanical properties. Using MATLAB, we define the number and coordinates of cells based on their shape and desired arrangement. We input this geometric information into Visual Basic for Applications (VBA) code which utilizes the Autodesk Inventor API to automatically generate 3D RVE models.
Our MATLAB and VBA code can produce models of soft tissues with a variety of different geometric and material properties. We will demonstrate single-cell and multi-cell representative volume element models, each with differing cell shape and arrangement. Cells can be configured to have circular or elliptical cross sections with hollow nuclei that are extruded or revolved. These cells can be placed in a uniform grid or by using a close packing algorithm. The generated 3D models are used for simulation of mechanical properties.

Poster Presentation # 061
Internal Flow in Urethra and Draining System

Anthony Chen
David Hu, PhD (Mechanical Engineering)

Draining systems are essential to everyday life and critical to body function. What is the most efficient way of draining fluids? In this combined theoretical and experimental study, we investigated the urinary system mimic in the lab, artificial draining system in daily life and urethras from pigs. We built the draining systems to mimic the urinary system. The experiment included containers and draining pipes in varied dimensions. Animals have optimized length of urethra as entrance length to minimize the duration of urination. We compared the designs of urinary system with artificial draining systems. Animals have geometrically similar urinary systems made of smooth muscle; while the draining systems varied the geometry with different materials based on cost, friction loss and strength. We set up a pumping system with pig urethras. The forward flow rate is 20% higher than the flow rate backward. This indicates the asymmetric internal roughness and change of elasticity

throughout the urethra. Studying biological piping system is useful for further understanding the internal structure and biological pipe flow, helping to improve the design of draining systems.

Poster Presentation # 062
Bone Repair: Limiting Bone Growth to Where It Should Be

Catherine Chou
Robert Guldberg, PhD (Mechanical Engineering)

In the United States alone, about half the adult population – approximately 110.34 million people – experience some form of musculoskeletal deficiency, making it the leading cause of disability. More than 130 million visits a year to US healthcare providers are due to musculoskeletal conditions, racking up $950 billion in total costs; meanwhile, developing nations see a quarter of health care costs going towards traffic accidents, which often result in bone or muscle injuries.
My research in the Guldberg and McDevitt labs focuses on improving the current method of bone repair through tissue engineering. More specifically, rather than using grafts, we look to deliver osteogenic (bone-inducing) growth factors so that the body can induce repair on its own rather than building off grafts from other parts of the body or even from other people, which introduce a multitude of complications within themselves (ie. graft rejection). One biomaterial, collagen sponges, has proven able to deliver our growth factors (specifically BMP-2) but do not do so very effectively, requiring such high doses of BMP-2 as to produce inflammation and causing ectopic bone formation. Our proposed solution to this is to attach BMP-2 onto microparticles (MPs) that are in turn secured to collagen or polycaprolactone (PCL), which allows for greater control over where the BMP-2 resides in vivo. Current variables in procedure that we are testing include having

1. BMP-2 in an alginate gel encased by a MP-impregnated PCL mesh,
2. BMP-2 solution in a collagen sponge and surrounded by the same PCL mesh, and
3. BMP-2 directly loaded onto the PCL mesh.

Poster Presentation # 015
Development of immunomodulatory biomedical in tissue repair

Yihsuan Chu
Edward Botchwey, PhD (Biomedical Engineering)

According to International Osteoporosis Foundation, osteoporosis causes more than 8.9 million bone fractures annually worldwide. In other words, a person suffers a fracture every three seconds (1). Many different surgeries can be performed depending on the type of fracture. For example, bone grafting helps severe trauma and commuted fracture. Nevertheless, regardless of the surgery performed, the primary goal after injury is to return the damaged tissue back to its original state. Bone healing is very complicated process involving proliferation of tissue cells and stem cell differentiation. A complex cascade of chemical signals and cells, such as growth factors, inflammatory cytokines, osteoclasts (cells that break down bone), and osteoblast (bone-forming cell), work as a team to perform a compact task. Seems like our body has a mysterious program that cell and chemical present in the certain stages in order. The injury site initiates inflammation and spreads a signal to recruit inflammatory monocytes. The inflammatory monocytes infiltrate the injury site and work to effectively defend and clear the virus, bacterial, and other infection from an external source. However, the functionality of inflammatory can also lead pathogenesis of inflammation and degenerative disease (2). Therefore, anti-inflammatory monocytes patrolling in the vasculature move from blood vessel to the tissue and differentiate into anti-inflammatory macrophage called "M2" macrophages. Anti-inflammatory macrophages clean the inflammation and also repair damaged tissues (3). Ideally, if we can identify the correlation within those components and speed up the procedure, we could increase the body's regeneration rate. Therefore, our research focuses on studying those components and developing strategies to increase the efficiency of recruitment of therapeutic cell types.

Poster Presentation # 010
Extra Vehicular Activity Research

Austin Claybrook
Karen Feigh, PhD (Aerospace Engineering)

The purpose of this research is to further develop an understanding of the crucial functions and types of support provided by ground control to astronauts during work outside of the space craft, also known as extra vehicular activity. A video study of conversations from recent missions on the International Space Station will better identify the roles and ways in which ground control assists crew with their operations and functions. Primarily analyzing a particular 8 hour EVA in which problems arose due to an ammonia leak, will show how ground and crew interactions vary when unexpected situations arise. Determining the reactions of crew during unexpected situations, and how ground directed them, is important for future space missions with potential time delays in communications. As manned missions start to travel further into space to places such as Mars, communication delays between ground control and crew will arise on the order of minutes. By inspecting current EVA communications, a better definition of the roles ground control plays will be developed, which may aid in developing new technology and methods to deal with future time delays.

Poster Presentation # 063
Small Animal Model of Juvenile Osteochondritis Dissecans

Destiny Cobb
Robert Guldberg, PhD (Mechanical Engineering)

Juvenile Osteochondritis dissecans (JOCD) is a joint disorder characterized by lesions in subchondral bone and overlying cartilage whose progression leads to osteochondral loose bodies. Onset usually occurs during adolescence, especially seen among athletes. Limited knowledge of the disorder has led to there being few treatment options, limited to restricted physical activity and surgery to remove loose bodies. In order to expand treatment options we are developing a small animal model using Lewis rats. This is done surgically via the injection of monoiodoacetate, a glycolytic inhibitor, into the medial condyle of the left femur, inducing necrosis in the area just below the subchondral bone. The right leg is not operated on and serves as a contralateral control. 3 weeks after the surgery, the animals are sacrificed and the morphology and integrity of the articular cartilage of both the left and right femurs found using EPICmicroCT. This allows comparison of cartilage thickness, volume, and attenuation between the affected and unaffected leg, providing information about the efficacy of the model. In addition, human biopsy samples provided by Children's Healthcare of Atlanta are being analyzed in the same manner in order to further characterize the disorder and provide a standard by which the model can be compared. Over the course of the previous three completed pilot studies, the procedure has been troubleshooted and iteratively altered. The procedure is currently being further refined in preparation for the start of the 4th study. This model would serve as a platform for future studies testing new regenerative therapeutics and developing better treatment options for patients.

Poster Presentation # 039
Comparison of Electromagnetic Side-Channel Energy Available to the Attacker from Different Computer Systems

Angel Andres Daruna; Eric Pollmann
Alenka Zajic, PhD (Electrical and Computer Engineering)

This research project evaluates electromagnetic (EM) sidechannel energy (ESE) available to the attacker from several different computer systems. In particular, we present measured ESE for several common instructions executed on a laptop, a desktop, and an FPGA at several different frequencies. The results show that ESE measurements are repeatable across a range of frequencies, and that similar frequencies result in similar ESE. While FPGA ESE is smaller than desktop or laptop ESE, similar trends are found between all three systems. The presented results can be useful to computer designers who wish to find out which parts of the design are most susceptible to EM side-channel vulnerabilities, and to software developers who need to know which variations in program behavior are most likely to allow successful side-channel attacks, especially for behaviors that are consistently vulnerable across processor generations and across processor manufacturers.

Poster Presentation # 028
Development of a Thermostable Microneedle Patch for Influenza Vaccination

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

The goal of this study is to optimize thermostable formulations of influenza vaccine to be used and delivered with microneedle patches. Thermostable formulations of vaccine are less reliant on cold chain transport and storage and will lead to cost and energy savings. Fabrication of influenza vaccine microneedle patches involves drying of vaccine in the patches, which can alter the molecular structure of the vaccine and lead to decreased activity. Before drying, replacement of phosphate buffered saline with an ammonium acetate buffer as well as the addition of other excipients such as polysaccharides and amino acids increased stability and helped retain vaccine activity. It was also found that drying the vaccines on PDMS resulted in greater stability as opposed to drying on stainless steel, while drying in the presence of surfactants was detrimental to stability and rendered the vaccine less effective. Lastly, microneedle patches formulated with a combination of calcium heptagluconate and arginine showed no loss in stability, even after drying and storage of the patches for six months at room temperature. The best retention of vaccine activity and stability resulted from combinations of various stabilizers, and this holds true even when stored for long periods of time. By combining stabilizers in the proper amounts, it is possible to drastically increase the thermostability of vaccine delivered by microneedle patches. This will allow vaccines to retain function even after drying and exposure to a wide range of temperatures and external conditions. Effectively implementing this concept can lead to elimination of cold storage and transport while maintaining optimal vaccine activity.

Poster Presentation # 064
Fc-functionalized microparticle mediated cytotoxicity via complement activation

Matthew Devlin
Todd Sulchek, PhD (Mechanical Engineering)

Introduction: Regulating the levels of classical complement activation could lead to future applications in various diseases such as immune-deficiency diseases or cancer. Our lab has previously shown that beads coated in high densities of Fc regions of antibodies are capable of activating the complement system in a controlled fashion (1). Our hypothesis is that

activating the complement pathway with Fc functionalized polystyrene beads can be further controlled through particle concentration and then applied towards directed cell death. Preliminary research conducted on E.coli bacteria has shown a positive relationship between ratio of cells to beads and the amount of cell death. If the relationship holds true for leukemia cells, this will benefit the understanding of complement resistance to tumor cells.
Materials and Methods: Carboxylated polystyrene beads of 0.5um and 1um diameters from Bangs Laboratories (Fisher, IN) were incubated in a saturating solution of bovine serum albumin (BSA) (Sigma Aldrich, St. Louis, MO). Sheep polyclonal anti-BSA IgG antibody (Abcam, Cambridge, MA) was added in various molar ratios of antibody to antigen as done previously (2:1, 1:1, 1:5, 1:10, 1:50, and BSA-only) (1). This serves to orient the Fc domains of the bound anti-BSA IgG molecules outwards. Fluorescence was measured on all beads using a flow cytometer after incubation with a fluorescently labeled secondary antibody (1). Heat aggregated gamma globulin (HAGG) was used as a positive control for complement system activation and isopropyl alcohol or ethanol as a positive control for cell death. A cytotoxicity study was conducted using the beads, in increasing cell to bead ratios of 1:50, 1:100, and 1:200, to activate complement components in human serum and lead to complement-mediated cell death of K562 leukemia cells or E. coli under various conditions. The cells and beads will then incubate for eight hours. After the incubation, the samples were run through a flow cytometer to determine the percentage of dead cells under each condition.
Results and Discussion: The results of our ELISA test for complement system activation showed increases in particle concentration corresponded to increase in complement activation with the greatest amount of activation seen in the 0.22um beads. We also showed that E. coli death could be achieved at greater levels than our positive control for cell death and at equal levels to the HAGG complement activation positive control. However, as the particle size increases and particle concentration decreases, the amount of E. coli death also decreases. (Figure 1) This suggests that high concentrations of the smaller sized Fc beads are most effective at activating the complement system and causing complement-mediated cell death. Preliminary data has also shown that the HAGG complement activator can lead to significant death of leukemia cells.
Conclusion: If a positive relationship exists between the ratio of cells to beads and the amount of cell death induced by the beads, then this could provide foundational evidence for future studies. Future studies could be carried out on other disease models, where there is a lack of complement activation, with Fc beads which may lead to future treatments.

Poster Presentation # 065
Maximizing Direct Electrical Power Generation from Ionizing Radiation

Jefferson Dixon
Shannon Yee, PhD (Mechanical Engineering)

Radioisotope-based energy storage devices are an attractive form of energy storage due to their potential for higher energy densities and longer battery lifetimes compared to other modes of energy storage. These factors make them ideal for applications in which a self-sustaining power source is needed for a long period of time. A new class of ionization-voltaic (IV) device has been designed, in which the energy source is integrated into the device itself. In such a device, the charged particles, recoiling nuclei, and decay products may all contribute to electron-hole production. The device has been designed as a series of p-i-n, p-m-n diodes stacked to make a module with the desired power output. The intrinsic layer thickness is scaled to match the length scale of the ionizing radiation, so that there is increased electron-hole production in the depletion region, thus yielding higher absorption rates. The work outlined in this project describes the development and simulation of the aforementioned device, providing important insight into its device physics.

Oral Presentation
Information Theoretic Characterization of Indoor Wireless Channels for Physical Layer Secret Key Generation

Alan Dong
Matthieu Bloch, PhD (Electrical and Computer Engineering)

Physical layer security is slowly paving the way towards wireless communication that is secured at every layer of the network protocol stack. One physical layer technique is to exploit random noise in wireless channels to generate secret keys that can be used to encrypt messages between two legitimate users. Although many such systems have been implemented and tested using several performance metrics, none have been shown to provide information theoretic security. To do so requires a precise characterization of the statistics of the wireless channel to estimate the secret key capacity, the maximum rate at which secret keys can theoretically be produced. This study seeks to estimate this quantity for wideband wireless channels utilizing orthogonal frequency division multiplexing (OFDM) in several different indoor environments. The experiments are conducted using the Wireless Open-Access Research Platform (WARP). The data are analyzed and conclusions are drawn to inform the design of future physical layer secret key generation systems.

Poster Presentation # 066
Optimizing the thermoelectric properties of n-type poly(nickel-1,1,2,2-ethenetetrathiolate) films

Arnold Eng
Shannon Yee, PhD (Mechanical Engineering)

Nickel ethenetetrathiolate (Ni-ett) polymers have been shown to have promising properties as an n-type thermoelectric material. These polymers are produced by reacting 1,3,4,6-tetrathiapentalene-2,5-dione with an alkyl ammonium salt or alkali methoxide followed by the addition of nickel (II) chloride. Potassium nickel ethenetetrathiolate (poly[Kx(Ni-ett)]) is the best performing n-type thermoelectric material with a reported electrical conductivity of 40 Scm-1 and a Seebeck coefficient around -115 μVK-1 near room temperature. Despite these attractive thermoelectric properties, poly[Kx(Ni-ett)] has challenges for applications in a thermoelectric generator owing to its infusible and insoluble nature in common reagents such as methanol and water. One possible solution is to make a composite by combining poly[Kx(Ni-ett)] with a polymer matrix in a solvent suspension in order to open avenues for solution processing. However, this method has been shown to significantly reduce the electrical conductivity and Seebeck coefficient of the material thereby affecting its thermoelectric potential. In this work, we perform synthesis studies that involve varying the reactant concentration and oxidation time during the reaction. We also study the effects of film processing on the thermoelectric properties of poly[Kx(Ni-ett)] by testing different composite combinations i.e., by varying the solvent and film forming polymer matrix. A Van der Pauw measurement technique is used to measure the electrical conductivity and Seebeck Coefficient values for these different samples for use in a high-performance polymer thermoelectric generator.

Poster Presentation # 040
Data Manipulation to detect Network Security issues

Michael Evzonas
Emmanouil Konstantinos Antonakakis, PhD (Electrical and Computer Engineering)

In a world, where information technology and more specifically the use of internet is so extensive. Many users are enjoying the benefits and the goods of the Internet, while some had to go through all the negatives that come with it. Internet can solve and cause many problems at the same time. What I am trying to achieve here is solving some of the problems that come with the extensive Internet use. Network Security is what shields our data, systems and important information from being inappropriately used or manipulated. Here I will explain same of the techniques I used to crawl and parse data and also my overall research achievements in the field of Spam detection and more specifically in Network Security in general. Also I will try to identify how all the data gathered will be used in order to detect vulnerabilities and spam.

Poster Presentation # 041
Parallel Multiresolution Techniques for the Electromagnetic Potential Wave Equation

Christopher Fadden
Manos Tentzeris, PhD (Electrical and Computer Engineering)

The Finite Difference Time Domain (FDTD) algorithm was first published by Kane Yee in 1966. In the almost 50 years since its introduction, the algorithm has been extensively expanded, and has become one of the core techniques for numerical electromagnetics. The goal of many new codes is to be more memory efficient, and take less time, taking an FDTD to be a baseline. One more memory efficient implementation is to use wavelet and multiresolution analysis. This has been applied to FDTD over the past 20 years, but has not been applied to the wave equation. This research is based on applying those same multiresolution techniques to the wave equation, solving for vector magnetic and scalar electric potential in the Lorenz gauge. Parallel techniques taken from both FDTD and wave equation analysis will be applied, to form a computationally efficient algorithm for numerical electromagnetics.

Poster Presentation # 016
Modeling Non-Invasive High-Frequency Electrical Nerve Conduction Block

Miguel Flores
Stephen DeWeerth, PhD (Biomedical Engineering)

Various illnesses and conditions arise due to the occurrence of continuous and unnecessary nerve conduction. Ideally, the solution to the problems associated with these conditions, namely pain and undesired muscle spasms, would be a way to cease neural conduction. One novel way to approach this problem is the use of high frequency electrical stimulation to the nerve (>3kHz) (Bhadra 2007). Stimulation within an appropriate range activates various mechanisms that cause nerve conduction in targeted nerves to cease. This study seeks to test high-frequency current (10 to 25 kHz) applied to the skin of human subjects, to see if it can effectively block various modalities of touch such as heat, itch, and pressure. Previously, mathematical, computational, and animal models have been used to study this phenomenon. However, no studies have been conducted aiming to apply this stimulation non-invasively. Research in the field of high-frequency nerve conduction block can help move forward research in pain, locomotion, and may even help in the development of medical and clinical devices. This study aims to understand how high-frequency conduction block might be applied non-invasively by using a finite element modeling to see how current flow, and heat flow at the site of stimulation are affected by electrode distancing and the electrical properties of biological tissues.

Poster Presentation # 067
Fabrication and Characterization of Polydimethysiloxane nanocomposites infused with Barium Titanate fillers

Felix Fu
Kyriaki Kalaitzidou, PhD (Mechanical Engineering)

Recent advances in electronic devices have created a demand for high performance and low cost energy storage devices. The current energy storage devices with the highest power density are capacitors however they suffer from low energy storage capabilities due to the low energy density of the dielectric materials that compose them. A polymer composite is a potential candidate to possibly fit in this role. Polymers exhibit high breakdown strength and flexibility however they have the same low dielectric permittivity as the current materials. Barium titanate is a non-conductive ferroelectric ceramic that has strong dielectric behavior. This project's goal is to characterize the properties of a nanocomposite that has polydethysiloxane (PDMS) as a base matrix and Barium titanate as a filler. The samples were prepared with varying compositions as well as different sizes of Barium titanate. Mechanical properties of the nanocomposites were examined by subjecting the samples to tensile tests and frequency sweeps on a Dynamic Mechanical Analyser. The morphological characteristics were examined with a scanning electron microscope. Based on the results on the tensile test, it was found that varying the composition of the sample leads to a change in the elastic modulus. It also showed that different filler sizes also have an impact on the sample's elastic modulus.

Poster Presentation # 042
Bluetooth based Data Interface for Neural Recording and Stimulating to control a Cockroach Brain or Muscles Wirelessly via PC or Smartphone

Timothy Gassner
Maysam Ghovanloo, PhD (Electrical and Computer Engineering)

Purpose: To wirelessly power and transmit neural data using an Ultra-Low-Powered Bluetooth neural data interface. An additional set of goals to our study is to better understand neural recording and stimulating to control brain functions or muscles wirelessly via a PC or Smartphone.
Methods: We have selected the cockroach as our research subject for the reason of 1) simplicity of its neural network and 2) the ethical freedom to experiment on this organism in particular (no formal paperwork is required in order to experiment on a cockroach). We plan to directly integrate a custom made neural device within the cortex of our organism, while simultaneously receiving power via inductive coils.
Scope: The significance of our project is to hopefully pave the way for next generation neuroprosthetics – which can harness power inductively while simultaneously communicating wireless information. This potentially could alleviate the limitation of recharging or replacing a battery.
Results: Not yet conducted experiment.

Oral Presentation
Beyond Cost Tools: Spacecraft Net Present Value and the Hosted Payload Paradigm

Fan Geng; Robert Herd
Joseph Saleh, PhD (Aerospace Engineering)

This work is at the intersection of and integrates two broad considerations in the space industry, namely the emergence of the hosted payload paradigm on the one hand, and the increased emphasis for the acquisition of space systems to be value-driven on the other hand. Spacecraft, and hosted payloads, are value delivery artifacts; their value derives from the flow of service they provide to different stakeholders. Their design and acquisition should be value-centric or at a minimum value-informed.
In this work, we first provide a value model and analysis for a spacecraft, which includes its lifecycle cost as well as its revenue model. The revenue model accounts for the services provided by the primary payload and their lease price, the loading dynamics, and various provisions for its obsolescence. When integrated, these two models allow us to calculate the spacecraft Net Present Value (NPV) and its return on investment. A sensitivity analysis helps us to identify the effectiveness of the different value levers of a spacecraft.
Second, after a brief review of the hosted payload paradigm, and having developed a baseline spacecraft NPV model, we integrate considerations of the hosted payload into the value analysis, and in the process, we develop a pricing standard (and model) for hosted payloads. For the hosted payload business model to be sustainable, both main stakeholders in the transaction, the owner of the spacecraft (host) and that of the hosted payload (guest), have to see a net value in the hosting arrangement. We propose that the pricing of the hosted payload should be at a minimum DNPV neutral. This condition helps us calculate the lower bound for either an upfront payment from the guest, an annuity or rent-like payment, or a combination of both. We developed the analytics for this condition and the three payment options, and we extended it beyond the DNPV neutral baseline to include an X% incremental return on the hosted payload. We conclude with a general reflection on value considerations in space systems and a series of analytical questions raised in this work and left as a fruitful venues for future work.

Poster Presentation # 068
Optimizing in vitro behavior of heparin and polycaprolactone BMP-2 drug delivery system

Nikhil Gupte
Robert Guldberg, PhD (Mechanical Engineering)

Bone tissue is a highly dynamic system which undergoes constant remodeling. Despite its highly dynamic character, large bone defects remain challenging to heal and require autologous transplants to bridge the gap.[1] Unfortunately, such transplants are limited by donor site availability. [2] Biomolecules and growth factors such as bone morphogenetic protein (BMP-2) aid in recruiting and promoting bone forming cells. [3] Still, this treatment is inefficient due to poor drug delivery methods and understanding of dose requirements. Thus surgeons apply supraphysiological levels of growth factors to elicit bone formation. This issue inspires a biomaterials focused solution to create a delivery system which efficiently presents growth factors by maximizing drug concentration near defects to regenerate bone and minimize drug concentration outside of a desired region to avoid ectopic bone formation. Heparin reversibly binds positively charged proteins such as BMP-2 and allows sustained delivery—eliciting cell response comparable to soluble BMP-2 treatment.[4] Currently a polycaprolactone (PCL) and heparin system is being tested to prevent BMP-2 from escaping the defect region as the PCL allows for spatial localization and heparin microparticles provide a dynamic temporal control. Protein diffusion through a mesh membrane is measured using a dialysis chamber, which simulates protein crossing the biomaterial in vivo. Current methods involve loading BMP-2 onto a collagen sponge on one side of the mesh and measuring the amount of BMP-2 diffusing through to the dialysate. From this, a significant difference in the amount of BMP-2 diffusing into dialysate was measured between control and heparin covered microparticles using an ELISA. While current methods reveal less than 2% of initial BMP-2 being released, modifications that better imitate in vivo interstitial flow conditions may provide better explanations on the efficacy of the PCL-heparin conjugated system.

Poster Presentation # 069
Analyzing differences in structural gene expression between soft and stiff human embryonic stem cells sorted by a microfluidic separation device

Jeremy Gura
Todd Sulchek, PhD (Mechanical Engineering)

Understanding of the relationship between cellular stiffness and gene expression during differentiation will enable improved stem cell purification using new biophysical sorting methods. Purifying stem cells will benefit clinical environments, in which tissues need to be created using specific types of stem cells. When creating tissues from stem cells, it is imperative that only the desired cells are utilized, and that the population of cells is pure and free from unwanted cell types that typically exist in heterogeneous cell populations. My graduate mentor has recently demonstrated a microfluidic device that will allow for cells to be sorted based upon a specific stiffness of the cell type needed, allowing for purified populations of stem cells. The device separates cells into two distinct groups, "soft" and "stiff", of which the specific stiffness can be tuned to the cell type needed. The objective of this proposal is to characterize stiffness-sorted stem cells to identify structural gene expression differences of both "soft" and "stiff" embryonic stem cells (ESCs). The goal is to test whether certain genes have a higher level of expression in stiff cells, thus determining if the proteins coded for by these genes play an important role in cytoskeletal stiffness and/or pluoripotency1. Differences in cytoskeleton arrangement should lead to differences in cell stiffness, which my mentor has also shown correlates to stem cell stiffness.
We will utilize the tool polymerase chain reaction (PCR) to determine the levels of gene expression in each stiffness-sorted ESC Population. Two genes will be explored initially, the ACTN1 gene, which directs the production of α-actinin (a crosslinking microfilament protein that binds actin filaments together) 2, and the LMNA gene, which directs the production of lamin A (which structurally support the nucleus) 1, 3. After these two genes, more genes can be explored to determine their expression in both the "stiff" and the "soft" cell types. Studies have shown that the proteins desmin5, emerin5, fascin2, fimbrin6, spectrin7, synemin8, and vimentin9 all have potential to be involved in the stiffness of a cell during differentiation. The results from this research proposal could improve our knowledge of the interplay between cell mechanics and cell differentiation and we plan to publish our results in peer reviewed literature. In addition, demonstrating stem cell sorting will also improve the quality of laboratory created tissues, which would allow tissue engineering to become more feasible as a viable alternative for many patients in clinical environments.

Poster Presentation # 017
Effects of Shear Stresses on Aortic Valve Extra Cellular Matrix

Pouria Hosseini
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The aortic valve (AV) experiences a variety of mechanical stimuli that constantly renew, remodel and maintain the extracellular matrix (ECM) of the AV. AV calcification is a side-dependent disease characterized by a stiffer and more disrupted ECM on the fibrosa side, possibly due to the altered hemodynamics; however the process by which this occurs is not well understood. The effect of bidirectional oscillatory (OS: +/- 5 dyne/cm2) and unidirectional pulsatile (LS: 0-80 dyne/cm2) shear stresses on AV were investigated in this study. Tissues from five conditions were stained with Verhoeff-Van Gieson stain and analyzed (n=4): static (control), fibrosa exposed to OS (FO) or LS (FL), and ventricularis exposed to OS (VO) or LS (VL). Relative thicknesses of fibrosa, spongiosa, and ventricularis were

measured for each tissue sample in all conditions and compared with the calcified tissue data obtained from literature. The results show that the thickness of the fibrosa layer exposed to OS was significantly larger as compared to control conditions, but was similar to that of calcified tissue. Thickness of the ventricularis layer exposed to LS was maintained and was comparable to the fresh tissues. Neither LS nor OS changed the thickness of spongiosa. These results suggest that low magnitude OS significantly alters ECM on fibrosa, whereas LS preserves the ECM on ventricularis. It is speculated that low magnitude OS can cause atherosclerosis in blood vessels and calcification of the AV, one possible mechanism could be by the ECM alteration on the fibrosa side, as observed in this study. Thus, shear stress, when altered can play a significant role in the progression of side-dependent AV disease.

Poster Presentation # 043
Power management of Supercapacitor-Operated Wireless Sensor Network

Jinming Hu; Erik Fagan; Kyu Jin Lee
Qianao Ju, PhD (Electrical and Computer Engineering)

Wireless sensor networks (WSN) are comprised of embedded devices called nodes and are used for application specific analysis. Based on the application the nodes can be equipped with sensing, communication, memory storage, power source, and computational capabilities. These nodes will operate for a finite duration, only as long as the power buffer maintains a proper operating voltage. Batteries are widely used in WSN as a power buffer. Manual replacement or recharging the batteries is not an easy or desirable task, especially when the WSNs are deployed in remote areas or extreme environments. A popular solution is to enable WSNs to perform ambient energy harvesting, which will in turn, increase their lifetime and capability. Supercapacitors are well suited for energy-harvesting environments, offering improved performance characteristics for a longer life cycles and high charging and discharging efficiency. A major performance issue with supercapacitors is self discharging and internal charge redistribution, which causes extra energy dissipation. To address this drawback, this project will primarily focus on making a WSN as self-sustaining as possible by utilizing the supercapacitor, a variety of hardware components, and by programming onto the WSN.P Power efficiency is a point of emphasis in this project, and requires the minimization of leakage in the supercapacitor, finding the most power efficient circuit model, and development of a power conserving algorithm for the nodal network. Overall, the objective over the next two semesters is to improve the power management in WSNs by maximizing efficiency of the hardware, software, and incorporating supercapacitors into the current off-the-shelf sensor node platform.

Poster Presentation # 048
Synthesis of ZrO2 Coated LiMn2O4 as a Positive Cathode Material

Nicholas Kane
Meilin Liu, PhD (Materials Science and Engineering)

The objective of this study is to improve the electrochemical performance of LiMn2O4 by reducing the particle size and coating the surface with an inorganic coating. The desired physical properties of this electrode include nano-sized LMO particles with a very thin oxide coating on the surface, and the desired electrochemical properties include high cycling capacity, high rate capabilities, and relatively a high specific capacity.
The first step is to create nano-sized LMO by controlling and reducing the size of the MnCO3 precursor. The nano-sized LMO particles are then coated with ZrO2 in order to prevent manganese dissolution into the electrolyte and increase capacity retention. The LMO active material is then tape cast onto aluminum foil and assembled into cells in a glove box under argon with lithium as a counter electrode. Galvanostatic testing is run on the cells with different current densities to obtain the specific capacity and rate capabilities. Extended galvanostatic testing, totaling over 100 cycles, is run to determine the capacity retention properties of the active material. Similar studies as well as early state results suggest that LiMnO4 is a promising positive electrode material.

Poster Presentation # 070
Flexible microfluidic pump for drug delivery system

Inseung Kang; Monica Choudhury; Sung Wook Lee
Todd Sulchek, PhD (Mechanical Engineering)

Recently there has been an increasing interest in the research and development of a micro-pump, considering it as a key functional component in microfluidic systems. The micro-pump is a specific device that can provide driving forces to control fluid movement in the system, which then enables functions such as mixing, reacting, injecting and separating. Due to high demand from biomedical applications such as genomics and drug delivery, a large number of reports on the design and fabrication of micro-pump has been issued over the past decades.
In this study, a new approach to the design and fabrication of a micro-pump and its associated mechanism and material will be presented. This micro-pump is fabricated with polydimethylsiloxane (PDMS), because of its merits in transparency, biocompatibility and a low production cost. A novel actuation method is employed to this micro-pump; this pump will be activated solely via bending or compression forces, exerted by the motion of a human body such as bending of an arm or a knee. In this way, the pump does not require an external power source or additional electric input power to run continuously. The study also tries to focus on the device's wide range of biomedical applications such as a drug delivery patch and non-invasive implantation. In order to excel integration limitation

of the current micro-pump, it will be designed as a cheap, self-powered, non-invasive, and simple device that can be easily accessible to each individual whoever needs it.

Poster Presentation # 053
Computational NanoBio Technology Molecular Modeling of Dental Resins

Jacob Kim
Seung Soon Jang, PhD (Materials Science and Engineering)

Improvements in dental composite materials, particularly in resin-based filling composite, have modernized the field of dentistry. Dental resin composites, which are tooth-colored materials used as adhesives or restorative materials, have replaced a mercury in dental amalgam filling due to aesthetic appeal. Most dental resin composites are composed of bisphenol-A-glycidyl-dimethacrylate (BisGMA) and triethyleneglycol-dimethacrylate (TEGDMA). Although these are beneficial advances, there are still limitations on the use of composites in dental restoration. Accordingly, our research team has put an increasing effort on researching the mechanical properties of dental composites resins.
The molecular dynamics simulation showed that the density of resin composite agreed with other research literatures and our expectation. As shown in deformation simulation, the internal pressure and stress increased in order to overcome the applied external force. As a result, the volume of resin composite decreased and this decrease resulted the increase in the density.

Poster Presentation # 049
Molecular Dynamics Simulation of Temperature-Dependent Structural Properties of Mixed-Dispersed and Mixed-Island Model of Dipalmitoyl Phosphatidyl Choline and Lysolipid

Young Kyoung Kim
Seung Soon Jang, PhD (Materials Science and Engineering)

Liposomes, a spherical nanoparticles composed of phospholipid bilayers, has been suggested as a drug delivery system for potent chemotherapeutics. As the lipid structure transitions from gel to liquid- crystalline the structure reaches its maximum permeability, which then the encapsulated drugs can be released. As this phase transition occurs with changes in temperature, it has been suggested to incorporate lysolipid as part of the phospholipid bilayer systems to control this transition temperature. This study runs fully atomistic molecular dynamics (MD) simulations with flat liposome mixed-dispersed and mixed-island model. Mixed-dispersed model has lysolipid evenly distributed across the structure; Mixed-island model has lysolipid aggregated in the middle of the structure. The system is comprised of 10 percent lysolipid and 90 percent Dipalmitoyl Phosphatidyl Choline (DPPC). MonoPalmitoyl Phoshatidyl Choline (MPPC) is used as lysolipid. The changes in structure through the phase transition are investigated.

Oral Presentation
Seamlessly Integrated Design and Analysis tools for Nano-filler Composites

Vikram Krishnaswamy; Won Sup Song; Izaak Lakhia Raghuram Pucha, PhD (Mechanical Engineering)

Computational modeling techniques for determining the mechanical properties of nanocomposites have proven to be very effective through parametric studies to facilitate the design and development of nanocomposites. Design and analysis models with quick what-if analysis are needed to quantify the effects of various process parameters on the desired properties of composites with various nanofillers.
This research focuses on generating and using Representative Volume Elements (RVEs) to simulate mechanical and electrical properties of various composite systems. Fillers, such as carbon nanotubes, silicon carbide nanoparticles, exfoliated graphite nano-platelets, soft tissue, composite fibers and syntactic foams are automatically generated and a 3D network of fillers within RVE are arrived using seamless integration of analytical tools (MATLAB), 3D solid modeling (INVENTOR) and Finite Element Analysis (ANSYS). The 3D network of fillers within RVE is controlled using a uniform grid, close packing algorithm, random distribution or by various probability distribution functions that control filler parameters like diameter, length, etc. These parameters are quantified using image analysis or through analysis of experimental composites from the literature. The primary objective of this research is to seamlessly generate 3D RVE models with filler geometries and viable FEA models of various composite systems based on user input that replicate and predict properties of experimental composites. User interface tools are being developed for user input in terms of material system of interest, geometric and process parameters, and interphase characteristics.
The presentation focuses on various algorithm developments for RVE models and their seamless integration. A case study of conductive percolation and electrical conductivity analysis using Resistor Capacitor method for CNT-based composites will be presented with developed RVE models. Ongoing work on GUI tools for RVE models will be briefly discussed.

Poster Presentation # 044
Binary Translation using Modified Superoptimizers

Michael Kuchnik
Linda Wills, PhD (Electrical and Computer Engineering)

Binary translation is the process of converting programs written for one Instruction Set Architecture (ISA) into equivalent performing programs running on a different ISA. The ability to perform translation is useful in situations which require an

executable to be run on a device with an ISA differing from the intended. Translation is a difficult problem because it involves interpreting the semantics of the original ISA and then encoding the semantics into the target ISA in the most efficient way possible. As the properties of the ISA differ, the translations become more abstract.
The proposed translator would target MIPS to ARM ISA translation. Some challenges include differences in instruction type, register count, and operational paradigm of the ISA. Algorithms can be implemented using different instructions while still retaining semantic equivalence in that specific context, and performance gains are found when the hardware is utilized in the way it was designed to be. Previous work such as Bansal and Aiken's Peephole Superoptimizer lay a foundation for the usefulness of discovering semantic equivalence between ISAs via combinatorial search.
The rules behind choosing the optimal set of instructions depends on the particular combination of input instructions, and for this reason, the chosen approach utilizes some of the standard superoptimizer techniques with modifications. An intermediate algebraic language was used to compress the solution space into a more manageable size. Combinatorial optimization was implemented on top of this intermediate language to discover peepholes in the ISAs using standard AI search techniques. Unlike previous techniques which focused on solving translations using all available instruction types, this approach allowed for simplifications by solving the ISA in layers of independent translators.

Poster Presentation # 011
Control of Centrifugal Instability in Vortex-Surface Interaction using Plasma Flow Actuators

Vaibhav Kumar
Narayanan Komerath, PhD (Aerospace Engineering)

The interaction of a rotating conical flow with a solid surface generates a centrifugal instability. This may be at the root of many vortex instabilities. Efforts at our laboratory have detected such structures using near-surface flow diagnostics, and shown that they can be effectively alleviated using passive flow control near the surface. However, passive flow devices negatively affect the reaction forces on the surface, especially when the vortex instability is absent. The purpose of this research is to explore the substitution of active flow control techniques based on plasma flow actuators that remain conformal to the surface and are only powered during conditions characterized by presence of vortex instabilities, such as a delta wing at a high angle of attack. The technique explored in this research involves the creation of counter-rotating vortices using empirically determined geometrical configuration of plasma flow actuators to suppress the vortex instability.
Plasma flow actuators are a type of actuator currently being developed for aerodynamic flow control. The working of these actuators is based on the formation of a low-temperature plasma between a pair of asymmetric electrodes by application of high voltage AC signal across the electrodes. The plasma exerts an induced body force on the air molecules which results in a Coanda effect. By altering the excitation frequency, input voltage and geometry of electrodes, this Coanda effect can be used to create wall jets, vortex sheets and boundary layer perturbations. In this research, multiple configurations of the actuators are analyzed using empirical means and, consequently, a suitable configuration of actuators is chosen which result in counter-rotating vortices that affectively suppress the instability discussed above.

Poster Presentation # 050
The Effect of Halogenation Group on Amyloid-Beta 40 Oligomer Aggregation in Alzheimer's Disease Using molecular modeling approach

Woo Yaa Lee; Sunju Kang; Joy Kim; Hanbyeol Jin; Hyeonjin Kwon
Seung Soon Jang, PhD (Materials Science and Engineering)

Alzheimer disease is the one of the most common form of degenerative dementia. There is no cure for the disease and current treatments only help with the symptoms of the disease. As a main cause of the disease, the formation of neurotoxic plaque composed of 39 to 42 residue-long amyloid beta (Aβ) fibril has been found in the patient's brain with relatively high portion. Through a series of investigation about the mechanism of beta amyloid aggregation, it was found that initial Aβ monomer undergoes intermediate state for aggregation so-called aggregation-prone state (APS) which is partially folded. Erythrosine B (ER) is one of the prominent drug candidates to impede the aggregation of the Aβ peptides. ER is a common xanthene dye approved not having any toxicity to humans under daily dose of 60 mg/kg and generates fragmented Aβ fibrils and protofibrils. As a collaboration work, the effect of ER on the Amyloid beta monomer has been suggested as an inhibitor of fibril elongation through in vitro experiment. Recently, it was reported that halogenation of aromatic molecules greatly affects aromatic interaction-mediated self-assembly processes. Aromatic interaction plays a role of critical contributor to form amyloid fibrillar structure. Modulation of Aβ aggregation using small molecule is one of prospective to reduce the toxicity related to Aβ aggregation. In this study, molecular modeling methods such as docking and molecular dynamics (MD) simulation will be provided to investigate the specific effect of halogenated ER on Aβ40 monomer by replacing the functional group of ER with halogens.

Poster Presentation # 071
The Fluid Mechanics of Wave Drag near the Surface

Richard Lehner; Jishen Cheng
David Hu, PhD (Mechanical Engineering)

Flying fish are well known for leaping far out of the water. Most of their movement is near the water's surface, suggesting that fluid mechanics in shallow water heavily influence their locomotion. By building a device that rotates a 3D printed fin using a motor, we investigated the interaction between the fin and the water's surface, and we measured these changes using an encoder on the motor. By varying the depth parameter in the water, we observed that the torque changed with water depth. As the fin gets closer to the water's surface, the torque is increased, implying that the drag is also increased. Flying fish utilize increased drag as extra purposive force when leaping out of water. This study furthers our understanding of biolocomotion near the water's surface and could improve the design of aquatic vehicles.

Poster Presentation # 072
Thrust generation of thickness-varying flexible fins

Yuanda Li
Alexander Alexeev, PhD (Mechanical Engineering)

We use three dimensional computer simulations to probe the hydrodynamics and thrust generation of an oscillating flexible fin with varying thickness. The fin is modeled as an elastic rectangular plate that plunges at its leading edge and is submerged in a viscous fluid. Since we assume that the thickest part of the fin is very small compared to its length and width, the plate is modeled as infinitely thin. We introduce an appropriate mass gradient and stiffness gradient in the plate to simulate the effects of the thickness gradient. As the fin flaps, fluid is displaced backwards and a net thrust is generated. We characterize this thrust generation as a function of driving frequency and find optimal conditions for largest propulsion. These findings are useful for designing biomimetic underwater propulsion devices.

Poster Presentation # 012
Divergence Speed Prediction for Slung Load Shapes

Brandon Liberi; Kijjakarn Praditukrit; Victor Heaulme; Yuanxin Shen
Narayanan Komerath, PhD (Aerospace Engineering)

Given the innumerable combinations of flight vehicles, loads and flight conditions, alternatives are sought to flight testing, to certify the safe flight speed with slung loads. With well-resolved airload maps now feasible for arbitrary shapes as analytical functions, dynamic simulation predicts divergence speeds, regardless of the symmetry of the object. To close the loop, wind tunnel experiments with free-swinging objects are used. The process of trying to match these experiments to the simulation is described.

Poster Presentation # 045
A Wireless and Wearable Health Monitoring System

Ziran Ling
Maysam Ghovanloo, PhD (Electrical and Computer Engineering)

Automated home health monitoring has become an area of increasing interest given the rising elderly population. As the population continues to age, the number of individuals living with chronic medical conditions will also continue to increase. Wearable health monitoring devices are among proposed methods of continually collecting health related data from their wearer in order to avoid complications due to undetected illness. Such a device would gather data from a multitude of strategically placed sensors and use the combined data to provide a description of the overall health of its wearer.
To this end, the GT Bionics lab has begun development of a Wireless and Wearable Event Detection and Adherence Monitoring System (WEAMS), which is to be worn around the neck. An initial prototype capable of monitoring sounds, relative angle, acceleration, and temperature at the neck area has already been developed. This data can be used to make predictions of the physical activities performed by the user like walking and the time durance for each activity.
So far, the first phase of data collection from healthy human subjects has been conducted. My primary contribution in this project is helping in processing the signals achieved from WEAMS. I have started with annotating different physical activities to make them ready to be fed to our action classifier. The classifier uses the trends in the data, such as period, shape, and peak values from different sensors as differentiating features. Ultimately, we plan to automatically classify various physical activities to come up with a daily log for each individual.

Oral Presentation
The vapor sensitivity of Morpho butterfly wing scales

Chunzi Liu
Mohan Srinivasarao, PhD (Materials Science and Engineering)

The iridescent blue color on Morpho butterfly wing scales results from the additive effect of interference and diffraction. The reflectance spectrum alters upon exposure to different vapors. It is proposed that the polarity gradient along the vertical ridges is responsible for the vapor sensitivity. However, it has been showed that the wing scales still possess the vapor sensitivity after oxygen treatment. Our group proposes that the wing scale is sensitive to vapors with different refractive indices.

We showed that the retardation of the wing scale changes when it is immersed in different medium. Possible applications of this vapor sensitivity are vapor detectors, security tags, gas separators, protective clothing, and sensors.

Poster Presentation # 073
Ordering of Nanoparticles on Wavy Substrate

Camila Luppi Sato
Alexander Alexeev, PhD (Mechanical Engineering)

Wrinkle-assisted assembly is a new technique to create ordered structures of nanoparticles on hydrophilic substrates. As an intermediate step in this process, nanoparticles are deposited within microscopically wrinkled surfaces, where they organize into patterned structures. However, the dependence of the resulting pattern on the nanoparticle concentration is not well understood. In our work, we use three dimensional computer simulations to investigate the ordering of nanoparticles confined within a wrinkled substrate. The wrinkled substrate is modeled as a periodic sinusoidal wavy sheet. In our simulations we systematically vary the nanoparticle concentration and wave dimensions to determine the resulting confinement pattern. We find that specific values of particle concentration lead to highly ordered structures. Our results will help predict the ordered structures that form as a function of particle size in order to more efficiently design anisotropic patterned surfaces.

Oral Presentation
Relationship between bicuspid aortic valve morphology and its hemodynamic characteristics

Daniel Mangiameli
Ajit Yoganathan, PhD (Biomedical Engineering)

Background: Bicuspid aortic valve (BAV) is the most common congenital heart defect affecting approximately 1-2% of the population. The aortic valve prevents regurgitation of blood flow from the aorta back into the left ventricle. BAV patients exhibit bileaflet morphology as compared to a healthy trileaflet aortic valve. Common secondary pathologies such as aortic stenosis, regurgitation, and aortic root dilatation have been linked to BAV and may eventually lead to serious complications such as aortic aneurisms and heart failure. There have been previous magnetic resonance imaging (MRI) based studies used to characterize the hemodynamics in BAV. However, previous studies have been impeded by lengthy data analysis protocols limiting their effectiveness and reproducibility.
Methods: This work further develops and applies a novel semi-automated technique developed during a pilot study to characterize geometry and hemodynamics of the aorta and the aortic valve based on 2D bSSFP cine and 4D flow MRI data. The protocol includes the aortic valve region of interest determination, anatomy and velocity segmentation of 4D flow MRI data, and spatial registration of 2D and 4D data. The protocol was applied to a cohort of 25 BAV and 20 control subjects. Table 1 summarizes the preliminary analysis of a subset of the cohort (25 BAV and 20 TAV), analyzed at cross sectional planes alone the centerline. Statistical differences between the groups were identified and linear regression models were developed to demonstrate the potential of this protocol to investigate the risk of disease progression.
Results: Various geometric metrics (Table 1) were found to be significantly larger in the BAV subjects than in the control group (preliminary results are summarized in the table). Figure 1 illustrates a summary of the results from the subset of the complete cohort. The average velocity in BAV cases is elevated compared to TAV cases. It was seen that BAV right coronary-non-coronary (RN) subjects tend to have higher orifice eccentricity. BAV right-left coronary (RL) subjects presented with higher jet angle than RN subjects. In addition, RL and RN subjects have higher jet angles in the proximal ascending aorta as compared to TAV subjects.
Conclusion: This study demonstrates a novel semi automatic protocol to analyze 2D cine and 4D flow MRI data acquisitions in order to study hemodynamics relating to BAV. Analysis of 25 BAV and 20 TAV patients revealed an elevated mean velocity, jet angle and forward flow displacement in BAV subjects in the proximal ascending aorta. In addition, differences can be seen between the varying leaflet fusions of the aortic valve. The results from the complete cohort will provide an assessment of correlations between geometry and hemodynamics associated with BAV disease.
Funding Source: NHLBI grant R01HL115828 and K25HL119608. PURA for Elizabeth Coco

Poster Presentation # 074
Determining the phenotypic stability & ex vivo expansion of human chondrocytes on decellularized cartilage microcarriers

Elizabeth Marr
Robert Guldberg, PhD (Mechanical Engineering)

Osteoarthritis (OA) is the most common form of arthritis, and the CDC predicts that OA currently affects 13.9% of U.S. adults aged 25-65 and 33.6% of U.S. adults over 65 [1]. Though multiple surgical treatment options exist, many do not promote cartilage regeneration and are ineffective in the long-run, often leading to complete joint arthroplasty (total knee or hip replacements). These invasive surgeries have long recovery periods and residual weakness is often detected even years after the initial operation [2].
One of the few therapies aimed at regenerating cartilage is autologous chondrocyte implantation (ACI), in which a patient's own cartilage cells are expanded ex vivo, then injected into the defect in the joint [3]. The success of this procedure depends heavily on the expansion of chondrocytes, but is currently hindered by their slow proliferation and loss of phenotype during ex vivo culture. Microcarrier culture has been shown to improve

chondrocyte expansion when compared to 2D monolayer culture [4], but most microcarriers are created for expansion of multiple cell types and thus chondrocytes still de-differentiate over time.
Conversely, the cartilage extracellular matrix (ECM) contains multiple bioactive factors important for chondrogenesis. While cartilage ECM alone has been shown to support chondrocyte phenotype and chondrogenic differentiation, pre-clinical studies indicate that in vivo implantation of cartilage ECM alone does not result in integrative cartilage repair due to limited host cell infiltration [5,6]. Therefore, cartilage ECM microcarriers may be an effective means to culture and deliver chondrocytes to improve ACI therapy for cartilage repair. The hypothesis of this proposal is that chondrocytes cultured and expanded ex vivo on a more physiologically relevant microenvironment, such as microcarriers derived from cartilage ECM, will yield a more consistent chondrogenic phenotype when compared to both 2D monolayer expansion and expansion on commercially available microcarriers.

Poster Presentation # 018
Investigation of shear- and side-specific miRNAs in Aortic Valve Disease

Elsa Mathew
Ajit Yoganathan, PhD (Biomedical Engineering)

The aortic valve (AV) experiences a dynamic mechanical environment, and preliminary studies demonstrated that when the shear stresses are altered, inflammation and calcification could preferentially occur on the fibrosa (the side facing the aorta) of the valve. The effect of shear stress on the ventricularis, or the side facing the left ventricle, is significantly less than on the fibrosa, and the molecular mechanism(s), particularly the expression pattern of miRNAs (small nucleotide RNAs) behind this process are widely unknown. Side-dependent AV disease is hypothesized to occur due to low magnitude shear stresses on the fibrosa, which prompts different miRNA expressions in comparison to the ventricularis. The miRNAs-181a, 181b, 214, and 199a-5p are strongly related to inflammation and calcification in conditions such as chronic kidney disease, ischemia, etc., and were chosen in this study because of their relevance to AV calcification. To investigate shear and side specific dependency of the miRNAs in AV, freshly isolated porcine AV leaflets (n=9) were cultured ex vivo in a bioreactor for 48 hours. Bidirectional oscillatory (OS: +/- 5dyne/cm2) and unidirectional pulsatile (LS: +/- 80dyn/cm2) shear stresses were used. Four conditions were investigated: fibrosa exposed to OS (FO), LS (FL), ventricularis exposed to OS (VO), and LS (VL). MiRNAs-181a and 214 exhibited side-specificity (FO vs VL) and shear-dependency (FO vs FL) but miRNAs-181b and 199a-5p did not. Thus, miRNAs 181a and 214 are preferentially upregulated on the fibrosa side of AV and could play an important role in calcific AV disease.

Poster Presentation # 019
Type I vs. Type II Cytokine Levels in SOD1 G93A Mouse Model Amyotrophic Lateral Sclerosis (ALS) Disease Progression

Eric McKissick; Benjamin Mertens; Amilia Jeyachandran
Cassie Mitchell, PhD (Biomedical Engineering)

Background: Amyotrophic Lateral Sclerosis (ALS) is a fatal neurodegenerative disease that is characterized by the degradation of neurons throughout the central nervous system. Uncontrolled amounts of inflammation occur that is a main contributor of neurodegeneration. The goal of this study is to define the correlation between the varying levels of pro-inflammatory type I cytokines (IL-1β, IL-1α, IL-12, TNF-α, and GFAP) and anti-inflammatory type II cytokines (IL-4, IL-6, IL-10) throughout the progression of ALS in the G93A SOD1 mouse model.
Methods: Cytokine level data of high copy number SOD1 G93A transgenic mouse was collected from 66 peer-reviewed studies. For each corresponding timepoint over the course of the disease, the ratio of transgenic to wild type (TG/WT) cytokine was calculated to normalize the data. Each ratio was weighted according to the sample size. One way ANOVA and t-tests were used to analyze the data.
Results: A significant increase in TG cytokine levels was found when compared to WT cytokine levels across the entire SOD1 G93A lifespan for majority of the cytokines. The rates of change of the individual cytokines, and type I and type II were not significantly different; however, the mean fold change of type I was expressed at significantly higher levels than type II levels across all stages with the difference between the means becoming more pronounced at the end stage.
Conclusions: An overexpression of cytokines occurred not only after ALS onset, but also before. The trend between pro-inflammatory type I and type II cytokine means indicate the progressive instability of the dynamic balance between pro- and anti-inflammatory cytokines as anti-inflammatory cytokines fail to mediate the pronounced increase in pro-inflammatory cytokines. After onset, the immune system appears to balance the rates of change of the cytokines as the disease progresses.

Poster Presentation # 013
Extracting Static Pressure from Velocimetry in Vortical Flows

Jackson Merkl
Narayanan Komerath, PhD (Aerospace Engineering)

The problem of extracting static pressure fields on and away from flow boundaries in complex flows is an ongoing challenge for modern research in aerodynamics. The velocity field around an object can be found using (Stereo Particle Image Velocimetry) which uses high speed cameras and lasers in the wind tunnel to take pictures of the seeded flow at rapid intervals, allowing

the instantaneous velocity field to be found. Using this method to obtain the velocity field, a corresponding pressure field that assumes a steady flow with no friction can be obtained by using Bernoulli's equation to relate the velocity and pressure. This pressure field is then used to initialize a custom pressure solver using the Navier-Stokes equations which will recursively modify the pressure field to include viscous effects through spatial integration paths, and to include unsteady effects using time differencing schemes. From this solver the viscous and unsteady distributions of pressures are found and converted into dimensionless coefficients of pressure, yielding distributions capable of conveying complex turbulent structures to a high degree of accuracy while being entirely un-intrusive. As a point of validation for this research, this method is applied to the bottom surface near the sharp trailing edge of a rotating rotor blade in the reverse flow domain encountered at high advance ratio in a wind tunnel. The pressure field successfully explains some of the complex features that could not otherwise be explained or accurately identified.

Oral Presentation
Pan-Cancer Analysis for Studying Cancer Stage using Protein Expression Data

Sameer Mishra
May Wang, PhD (Biomedical Engineering)

Pan-cancer research examines the similarities and differences among different cancer types in order to better understand fundamental factors in cancer biology. This study investigates changes in protein expression between early and advanced stage cancer patients across nine cancer types, including breast invasive carcinoma (BRCA) and head and neck squamous cell carcinoma (HNSC), to identify proteins that may be relevant to cancer progression. The predictive capabilities of selected proteins were evaluated by developing classification models.
Protein expression and patient clinical data were obtained from The Cancer Proteome Atlas and The Cancer Genome Atlas, respectively. Protein features were selected through differential expression (DE) analysis and the mRMR method. DE proteins were identified through the two-tailed t-test and Wilcoxon rank-sum test, each with Bonferroni correction. Protein predictive capabilities were tested by performing K-nearest neighbor (KNN) classification, and evaluated using the Matthews Correlation Coefficient (MCC).
Pan-cancer DE analysis revealed several relevant proteins that were not found in the analyses of the individual cancer types. For example, Akt and mTOR are two proteins that have been implicated in BRCA and HNSC. Both of these proteins were found through pan-cancer analysis, but were not found in cancer-specific analyses of either BRCA or HNSC. Current predictive model performance suggests that using all protein expression information yields higher MCC results than only pan-cancer or mRMR-selected proteins. Testing other classification and feature selection methods may further improve prediction performance. This study demonstrates the potential of pan-cancer analysis in identifying proteins relevant to cancer progression.

Poster Presentation # 029
Increasing absorbency and stability of hydrogel and porous microneedle patches used to sample interstitial fluid

Katherine Neuberger
Mark Prausnitz, PhD (Chemical and Biomolecular Engineering)

During the past year and a half I have worked in the Prausnitz Drug Delivery Lab working on hydrogel and porous microneedle patches to sample interstitial fluid from the skin for detection of biomarkers and point of care diagnostics. The microneedles puncture the skin and act as conduits to draw out dermal interstitial fluid. I have worked on a number of different patch microneedle designs to determine the most absorbent system that can also hold mechanical integrity. Initially, I worked on porous microneedle patches made with PLGA and NaCl particles. These patches absorbed liquid quickly but did not maintain a solid structure. Thereafter, I started working on hydrogel patches with a polyacrylamide base. These microneedle patches demonstrated a high degree of swelling; however, these needles deformed during the casting process and did not maintain the structure upon drying. To give strength and bulk to the microneedles I added a varying concentrations of PVA, but this unfortunately decreased the absorbency of the microneedles drastically. I tweaked the fabrication process to make porous hydrogel patches. This was gone by frothing the casting solutions. These microneedles have high swelling and absorbency because of a combination of hydrogel an porous structures, but they also maintain mechanical integrity upon swelling. I have used this technique to make PVA as well as PVA+CMC microneedle patches.

Poster Presentation # 075
Effects of High Aspect Ratio Minerals on Physical Properties of Glass-Filled Nylon Composites

Phoenix Nguyen; Richard Flowers
Kyriaki Kalaitzidou, PhD (Mechanical Engineering)

The objective of this research is to investigate the mechanical properties of polymer composite made of glass fiber reinforced nylon as a function of the type and amount of different inorganic nanomaterials. Nylon is commonly used in extrusion and injection molding manufacturing processes. Its applications can vary in a wide spectrum of both industrial and commercial sectors. IMERYS, the company sponsor of this research, is a leading supplier of industrials minerals and fillers. Improving the desired properties of the glass-filled nylon composites with minerals would open new possibilities for their applications. Samples of different material compositions were produced and tested to examine changes in mechanical properties. This

research focuses on understanding the effect of nanomaterial type and content on the tensile and flexural properties and heat distortion temperature of the composite. Composite containing zero to 20 wt% glass fibers and zero to 15 wt% of each of the three types of nanomaterial were fabricated. The three types of nanomaterials are mica, talc, and kaolin. The equipment used to fabricate the samples are the Xplore 15 cc Twin Screw Compounder and the Xplore 10 cc Injection Moulding Machine. The melt mixing temperature is 190°C, the screw speed is 100 rpm, and the mixing time is 3 minutes. The molding conditions were at 108.79 psi for pressure and 190°C for temperature of the mold. It is expected that the addition of nanomaterial will enhance the composite properties and allow for weight reduction.

Poster Presentation # 030
Protracted Colored Noise Dynamics Applied to Simulations of Block Copolymers

Daniel Nicoloso
Clifford Henderson, PhD (Chemical and Biomolecular Engineering)

Mean field models and Monte Carlo simulations have been used to study polymeric systems in recent years. While these methods provide great computational expedience, they include less accurate potentials and require intelligently selected modes of motion, which can adversely affect outcomes. Conversely, molecular dynamics (which uses Newton's second law to calculate molecular movements) combined with realistic potentials provide more accurate movements and states, though computational efficiency is sacrificed. Using coarse graining and parallel computing greatly increases the time and length scales that can be accessed in MD simulations of polymeric systems, but some systems, especially systems with large energy barriers or with long chains, still require unrealistic simulation times. One example of such a system is a lamellar forming BCP with a defect. Although the defect density is very small at equilibrium, the activation energy can be large, causing a drastic increase in computation time. The purpose of this study is to apply protracted colored noise dynamics (PCND) to such systems with the goal of decreasing the simulation time required to reach equilibrium. PCND is a technique that applies time correlated stochastic forces in MD simulations. In linear polymer systems these forces can be made to act along the backbone of the chain. These forces broaden the energy distribution of the system, increasing the diffusivity of the molecules, and allowing energy barriers to be passed over more easily. Of course, the distribution of these forces must be carefully chosen so that the equilibrium state is not excessively perturbed. In this study, PCND was applied to BCP simulations from two initial states: mixed state, and defective lamellar state. The results of the mixed state simulations were used to fine tune PCND parameters to avoid excessive perturbation of system behavior. The defective state simulations were used to determine how much PCND would reduce computational time. The results have been promising, showing an order of magnitude reduction in computational time required to reach equilibrium for defective state simulations.

Poster Presentation # 031
Asymmetric Flat Sheet Membranes for Hollow Fiber Screening

Michael Orman
William Koros, PhD (Chemical and Biomolecular Engineering)

Separation of gaseous mixtures using membrane technology offers new avenues for energy savings and process simplification. Major reductions in capital investment and operating costs are also advantages of using the membrane platform. Membrane based separation has little environmental impact, and eliminates a need for extensive waste handling and disposal. Hollow fiber membranes with a molecularly selective thin dense layer are preferred for industrial applications. This morphology is referred to as "asymmetric" due to a dense skin layer with a supporting porous layer. Fabrication of hollow fiber membranes is accomplished in a process called "hollow fiber spinning." Complex solution formulations containing polymer, solvent and nonsolvents referred to as "dopes" are the mixtures from which hollow fiber membranes are spun. Optimization of these dopes are enabled by flat sheet membranes, which allow rapid screening of performance. More specifically, the permeability of the membrane and selectivity for component gases is characterized in such screening studies. The goal of my research is to perform gas permeation experiments to guide this screening process.

Poster Presentation # 046
Vital Sign Tracking from PPG Signal under Challenging Conditions

Huijie Pan; Chuyao Feng; Ke Tang
Ghassan Al-Regib, PhD (Electrical and Computer Engineering)

Heart rate monitoring can provide useful information for exercisers who want to adjust their exercise load accordingly. Ever since their emergence, wearable devices have become more and more popular for heart rate monitoring. Most of these wearable devices use Photoplethysmogram (PPG) signal sampled on a subject's ear, fingertip or wrist to track the subject's heart rate. Unlike electrocardiography (ECG) signal, which is not interfered much even in the presence of a subject's intensive motions, PPG signal is easily contaminated by motion artifacts, interference caused by a subject's motion. Thus, to track a subject's heart rate by analyzing the sampled PPG signal, methods have to be thought of to circumvent the contamination. In this project, we built our own PPG device and developed an algorithm that was able to track a subject's heart rate out of PPG signal with motion artifacts. A wearable earpiece was

selected as the device packaging design, which can be worn on the ear to stabilize the device. Refer to Fig. 1 for a prototype of our device. The device can emit red LED light and measure the changes in reflected red light due to fluctuation in blood volume and oxyhemoglobin levels subsequent to each heartbeat using photodiodes. The device amplifies the detected signal and generates voltage as its output, which will then be converted to digital signal for software analysis by ADC's. The device also contains an accelerator that can provide data relevant to the subject's motion. An ECG device will be used simultaneously on the subject. Since ECG is barely affected by motion artifacts, it can be used to obtain the ground truth of heart rates. The software analysis of PPG signal (the algorithm) contains three major steps: initial denoise, spectrum estimation, and heuristic picking of peaks that correspond to heart rate values in the spectra of PPG signal. Initial denoise techniques used include band-pass filtering and elimination of motion-related signal based on accelerator data. Different spectrum estimation methods such as periodogram will be tested for their respective robustness. The heuristic picking of peaks is based on observations of the relationships between the heart rate and the positions of the three most significant peaks in the spectra of the sampled PPG signal. The analysis results, the tracked heart rate, is expected to possess a high correlation with and a low mean absolute error with respect to the one tracked from simultaneously sampled ECG signal.

Oral Presentation
Mimicking in vivo Pharmacokinetics Improves in vitro Drug Screening Reliability in Metastatic Breast Cancer Cells

Krishan Patel
Michelle Dawson, PhD (Chemical and Biomolecular Engineering)

Despite major scientific advances, metastatic breast cancer has a 5 year survival rate of only 22%. While there are a large number of drugs available for treatment, their side effects are often quite severe, especially if the drugs are combined. Developing new strategies to eradicate these dangerous cancer cells is slowing down despite huge gains in knowledge of cancer biology. A problem arises when comparing the results of these in vitro studies with what occurs in vivo, for the results are significantly different. Having a more effective drug screening procedure to best mimic in vivo conditions may help to alleviate some of these discrepancies. The primary methods of in vitro testing of cancer drugs involve exposing different cancer cell lines to drugs for 48-72 hours and quantifying the resulting cell viability to determine factors like the IC50, the concentration that reduces viability by 50%. In vivo efficacy is typically affected by the dynamics of blood flow and composition that cannot be recapitulated in vitro. Moreover, drugs injected in vivo typically remain in circulation for less than 24 hours, far less than the typical testing time. Protocols for in vitro studies are not standardized, resulting in lab to lab variability. While methods of quantifying cell response to therapy have been extensively studied, there has been no systematic study on the effects of drug exposure time. In this study, we quantify the temporal effects of drug sensitivity by exposing tumor cells to differing concentrations of drugs and subsequently measuring the viability of the cells after different incubation time periods. These studies showed that DNA targeting drugs, like Carboplatin, exhibit a much longer latency period compared to cytoskeletal targeting drugs, like Vinblastine and Taxol. This may be in part to differences in the mechanism of action, since Carboplatin destabilizes the DNA molecule directly, creating crosslinks between different base pairs, while Vinblastine and Taxol aim to affect tubulin binding. These studies may improve drug screening methods, allow for better consistency among laboratories, and shed light on additional information about the mechanism of drug action.

Poster Presentation # 076
Quantification of N-Acyl Homoserine Lactone produced in bacteria within a microfluidic environment

Sagar Patel
Craig Forest, PhD (Mechanical Engineering)

Many species of bacteria use quorum sensing to coordinate gene expression and behaviors such as biofilm formation, virulence, and antibiotic resistance based on population density. This process of communication allows one population of bacteria to transmit a signaling molecule (N-acyl Homoserine lactone - AHL) to another receiving population and affect gene regulation in that population. In order to better understand and model two different transmitting populations of bacteria we need to be able to reliably quantify the amount of AHL being produced by those populations. This will allow for an accurate model to be developed to predict the AHL production.
Two different populations will be tested in the microfluidic device. The first population is an IPTG induced transmitting population that continuously produces a small quantity of AHL prior to induction. However, when induced by IPTG, it yields large quantitates of AHL. The second population is an Arabinose induced transmitting population of E. coli, which only produces AHL when induced by arabinose. In addition to housing the transmitting bacteria, the microfluidic device we also house a receiver population. During the experiment, the transmitter produced AHL flows through the chip to the receiving population of bacteria, which produces GFP (green fluorescent protein). Fluorescent imaging is used to monitor and measure the amount of GFP the receiving strain of E. coli produced over a given period of time. To better understand the transmitter, we will grow them alone in the device and collect the AHL being produced and extracted using ethyl acetate and a rotary evaporator. This method quantifies the amount of AHL produced by the transmitter population when stimulated by a certain amount of the inducer.
By quantifying AHL and GFP, a model of each transmitter can dictate which population of bacteria is best suited for the

microfluidic device. Using this information, we can expand previous knowledge of a single population by investigating the interaction and communication between two different populations of bacteria.

Poster Presentation # 020
Identification of Hot Spots for Suture Dehiscence following Implantation of Mitral Valve Repair Devices

Deborah Paul
Ajit Yoganathan, PhD (Biomedical Engineering)

Mitral regurgitation is the most common heart valve disease in the United States. One common method of surgical repair is undersized ring annuloplasty. However, suture dehiscence remains a common concern after annuloplasty. Our previous in vivo experiments have revealed that annuloplasty ring sutures on the anterior annulus experience higher forces in a beating ovine heart. However, clinically, ring dehiscence occurs more frequently on the posterior side, suggesting that the posterior annulus may have lower suture holding strength. Sutures were pulled to failure from 10 positions around mitral valve annuli (N=12) that were sutured flat on a platform in order to replicate the direction of applied force on sutures of an undersized annuloplasty ring after implantation. The maximum forces recorded on the uniaxial testing machine through suture dehiscence were expected to be greater on the anterior side than the posterior side. The results returned average anterior side pullout forces about 63% higher than the posterior side forces (6.38 ± 3.57 N and 3.91 ± 1.61 N respectively, $p<0.0001$ by Student's T-test) implying that the posterior annulus does in fact have a reduced suture holding strength. These findings suggest that ring implantation techniques may need to include measures to attach the ring more securely on the posterior side.

Poster Presentation # 077
Modeling and Validation of Bacterial Population Response: Multiple Pulse Inputs within a Microfluidic System

Jorge Perdomo
Craig Forest, PhD (Mechanical Engineering)

Molecular communication strategies can be used in biological applications. These biologically inspired systems can use quorum sensing, an intercellular communication technique for bacteria, to provide feedback of an organic system of interest. Genetically modified Escherichia coli bacteria serve as observable receivers of this molecular communication. Housed in microfluidic devices, these bacteria transmit signaling molecules. These microfluidic chips used in experimentation are composed of polydimethylsiloxane (PDMS). PDMS is permeable to oxygen therefore allowing bacteria to grow and function normally within the chip. Using an automated pumping system, it is possible to control the flow of media and stimulant into and out of the chip. Bacteria are caught in several chambers of the chip where they grow and function. When given the chemical stimulus, the receiver bacteria population will produce Green Fluorescent Protein (GFP). This GFP output can be captured using a fluorescent microscope and camera. This system allows for control over multiple pulse inputs while allowing observation and observation and quantification of the bacterial output. Models have been created and verified depicting the process of this genetically engineered signaling pathway through the use of fluorescent imaging of GFP produced by the bacteria. These models can accurately represent the responses of the bacteria to varying concentrations of stimulant. However, now multiple pulses, and varying time steps between stimulation periods are being taken into consideration. In order to update these current models, the optimal time step between two separate fluorescence periods must be determined as well as the effect of the perceived relative fluorescence in comparison to previous single stimulation experiments. This research could contribute to passive organic regulatory systems such as adding a passive biological component to a water filtration testing process.

Poster Presentation # 021
Characterization of the Contribution of Genetic Background and Gender to Disease Progression in the SOD1 G93A Mouse Model of Amyotrophic Lateral Sclerosis: A Meta-Analysis

Stephen Pfohl
Cassie Mitchell, PhD (Biomedical Engineering)

Background: The SOD1 G93A mouse model of amyotrophic lateral sclerosis (ALS) is the most frequently used model to examine ALS pathophysiology. There is a lack of homogeneity in usage of the SOD1 G93A mouse, including differences in genetic background and gender, which could confound the field's results.
Objective: In an analysis of 97 studies, we characterized the ALS progression for the high transgene copy control SOD1 G93A mouse on the basis of disease onset, overall lifespan, and disease duration for male and female mice on the B6SJL and C57BL/6J genetic backgrounds and quantified magnitudes of differences between groups.
Methods: Mean age at onset, onset assessment measure, disease duration, and overall lifespan data from each study were extracted and statistically modeled as the response of linear regression with the sex and genetic background factored as predictors. Additional examination was performed on differing experimental onset and endpoint assessment measures.
Results: C57BL/6 background mice show delayed onset of symptoms, increased lifespan, and an extended disease duration compared to their sex-matched B6SJL counterparts. Female B6SJL generally experience extended lifespan and delayed onset compared to their male counterparts, while female mice on the C57BL/6 background show delayed onset but no difference in survival compared to their male counterparts. Finally, different experimental protocols (tremor, rotarod, etc.) for onset

determination result in notably different onset means. Conclusions: Overall, the observed effect of sex on disease endpoints was smaller than that which can be attributed to the genetic background. The often-reported increase in lifespan for female mice was observed only for mice on the B6SJL background, implicating a strain-dependent effect of sex on disease progression that manifests despite identical mutant SOD1 expression.

Poster Presentation # 022
Tunable Degradation of Poly(ethylene glycol) Based Microparticles

Brandon Philbrick
Johnna Temenoff, PhD (Biomedical Engineering)

Controlled drug release is beneficial for many drug delivery and tissue engineering applications but is difficult to achieve. The use of biomaterials to encapsulate a drug of interest has allowed for drug release both in vitro and in vivo. Still, achieving sustained drug release over a long period of time remains a challenge. To overcome these challenges, a microparticle based technology with tunable degradation rates was developed. Poly(ethylene) glycol diacrylate (PEG-DA) microparticles (MPs) were synthesized using a water-in-water emulsion technique. 20 w/w% PEG-DA containing 0.05 w/w% D2959, 2 mg/mL PLL, and concentrations of 30, 35, or 40 mM Dithiothreitol (DTT; to enhance susceptibility to hydrolytic degradation) was mixed against 50 w/v% 70 kDa dextran at a 1:3 ratio (PEG:dextran) by vortexing for 30 seconds. Resulting MPs were then cross-linked under 17mW/m2 UV light for 10 minutes. Degradation was monitored in a 1 mL solution of 1 million MPs/mL over the course of 18 days. Day 1 sizes for MPs were 8.3 +/- 3.2 um, 19.2 +/- 13.5 um, and 42.4 +/- 19.7 um for 30, 35, and 40 mM DTT particles, respectively. In buffer solution, 30, 35, and 40 mM DTT MPs degraded by day 18, 15, and 10, respectively. Due to length of time it took them to degrade, 30 mM DTT PEG based MPs were chosen to be incorporated into aggregates of chondrogenic cells of a cell-MP suspension at a 3:1 MP:cell ratio. MPs degraded by day 14 in ATDC5 spheroids as assessed by histological analysis. Thus, by adjusting concentration of DTT, the degradability of the MPs can be altered in solution and in cell spheroids. This study displayed proof of principle that degradation of PEG-DA microparticles has potential to be used as a delivery system for controlled drug release.

Poster Presentation # 032
Increased Microtubule Dynamics in Taxol-Resistant Ovarian Cancer Cells by Alterations in Focal Adhesion Proteins

Kishan Pithadia; Niti Khambhati
Michelle Dawson, PhD (Chemical and Biomolecular Engineering)

Ovarian cancer is a leading cause of death in women. The majority of patients relapse despite primary treatment, and as the cancer cells become chemoresistant, prognosis dramatically worsens. Over 90% of ovarian cancer deaths are primarily caused by metastasis, or the spread of cancer. Taxol, a frontline chemotherapeutic drug, stabilizes microtubules, cytoskeletal filaments required for cell division. While microtubules do affect cell adhesion, it remains unclear if chemoresistance alters cell adhesion to the extracellular environment. This was tested by isolating Taxol-resistant cells, which displayed increased microtubule dynamics characterized by more rapid microtubule growth from fluorescently-labeled EB3 microtubule protein. In addition, the Taxol-resistant cells displayed greater adhesion rates and decreased adhesion strength, which could help overcome the rate-limiting step of metastasis. Adhesion strength was determined to be independent of microtubule polymerization and dependent on up-regulated focal adhesion kinase (FAK) in the Taxol-resistant cells. When FAK was inhibited in these cells, microtubule dynamics decreased, signifying that adhesive signaling is up-stream of microtubule dynamics. Therefore, by altering cell adhesion to the extracellular environment, Taxol-resistant cells show an increase in down-stream microtubule dynamics. Thus, this study made use of FAK inhibition as a therapeutic target to improve prognosis by regaining drug sensitivity.

Poster Presentation # 033
Characterizing Insertion Mechanics Of Hypodermic Needles And Microbiopsy Punches

Anushya Raghuram
Mark Prausnitz, PhD (Chemical and Biomolecular Engineering)

Having a fundamental understanding of insertion dynamics can influence needle geometry design, which must not expose the provider to any avoidable risk or result in waste that is dangerous to others. Based on the type of injection, the needle geometry design will play a role. For example, subcutaneous injections go into the fatty tissue below the skin and require smaller, sharper needles. Intramuscular injections go into the muscle below the subcutaneous layer so the needle must be thicker and longer. The effect of gauge sizes of hypodermic needles on skin insertion is analyzed. Hypodermic needles between 16-30 gauges were inserted into PDMS sheets with speeds of 1.5-12mm/min. Force Displacement measurements were used to generate design criteria that would create a more complete understanding of how hypodermic needle size affects insertion force and elongation. Needle gauge was found to have an effect on insertion force. At a speed of 1.5mm/min, the average force exerted by the 20 gauge was the highest at 15.962g. At a higher speed of 3mm/min, the average force exerted by the 30 gauge was the highest at 18.464g. Average insertion elongation increased as the speed increased and as the gauge increased. Additionally, sheet thicknesses of 25-254μm were used to investigate integrity mechanics of novel microbiopsy designs. Microbiopsy structures were visually observed before and after insertion into porcine skin to evaluate mechanical integrity. Results indicated that 254μm retained the

most mechanical integrity, while 178 μm lost mechanical integrity after insertion.

Oral Presentation
Cellular Neural Networks – Image Processing Applications using FPGAs

Janani Ramakrishnan
Saibal Mukhopadhyay, PhD (Electrical and Computer Engineering)

Objective: The primary objective of the research experiment is to develop a cellular network algorithm and simulate it on an FPGA to perform image processing on simple images. The experiment also involves a comparison of performance between the implementations on FPAGs and SOCs.
Concept – Cellular Neural Network: Cellular Neural Networks are a type of Neural Networks that contain locally interconnected cells. Each cell is connected to an adjacent cell within a stipulated R-Neighborhood or radius. The idea of cellular neural networks has been exploited in various applications such as image processing, network connectivity etc. due to a localized interconnectivity between the cells. Within the image processing domain, these networks are typically used for edge detection, image filtering, feature extraction. The fact that there are locally interconnected cells provides a potential for them in parallel computing and fast computation. This property of CNNs can be exploited in mobile applications using system on a chip (SOC).
Project Abstract: A CNN is implemented in Verilog and simulated to ensure proper functionality. These cells are multiplied to form a cellular neural network array and this array is implemented on an FPGA. An image preloaded on the FPGA is acted upon by the CNN to perform image processing such as edge detection or feature extraction. The working of CNN on hardware is then compared with a software implementation of the same on MATLAB and Modelsim.
Project Goals:

- To design a CNN using several cells on Verilog and simulating it to verify functionality.
- Importing CNN into the FPGA and extracting parameters to perform any suitable image processing on pre-determined images.
- Determining the feasibility of the neural networks on a mobile platform.

Poster Presentation # 047
Method Of Fabrication For Nerve Cuff Electrodes For Chronic Implantation

Brian Sanner
Robert Butera, PhD (Electrical and Computer Engineering)

Many electrophysiological experiments require the need to record, stimulate, or both through the peripheral nervous system. There are many electrodes currently on the market, but they are either not designed for implantation or are not robust enough to be used multiple times in situ. The cost of buying these electrodes from a manufacturer can be prohibitive and many labs prefer to make their own. This introduces uncertainty, as different techniques and configurations in the design and fabrication of electrodes can create variance in electrical impedance, spatial arrangement, or other factors. This paper presents a detailed methodology for the construction of electrodes that are robust, have uniform impedance values of $Z = 2.375 \pm 0.9058\ k\Omega$. at 1 kHz alternating current (AC), and can be used in multiple in vitro or in situ experiments, or for chronic implantation in vivo. This method will reduce the amount of time and material needed to construct electrodes for experimental studies in animals, as articles do not explain the detailed techniques in the construction of the electrodes used which can take weeks or months to master without such instruction.

Poster Presentation # 023
Engineering a Chondrogenic Microenvironment to Promote MSC Chondrogenesis

Apoorv Saraogee
Robert Guldberg, PhD (Biomedical Engineering)

Osteoarthiritis (OA) is the degradation of articular cartilage and affects 26.9 million people in the US [1]. One of the current treatments for cartilage defects, autologous cartilage implantation, involves harvesting chondrocytes from a non-load-bearing area then re-implanting into the defect where the periosteal flap is used to prevent leakage of grafted chondrocytes. In vitro chondrocyte culture often leads to de-differentiation, however, and the use of the periosteal flap for sealing often stimulates osteophyte formation [2], both of which lead to pain and eventually total knee arthroplasty [3]. Mesenchymal stem cells (MSCs) may be a promising alternative cell source because they can be isolated from adult tissues, have been shown to have immunomodulatory properties [4], and can be differentiated along a chondrogenic lineage [5]. Traditional chondrogenic differentiation relies on growth factor induction (TGF-βs and/or BMPs) which stimulate hypertrophic and osteogenic differentiation in addition to chondrogenesis, which can stimulate formation of calcified cartilage instead of healthy chondrocytes [5]. Pellet culture can improve chondrogenic differentiation as it provides a 3-D environment that allows cell-cell interactions, but it is still not able to recapitulate the complex microenvironment experienced in vivo[6]. Alternatively, decellularized cartilage (cartilage extracellular matrix where the cellular and immunogenic components have been removed to avoid an immune response) may more closely mimic the natural cartilage microenvironment as it contains important growth factors, glycosaminoglycans (GAGs), and extracellular matrix (ECM) proteins to support chondrogenesis [7]. Therefore, this study will investigate whether cartilage ECM incorporation into MSC pellets improves chondrogenic differentiation and if the

cartilage ECM provides enough instructive cues to direct MSC chondrogenesis without the addition of exogenous growth factor. The hope is that incorporating decellularized cartilage ECM will improve chondrogenic differentiation and will result in less hypertrophic and osteogenic differentiation in comparison to traditional exogenous growth factor mediated differentiation.

Oral Presentation
Robustness Analysis of the Total Cavopulmonary Connection with Steady and Pulsatile Computational Fluid Dynamics Simulations

Jake Sebring
Ajit Yoganathan, PhD (Biomedical Engineering)

Computational fluid dynamics can be used to simulate blood flow through the total cavopulmonary connection (TCPC) and allow clinicians to examine the performance of different surgical connections before the Fontan procedure for single ventricle physiologies. Optimization of the TCPC for a patient-specific anatomy is believed to help prevent many long-term complications such as pulmonary arteriovenous malformations, decreased exercise capacity, and heart failure. Virtual surgical planning tools have been used to pre-operatively design the best surgical connection on a patient-specific basis. However, this optimal option may not be exactly implemented in the operating room. Accounting for these differences is essential to ensure that hemodynamic results will be similar if small geometrical variations from the optimal surgical option occur. Historically, steady flow was assumed to computationally model patient hemodynamics, and at least one study exists examining the robustness of surgical options modeled with steady flow. However, pulsatile flow has been incorporated into the modeling process more recently, and it is imperative to understand the effect of altered boundary conditions on the robustness of a surgical option. Seven patients were evaluated in this retrospective study. Surgical variations were generated for each patient by changing the diameter, angle, and offset of the connection. Both pulsatile and steady computational fluid dynamics simulations were performed on the geometries and differences in hemodynamic results from the original option were assessed. Hemodynamic metrics evaluated include power loss, a measure of the efficiency of blood flow in the TCPC, and hepatic flow distribution, which is defined as the amount of flow going from the inferior vena cava to each pulmonary artery. The impact of steady vs. pulsatile boundary condition differs based on several factors, such as the patient-specific geometry.

Oral Presentation
Modeling of air-coupled transducer transfer functions to allow for absolute nonlinear ultrasonic measurements

Nicholas Selby; Preston Culbertson
Laurence Jacobs, PhD (Civil and Environmental Engineering)

In 2012, Nuclear power plants provided 12.3 percent of the world's electricity production [1]. In this growing market, it is vital that nuclear power plants have methods of testing the containers of nuclear material for structural integrity. Conventional methods involve testing material limits by applying large forces to a sample of the material, using data from sample failure to make inferences about the integrity of the rest of the structure. In applications like nuclear power plants where sample removal is not an option, in-situ nondestructive testing (NDT) is required to understand the state of the components under test. Microstructural impurities and substructural changes in specimens alter the stress-strain relationship of the material, causing it to become more nonlinear [2]. These nonlinearities can indicate changes such as plasticity, fatigue, thermal aging, creep, and radiation damage in metals [3]. As damage occurs, this nonlinearity, characterized by the nonlinear parameter β, changes as a result. Second harmonic generation (SHG) methods that exploit this change in material properties are a valuable ultrasonic testing procedure that has proven to be sensitive to the modes of damage that are of interest to a broad cross-section of industry. When a monochromatic input of frequency f is excited in a material, the nonlinearity causes the output to contain this original signal as well as a generated second harmonic signal at 2f, the strength of which is proportional to the parameter β. By tracking the evolution of β with this technique, the microstructural damage in the material can be assessed [4]. Currently, nonlinear ultrasonic measurements are conducted using either contact or noncontact methods for the receiver. Noncontact methods are vastly beneficial for in-situ measurements, and are primarily conducted with either laser interferometers or air-coupled piezoelectric transducers. Laser techniques are better understood and have the capability of detecting an absolute, point-like displacement measurement [3] whereas air-coupled transducers are less dependent on surface conditions [2] but do not immediately provide absolute readings of surface displacements. As a consequence, all air-coupled measurements must be compared to a baseline reading from a healthy sample to gain insight into the microstructural material state. By creating a transfer function by which the voltage output from air-coupled transducers is transformed into a surface displacement value, experiments with air-coupled transducers will provide readings of absolute material state changes that can be linked to the amount of damage that material has undergone without the need for baseline measurements [4].

Oral Presentation
Simulating the effect of the geometry and mechanical loading on the function of the tympanic membrane

Alvin Si
Julien Meaud, PhD (Mechanical Engineering)

The tympanic membrane (TM) plays a crucial role in human hearing. The TM converts sound waves received in the ear canal into mechanical vibrations transmitted to the middle ear. The structure and mechanical properties affect the quality of sound transmission. Thus, the task of modeling the TM becomes crucial in order to improve clinical surgical intervention. The TM was modeled in ABAQUS, where the free response and the response due to a harmonic, uniform pressure load were simulated. Python and MATLAB were used to plot amplitude and frequency responses with data obtained from ABAQUS simulations. For the free response of TM, natural frequencies and mode shapes within hearing range were examined. For the forced response, the amplitude and phase of the TM are examined. Incremental changes were made starting from simple round plate model by adding manubrium, damping, and conical feature. In addition, by exploiting the symmetry of the full model, a half model was developed afterwards to reduce computation time. In this work, the effect of adding each feature is discussed. Currently, the effect of adding the ossicular chain, modeled as a network of spring, mass, and dashpot, on the function of TM is being investigated. The results from this future simulation will be compared with the experimental data published by other researchers (Cheng et al, 2013).

Poster Presentation # 037
Nanoindentation Measurement of Epoxy-Cement Paste Adhesion

Katherine Siegel
Trey Hamilton, PhD (Civil Engineering, University of Florida)

The use of externally bonded fiber reinforced polymer (FRP) to repair and strengthen concrete bridges has been widely explored. Success of such repairs relies heavily on maintaining a perfect bond between the FRP and underlying concrete substrate, which is established by use of epoxy adhesives. Research has shown that concrete-epoxy bond, however, is susceptible to degradation when exposed to severe environmental conditions, particularly high levels of moisture. Effects of moisture on the bond are two-fold: (1) hydrogen bonds that are created at the concrete-epoxy interface can be replaced by water molecules; and (2) effectiveness of mechanical bond is affected by plasticization of epoxy matrix. The objective of this study is to investigate the epoxy-cement paste chemical bond at the nanoscale and characterize adhesion mechanisms between cement paste and epoxy by utilizing an existing method of interface nanoindentation for coatings. To eliminate mechanical interlock, cement paste substrate was thoroughly polished before the application of epoxy. Interface was then examined by both atomic force microscope (AFM) and nanoindenter to determine the properties of epoxy-cement paste interface. The developed test method displayed promising results and is deemed a potential tool for evaluation of epoxy-cement paste interface fracture properties at a very fine scale.

Poster Presentation # 024
Utilization of Magnetic Resonance Imaging for the Full Characterization of Aortic Regurgitation

Mohit Singh
Ajit Yoganathan, PhD (Biomedical Engineering)

Background: Aortic regurgitation (AR) is the diastolic flow of blood from the aorta into the left ventricle (LV) due to incompetence of the aortic valve or any disturbance of the valvular apparatus. Mild AR can result in fatigue and shortness of breath. In severe cases, it can lead to heart failure. Currently, there is a need for better understanding of the mechanics underlying AR and its treatment.
Objective: The overall objective of this research is to utilize magnetic resonance imaging (MRI) for the full characterization of AR. This study is important because it will give novel insight into the trends of parameters that are assumed to be affected by AR but have not been specifically studied together in the past. The findings will directly support industrial and clinical efforts to improve device design and to optimize patient-repair selection.
Methods: Patient selection was categorized into mild, moderate and severe based on echocardiography. Three different MRI scans were performed: 3D cine of the left ventricle, 2D cine of the aortic valve and 4D phase contrast magnetic resonance (PCMR) of the aorta for velocity over time data. MATLAB, ParaView, OsiriX and Vascular Modeling Toolkit (vmtk) (Figures 1 and 2) were used to find correlations between various hemodynamic principles such as regurgitant volume, regurgitant fraction, end diastolic volume (EDV), end systolic volume (ESV) and cardiac output in order to find trends.
Results: The data showed many of the trends that were expected at the beginning of the study. The overall volume of the ventricle including EDV and ESV (Figure 3) increased as the severity of the aortic regurgitation increased. This could be due to the ventricular dilation that can occur with severe and prolonged AR. The minimum opening sizes for the aortic orifice show that there is an increase in size as severity increases (Figure 4). This could be due to the increased pressure of blood flow against the aortic leaflets that can occur with severe and prolonged AR.
Conclusion: AR was successfully characterized and relevant trends were found successfully.

Poster Presentation # 078
EMI shielding Effectiveness Analysis of CNT Composites

Won Sup Song; Thomas Ming
Raghuram Pucha, PhD (Mechanical Engineering)

An electronic device is considered electromagnetically compatible with its surrounding if it does not interfere (Electromagnetic Interference- EMI) with other devices or itself, and it does not affected by emissions from other devices [1]. Conventional conductive polymer composites made of stainless steel fibers, nickel coated carbon fibers are cost prohibitive for EMI applications because of the high concentration of filler required to achieve an adequate level of shielding. At the same filler loading, polymer filled with nano-sized carbon filler has higher EMI Shielding Effectiveness (SE) than polymer filled with micro-sized carbon filler. The EMI SE of a material is defined as the ratio of transmitted power to the incident power. The distance required by the power wave to be attenuated to 37% is defined as the skin depth. The primary objective of this research is to develop computational tools to quantify and optimize the EMI SE of CNT Composites.

- Develop an algorithm to convert a 3D Representative Volume Element (RVE) with Carbon Nanotubes (CNTs) within polymer block in to an equivalent R-C network
- Develop the equivalent circuit procedure to quantify conductivity.
- Solve for the composite electrical conductivity of the RVE including tunneling effects and validate the models with experimental composite results existing in literature.
- Quantify and optimize EMI SE of CNT composites by studying various factors affecting the composite conductivity.

The poster will present the algorithm development and quantification of direct, tunneling current EMI SE for percolated and non-percolated 3D network of CNTs within RVE. The conductivity of composite system is compared with the FEA analysis results using COMSOL.

Poster Presentation # 025
Immuno-modulatory Hydrogels for the Enhanced Survival of Neural Stem Cells after Traumatic Brain Injury

Shraddha Srivastava
Ravi Bellamkonda, PhD (Biomedical Engineering)

Approximately 1.7 million Americans sustain a traumatic brain injury (TBI) every year. TBI is caused by a sudden blow to the head or a penetrating head injury that disrupts the function of the brain. It can cause epilepsy; increase risk of Alzheimer's or Parkinsons' disease; and other brain disorders that affect thinking, language, learning, and/or behavior. In the past few years, stem cells have been seen as a promising source for cell replacement therapy for degenerative diseases. However, various shortcomings such as poor cell survival and lack of phenotypic stability need to be overcome in order to achieve a successful neural stem cell (NSC) treatment.
We proposed to use a hydrogel based NSCs carrier that delivers FasL in order to create a localized immune-suppressive environment at the site of stem cell transplantation. Hydrogels are cross-linked networks of polymers with a high water content that allows them to promote cell viability. One of the major contributors to poor cell survival post-transplantation of the NSCs is the negative response of the immune system from T-cells. An important regulator of T-cell activation is the cytokine or protein known as FasL. The binding of FasL to the cell surface receptor of T-cell induces their cell death by apoptosis.
The purpose of this project is to determine if Fas ligand presenting hydrogels can be used to enhance the survival of neural stem cell after TBI. Found that MfasL affects T-cell without affect the NSCs and the release can be extended by the presence of microtubules. During this semester we want to determine the effect of FasL delivery on the inflammatory response using gene expression analysis. In addition, we would like to determine the survival of the NSCs after four weeks post transplantation in order to determine the effectiveness of the hydrogels.

Oral Presentation
Device for minimally invasive measurement of intracranial pressure

Max Stockslager; Zoe Klesmith
Craig Forest, PhD (Mechanical Engineering)

The brain and spinal cord are bathed in a clear, colorless fluid known as the cerebrospinal fluid, and the continual production and drainage of this fluid generates a pressure, the so-called intracranial pressure (ICP). Small alterations in ICP are implicated in glaucoma, hydrocephalus, and ischemic stroke, but current measurement techniques are highly invasive; faster and less invasive ICP screening could directly lead to earlier detection and treatment of these conditions. Progress has been made toward a novel device for minimally invasive measurement of ICP. This device manipulates the intraocular pressure while pulsations of the retinal veins are observed within the eye, exploiting a little-known fluid dynamic property of the retinal vasculature to indirectly assess ICP [c.f. Jacks & Miller 2003]. A lumped parameter model was developed for the dynamics of aqueous humor flow in the eye, including the effects of aqueous humor outflow resistance and ocular compliance. An ocular perfusion system was designed and built, allowing control of intraocular pressure with the required precision (< 0.5 mmHg) and controllable range (0-40 mmHg). Accuracy and repeatability were confirmed ex vivo in enucleated porcine eyes. The system was tested in live rabbits for its efficacy in measuring ICP, as well as two other fluid dynamic properties of the eye, the ocular compliance and outflow facility. Validity of ocular compliance and outflow facility measurements were confirmed using alternative techniques. Current work involves testing the device in vivo in a tree shrew model.

Poster Presentation # 014
Wind Tunnel Prototype Building

Eric Stoker-Spirt; Max Germain; Thomas Rainey; Franklin Turbeville; Dyllan Russell
Narayanan Komerath, PhD (Aerospace Engineering)

The purpose of this project is to create models of bluff-body objects to be used in determining both airload maps and swing dynamics in the wind tunnel. They are scaled down from objects as slung loads in geometry and inertia. Objects to be made include a ribbon bridge, which is a portable, floating bridge used by the army, and various cylinders. The moment of inertia is determined using two methods: torsional and compound pendulum experiments, and from computer-aided design software. Another part of the project is to obtain numerical representations of objects suitable for computational fluid dynamics codes.

Poster Presentation # 079
Effects of Radiation Damage on Graphene and Iron

Amelia Tee Qiao Ying
Chaitanya Deo, PhD (Mechanical Engineering)

Graphene and iron are both extremely sturdy materials. Graphene is well known for is its strength. Its atomistic properties and electronic configuration makes it resilient to radiation damage. Iron is also a formidable material as its high binding energy and structure renders it durable against radiation. The objective of this project is to compare the outcomes of radiation damage in both of these substances using molecular dynamics (MD) simulation and AIREBO potential. Results of this undertaking will be centered on the different type of defects formed in each material, the minimum energy displacement needed to deform both materials from different angles of primary knock-on atom (PKA) irradiation and effects that the defects have on the materials. Such an analysis will reveal that although iron is more resistant to defect formation due to its higher threshold displacement energy, Graphene displays 'self-healing' behavior which may lessen any detrimental effects that any defects may have caused.

Poster Presentation # 035
Enhancing Fibronectin 4G for Bacterial Surface Display Using Overlap Extension PCR Cloning

Evan Teng
Haylee Bachman, PhD (Chemical and Biomolecular Engineering)

The project goal is to efficiently produce fragments of the extra-cellular matrix (ECM) protein, fibronectin, which can be expressed on the surface of bacteria and then cleaved off of the bacterial surfaces for mass production and subsequent use. Fibronectin is an ECM protein that has a role in extra cellular matrix contraction, which can affect multiple cell activities; including cell binding and cell phenotype. These surface proteins could then be fused to a hydrogel (a biomaterial that is very suitable for culturing human cells). The hydrogel-fibronectin fragment hybrid can allow for embryonic or pluripotent stem cells to differentiate, proliferate, and adhere to surfaces such as hydrogels.
To create the surface display of the fibronectin fragments, we intend to transform plasmids containing key sequences of DNA that code for the desirable fibronectin fragments, PET system, and GST tags for processing into bacterial cultures. The general methodology to create the plasmids is by PCR. In particular, we used Overlap PCR in order to combine the pieces of double stranded DNA into one single loop of plasmid. After creation of plasmids, they were transformed into the corresponding bacterial cultures with the proper polymerases to utilize the plasmid sequence and produce the proteins.
The next step is to confirm the proteins are on the surface by using flow cytometry. After confirmation, purification of the proteins using the surface display will be tested for efficiency and functionality.

Oral Presentation
Biomechanical comparison of leukemia cells and their healthy counterparts

Cory Turbyfield; Kaci Crawford
Todd Sulchek, PhD (Mechanical Engineering)

Every three minutes, someone in the United States is diagnosed with blood cancer, the most common of which being Leukemia, or the cancer of white blood cells. Differentiating between healthy and cancerous white blood cells through traditional techniques has proven to be difficult and inconsistent. The purpose of this study is to investigate the use of biomechanical characterization to differentiate between healthy and cancerous cells, and its future application in diagnostics.
Atomic Force Microscopy (AFM) and image processing was used to determine the diameter, viscoelasticity, and elasticity of two leukemia types and their healthy counterparts. HL60 was chosen as a model of Acute Myelogenous Leukemia, the most common type of adult leukemia, and compared its biomechanical properties to its most common healthy counterpart, neutrophils. Additionally, Jurkat was selected as a model of Acute Lymphocytic Leukemia, the most common type of childhood leukemia, in comparison with its healthy counterpart, lymphocytes.
We conclude that there are distinct differences in the biomechanical properties between healthy and cancerous blood cells. The results of this study have the potential to significantly impact the current practices in diagnostics of leukemia. Currently, the most common method of diagnosis of leukemia is a bone marrow biopsy, which is a highly invasive and painful procedure. Recently, a microfluidic separation chip was developed to separate cell types from a single stream based on the biophysical

properties tested in this study. With improvements on said technology, and increased characterization of healthy and cancerous leukocytes, this microfluidic chip technology could one day be used as a minimally invasive diagnostic tool for leukemia, with the possibility of shifting the diagnostic procedure from a bone marrow biopsy to a simple blood test.

Poster Presentation # 036
Excitotoxicity and ALS: The relationship between glutamate and EAAT-2/GLT-1 expression and the progression of amyotrophic lateral sclerosis in the G93A mouse model

Isabelle Vernon; Yingbo Shi; Zoe Sieling
Cassie Mitchell, PhD (Chemical and Biomolecular Engineering)

No singular cause of amyotrophic lateral sclerosis has been isolated; it is thought to be a combination of factors, most notably excitotoxicity. Excitotoxicity occurs when an abnormal amount of glutamate is present in the synaptic cleft of the pre- and post- synaptic neuron, causing the post-synaptic neuron to die. This abnormal amount of glutamate could be due to the pre-synaptic neuron releasing an irregular amount, or the cause could be that the glutamate transporter, commonly referred to as both EAAT-2 and GLT-1, isn't assisting in the reuptake of glutamate, thus leaving it in the synaptic cleft to stimulate the post-synaptic neuron. Experiments have observed changes in the levels of glutamate and EAAT2 in the G93A mouse model (one of the most common used as a representation for familial ALS), but these studies have been conducted separately, never discerning a relationship between these key factors in the excitotoxic path and the progression of ALS. The goal of this study is to take the enormous amount of published experiments concerning the G93A mouse model and these integral factors, normalize the data extracted, and create models of how both glutamate and transporter expression varies over the disease course in G93A mice. Preliminary results reveal that EAAT2 has a downward trend as ALS progresses, while glutamate expression has more of a parabolic fit with disease progression, meaning it increases over time but then begins to decrease at a certain point. Further analysis will reveal if the trends for glutamate and EAAT2 are related (for example, does EAAT2 only start decreasing after glutamate has reached its maximum), and the relationship of glutamate and EAAT2 to other measures of ALS progression, like motor neuron count.

Oral Presentation
Engineering Three Dimensional Cardiospheres From Pluripotent Stem Cells

Nicole Votaw
Tracy Hookway, PhD (Biomedical Engineering)

Previously, we have shown that generating 3D cardiospheres from pre-differentiated cardiomyocytes derived from human pluripotent stem cells has enriched and matured the cardiomyocyte populations compared to the 2D controls. However, current limitations with cardiomyocytes include highly variable efficiency resulting from differentiation protocols, and improvement in purification is necessary. Additionally, the differentiaton yields an immature phenotype resembling that of embryonic cardiomyocytes, not mature adult cardiomyocytes. In order for cell-based cardiac therapies to realize their clinical potential, methods to enrich and mature the cardiomyocyte populations are required. This project identifes which time point during the pre-differentiation process we can create cardiospheres with the highest yield of mature cardiomyocytes using the fewest number of steps, creating a faster protocol. The project forms cardiospheres at four different time points during the differentiation process. Time point one is equivalent to day zero of the protocol, where the cells are still pluripotent. Time point two is equivalent to day five of the protocol, after mesoderm differentiation is achieved. Time point three is equivalent to day nine of the protocol, when spontaneous beating is first noticed. Time point four is equivalent to day 14 of the protocol, when the cells show robust beating. At each of these time points 3D aggregates will be formed and will continue to be cultured for a total of 21 days before being evaluated. Initial results indicate the cardiospheres formed on day 5 are more mature than those formed in the control. Further experiments this semester will concrete the results.

Poster Presentation # 080
How the hairs of honey bees stick to and flick off pollen

D' Andre Waller
David Hu, PhD (Mechanical Engineering)

Many modern technologies utilize sensitive surfaces, like sensors. In practical use, a lot of these technologies are exposed to environments laden with micron-scale particulate matter. The success of sensing equipment relies on their sensitive surfaces being free from deposited particles, making the development of methods for keeping surfaces clean a critical part of design. This past year, our study investigated the mechanisms involved in grooming behaviors of insects in order to gain a better understanding of how to reduce particle deposition and efficiently clean sensitive surfaces. Our study focused on further study of the grooming habits of the honeybee, particularly how the bristles on the forearm facilitate more efficient pollen removal from bristles on the eye. Throughout the day, a honeybee accumulates eight times is body weight in pollen on average. The honeybee heavily relies on its eyes to perform day to day functions therefore the bee must be able to efficiently clean its eyes. Previous experiments have yielded results that show that the bristles embedded within the honeybee's compound eyes divert airflow and protect the eye from micron-sized particulate matter. Similar to many other insects, the honeybee has compound eyes that are composed of thousands of individual lenses called ommatidia. We have

observed that many insects, including the honeybee, have hair like structures or setae embedded throughout the compound eye structure. Using videos of the honeybee grooming itself, we observed that the honeybee uses its ipsilateral forearm to clean its head and eye region. We hypothesize that hairs play a critical role in the collection and removal of pollen. Specifically, hair-on-hair interactions between hairy libs and the hairy body drive particle removal. In order to obtain quantitative information about the eye grooming behavior, experiments were designed to replicate the grooming behavior. In order to maintain the integrity of the biology, we used freshly dead (within 1 hour), non-desiccated bees. The head of the bee is tethered to be stationary while to forearm of the bee is tethered to an Arduino-powered servomotor which the axis normal to the plane of the eye. This causes the arm to "swipe" the bee eye similar to the natural grooming behavior of the honeybee. In order to control the bristle interactions, we use wax to coat one of the forearms of the bee and thus laying the hairs down, creating a "smooth" surface. Before each trial, the bee eye is coated in pollen and images are captured before and after each swipe. From these experiments, we were able to observe that the hairy limbs remove eight times the amount of pollen that the hairless limbs will. In order to understand how efficient the hairy limbs are at removing pollen, we designed experiments to measure pollen removal rates with respect to time. Live honey bees were tethered and covered in pollen. Ventral perspective videos were taken of a petri dish collecting the pollen particles that the bee removed. A light diffuser was used to create a constant light gradient back lighting the bee in order to highlight the removed particles. By converting the frames from the ventral video to binary (black and white) images, we can count the number of pollen particles removed. From the early trials of these experiments, we can observe that most of the cleaning is completed by the initial swipe of grooming behaviors and that the pollen removal rate is greatest within the first minute of cleaning.
Conclusions: Honey bees have evolved specialized hair structures to efficiently control the transport of pollen. Learning how they implement these structures for removing pollen can inspire cleaning technologies to keep the sensitive equipment dust free. At the current stage of our study, we can definitely conclude that the hair structures facilitate cleaning of the bee eye.

Oral Presentation
Comparison of Electromagnetic Side-Channel Energy Available to the Attacker from Different Android Smartphones

Christopher Wang
Alenka Zajic, PhD (Electrical and Computer Engineering)

This presentation evaluates electromagnetic (EM) side-channel energy (ESE) available to the attacker from several different android smartphones. In particular, the ESE for different Android smartphones based on three ARM-based CPU architectures (Cortex-A5, Exynos 7420, and Snapdragon 400) for several common instructions were measured at several different frequencies. The results show that ESE measurements, even across multiple generations of smartphones, are repeatable across a range of frequencies and that similar frequencies result in similar ESE. The presence of side-channel energy can be audibly distinguished on a hand-held radio by alternating the different amounts of side-channel energy in a Morse code pattern. The results can be useful to smartphone designers who want to find out which parts of their design are most susceptible to EM side-channel vulnerabilities and to software developers who need to know which variations in program behavior, especially those that are consistently vulnerable across processor generations and manufacturers, are most likely to permit successful side-channel attacks.

Poster Presentation # 034
Probing for Allosteric Interactions in the Yeast Saccharomyces cerevisiae

Ariadne Watson
Mark Styczynski, PhD (Chemical and Biomolecular Engineering)

Microorganisms like Saccharomyces cerevisiae can be metabolically engineered to produce biofuels, pharmaceuticals and other useful chemical products that they do not naturally produce. Detailed information about the metabolic pathways of interest is necessary to facilitate these efforts. Much of this information is currently obtained through genomic and proteomic data, but current mathematical models seldom incorporate allosteric regulatory interactions, which can have important effects on how the metabolic pathways operate. Allosteric interactions are non-covalent, transient binding events of a non-substrate metabolite to a regulatory site on an enzyme, inducing a conformational change that activates or inhibits the enzyme's activity. These transient interactions are under-studied because their relatively weak and temporary nature makes them difficult to characterize. Efficiently characterizing allosteric regulatory interactions in organisms of interest will provide a clearer understanding of their metabolisms, which will in turn greatly aid future efforts in metabolic engineering. Proteins isolated from the yeast S. cerevisiae will be screened for potential allosteric regulatory activity. Binding interactions that may have regulatory activity will be identified via in vitro protein-metabolite binding assays, and analysis of metabolite sample composition will be accomplished using gas chromatography coupled to mass spectrometry (GC-MS). The information obtained will further characterize allosteric interactions in S. cerevisiae and contribute to the development of a more complete mathematical model for S. cerevisiae.

Poster Presentation # 026
Mobile Medical App For Remote Screening Of Appendicitis

Alexander Weiss
Wilbur Lam, PhD (Biomedical Engineering)

This study aimed to identify the possibility of using the sensors found in mobile devices as tools for remotely diagnosing or assessing the risk of appendicitis. The study was performed by creating a mobile application on an Android device and testing the repeatability of the palpations a physician would perform on a patient across patient groups and mobile environments. The results show that there is significant repeatability in devices and physicians.

Poster Presentation # 027
Collagen Heterogeneity in Mitral Valve Annulus: Clinical Insight from Two-photon Microscopy

Sarah Wells
Ajit Yoganathan, PhD (Biomedical Engineering)

Mitral valve regurgitation is a potentially life-threatening condition and one of the most common types of heart valve disorders, affecting 2-3% of the population. Implantable devices such as annuloplasty rings offer highly effective solutions; however, dehiscence of the sutures that secure these devices to the mitral annulus is a growing concern. To identify more secure suture placement methods, we sought to quantify the density of the structural protein, collagen in the mitral annulus. The following experiments were conducted in order to determine the concentration of collagen along the annulus of the mitral valve. Tissue samples from ovine mitral valves (N=5) were excised from the left trigone, right trigone, 12 o'clock, and 6 o'clock positions (Figure 1). Following a process of fixation and paraffinization, samples were sectioned into 30μm slices. Samples were imaged using two-photon excitation fluoroscopy on the Zeiss LSM 710 NLO Confocal Microscope. The tissue was excited at 800nm using a multiphoton laser and detected in two ranges: 390-420nm (to illuminate collagen) and 485-700nm (to illuminate myocardium and other non-specific fibers). Acquisition settings were optimized for maximum dynamic range and held constant for all samples from a given valve. The average density of collagen at each position was quantified over the entirety of the sample, using a custom MATLAB code. Each raw density value was then divided by the average density value at the 12 o'clock position for that valve, which consistently showed higher collagen concentrations than other positions. This was done so the density at each position could be quantified as a percentage of the highest average density seen in the annulus. On average, the collagen density for the left trigone, right trigone, and 6 o'clock position were 43.96%, 54.02%, and 48.54% of the 12 o'clock collagen density with standard deviations of 0.201, 0.280, 0.368, respectively. T-tests were run for data sets and the p values were found to be 0.003, 0.021, 0.035, which indicate that the differences in collagen density between the 12 o'clock position and other positions are significant. In addition to the varying quantities of collagen that were found, qualitative trends were observed. The 12 o'clock positions appeared to have larger regions of collagen towards the endothelial surface, while the trigone positions appear to have denser collagen regions farther from the endothelial (Figure 2). Two-photon microscopy can be used along with this MATLAB code to acquire and quantify the density in collagen at various planes along the mitral valve annulus. This quantifying technique can also be applied to further studies, where the density of a protein with a known detection rate is desired. Additional quantitative processing is ongoing to identify other meaningful spatial variations, such as by depth below the endothelium or height above the annulus. These results offer valuable insight into the extracellular structure of the annulus, and can ultimately guide best practices for suture location and suture depth during device implantation. Modifying suture placement to leverage areas that can better withstand suture tensile forces could improve the durability of mitral valve repair procedures.

Poster Presentation # 051
Exploring the Effect of Pore Size and Distribution on Shear Strength of Surface Porous Polyetheretherkeytone (PEEK)

Rebecca Wyche
Ken Gall, PhD (Materials Science and Engineering)

Cervical spinal fusion cages are primarily used to stabilize intervertebral space and provide an alleyway for fusion. Current cervical cages are made of either titanium or polyetheretherketone (PEEK), with PEEK recently becoming the more favorable choice due to its MRI compatibility. While previous research reveals ranges of pore diameters ideal for bone ingrowth, the effect of pore size on mechanical properties such as shear strength for PEEK, are not known at this time. The goal of this study is to determine the effect of pore size and distribution on shear strength of surface porous PEEK. Micro-computed tomography (μCT) will be used to analyze the porous layers on PEEK and the samples will then undergo shear testing. This data obtained will be used to determine ideal pore diameters and porosity distribution to promote osseointegration, while maintaining the ability to withstand shear stresses the device will face while implanted in the cervical spinal region of the body.

Poster Presentation # 081
Analysis of the Tectorial Membrane in the Inner Ear of Mammalian

Jaehyun Yi
Julien Meaud, PhD (Mechanical Engineering)

This research analyzes how the dimensions of isolated

tectorial membrane (TM) segments affect wave propagation and determines the material properties of the TM using experimental data for wave propagation. The TM is the membrane covering the organ of Corti. Models were created and optimized using Abaqus. Furthermore, models were simulated iteratively with various conditions to minimize the error between experimental and theoretical data. To analyze wave propagation, simulations were repeated for three different frequencies: 2 kHz, 10 kHz, and 20 kHz. The TM had more wave reflections and phase accumulations at high frequency. Wave propagation on the TM was frequency-dependent. The effects of the TM were investigated using models with various widths (from 20 to 10000 μm) and frequencies (from 10 to 20 kHz), and the simulations were in the frequency domain. The data obtained from simulations were plotted on various graphs: amplitude and phase. The results from finite element simulations were compared to two theories: the shearing wave theory (previously used by other researchers) and bending theory. With the small width of the TM, the simulation data tended to follow the results of bending theory. As the width of TM was increased, the observed data approached the values from shearing theory. The shearing wave theory, however, was not valid for the simulations in models with dimensions similar to typical experiments. Therefore, the most appropriate shear modulus (G´) and shear viscosity (n) had been determined to match data for the wave velocity and space constant provided by the collaborators.

Oral Presentation
Microfluidic chamber to generate uniform chemical gradients and application to chemotaxis

Hee Young Yoon; Brandon Lo
Todd Sulchek, PhD (Mechanical Engineering)

The objective of the this research is to engineer a microfluidic chamber in which to conduct controlled gradients of chemicals can be generated in order to conduct well-defined studies of its application of chemotaxis by artificial robots. The robots are designed from a specific type of nanoparticle called Janus Particles. We will establish a multitude of gradients within the microfluidic chambers to examine the motion of the Janus Particles. Utilizing appropriate microscopy, we quantitatively characterize the diffusion and convective processes occurring within the microfluidic channels of the chamber. We utilize MATLAB software's PDE toolbox to run simulations in order to discern the diffusion characteristics of the Flat-Iron Chamber Design and cross examine the theoretical results with our experimental results determined in the laboratory. The substrate used to generate the gradient will be hydrogen peroxide at a variety of concentrations. The optimal gradient profile would be a gradual change from a higher concentration to that of a lower one. Different types of food coloring would be employed to visually discern the gradient profile and Photoshop software will be utilized to analytically determine the gradient established. Different concentrations will be tested until the optimal concentration is determined. Once the gradient has been standardized for the straight segment of the Flat-Iron Design, the Gradient Chamber Fabrication team will attempt to build a maze with differing gradients.

Poster Presentation # 082
Role of boundary conditions in homogenized models for nanocomposites

Patrick Younes; Won Sup Song
Raghuram Pucha, PhD (Mechanical Engineering)

Introduction: Analysis of Carbon Nano-Tube (CNT) filled polymer materials is the focus of this work. These composites have far-reaching applications ranging from being applied in electronics as conductive polymer thin-films, in light weight aircraft structural components, and in many other engineering disciplines. These nano-composites can be challenging to process and scalability and cost-effectiveness are yet to be achieved. Upfront models for electrical and mechanical characterization of these composites are needed for quick what-if analysis, and cost-effective solutions in manufacturing for various applications. Homogenization techniques allow heterogeneous materials such as composites, to be modeled by macroscopic finite element models, thus simplifying numerical analyses of these materials. Statistically Representative Volume Element (RVE) models [1] with a spatially repeated 3D network of nano fillers represent an idealization of the actual nano structure of the composite. The choice of RVE is usually not unique, but it should be big enough to present the features of the material and as small as possible to reduce the computation cost. Furthermore, the RVE should have the same volume fraction as the composite [2].
Objectives and Results Presented: (1) Developing RVE models with a 3D network of fillers within the RVE. Both probability distribution functions and random function are used to develop the RVE models. (2) Simulating different boundary conditions within a Representative Volume Element (RVE) in order to homogenize the nano-structure. The periodic condition involves placing Carbon Nano-Tubes (CNTs) which exceed the RVE into their respective position as if the RVE were part of a larger set of RVEs. (3) Developing 3D models with and without periodic boundary conditions (see Figure 1) for subsequent Finite Element Analysis to quantify the effect of these boundary conditions on effective mechanical properties. (4) Study the effect of RVE size on the effective modulus of CNT filled nanocomposites.

Poster Presentation # 052
Influence of Substrate Surface Energy on the Network Formation of Spin Coated Thin Films made from Dilute Multiwalled Carbon Nanotubes

Yumeng (Hayley) Zhang
Rosario Gerhardt, PhD (Materials Science and Engineering)

Research on the electrical properties of graphitic materials such as multiwalled carbon nanotubes (MWNT) are mostly focused on coming up with a recipe for making a particular device or structure. The problem with that approach is that a method that was developed for a given application does not necessarily reveal what physical principle controls the formation of the network. Previous studies in our group have demonstrated that it is possible to obtain highly reproducible dropcasted thin films deposited onto paper substrates. Variables previously reported include the substrate paper pore size, the dispersion concentration, the number of layers, the drying method and even the graphitic fillers themselves including comparisons between single wall and multiwall nanotubes as well as graphite flakes and carbon black [1-3].
In this presentation, the focus will be on varying the substrate surface energy and fabrication method. The substrates were chosen to have approximately the same pore size (1 mm) but made from different materials so that the same MWNT dispersion (1mg/ml) could be evaluated as it is deposited onto varying substrates (paper, cellulose acetate, Teflon membrane, and glass fiber). Multilayer films containing 1, 2, 4, 8, 12, 16 and 20 layers were deposited using vacuum filtration and spin coating. Results show that the AC impedance of the thin films is dependent on the surface energy of the substrates and the fabrication method used. The optimized spin coating method forms more homogeneous MWNT networks, with a smaller standard deviation across all samples than the vacuum filtration made films. Single layer thin films deposited onto the paper substrate showed the highest sheet resistances (approximately 108 Ω for vacuum filtration and 1010 for spin coating). Thin films deposited onto the lower surface energy substrates tend to show inductive behavior, characteristic of highly conducting materials and a resistance < 102 Ω, while those with higher surface energy substrates are generally more resistant. The differences will be highlighted using contact angle measurements and detailed impedance spectroscopy and microstructural SEM analysis. Results also show that spin coated thin films have lower resistances for increased spin coating RPM.

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Poster Presentation # 086
Variation in human non-coding genomic region

Samridhi Banskota
Gregory Gibson, PhD (Biology)

A large fraction of the human genome consists of DNA that is not translated into protein sequence, and little is currently known about the functional significance of this non-coding region. In recent years, many non-coding genomic regions are proving to have important regulatory roles. However, the functions of majority still remain uncertain. The aim of this study was to assess the regulatory variation in human non-coding genomic region using CRISPR-Cas9.
Using statistical modeling, variants associated with pediatric abnormalities were identified from the non-coding genomic region. Out of the identified genes, we looked at the effect on transcriptional regulation by four genes: TDP2, Commd4, UQCC and DHX2. In order to understand the effect of these genes, we used CRISP/Cas9, a genome-engineering tool.
Initial screening was conducted using RT-PCR. It indicated a decrease in transcriptional activity for TDP2, UQCC, Commd4 and DHX29 knocked out cells. For each positive result, transfection was repeated and single cells was isolated by fluorescence-activated cell sorting (FACS) and expanded over a period of time to establish clonal cell lines. The efficiency of the CRISPR transfection was evaluated using the T7E1 assay (this assay detects mutations and mismatches in DNA insertion and deletion). This indicated an efficiency of 30% for TDP2 knocked out cells. In the future, the effect of CRISPR/Cas9 genome editing on the gene expression will be quantified by nanoscale qRT-PCR and droplet digital PCR. Following the knockout, we are hoping to introduce new variations and analyze their effect.

Oral Presentation
Neural Activation Patterns Arising from the Identification of Gestures

Sumia Basunia
Lewis Wheaton, PhD (Applied Physiology)

The human brain is composed of a complex network of neurons that create a representation of the world through sensation and perception. This representation facilitates interacting with the environment and is thus vital to the human experience. One aspect that is crucial to normal functioning is the ability to identify and classify the different types of gestures we see every day. Broadly, gestures are classified into three categories: transitive, intransitive and meaningless. Transitive gestures involve specific hand-object actions such as tool-use while intransitive gestures are communicative in nature. In this experiment, we propose that the main aspect of a gesture is the context in which the gesture is performed. For example, the gesture of waving goodbye to someone, an intransitive gesture, and the gesture of wiping a window, a transitive gesture, both involve the same biomechanics and motor control; however, they differ greatly based on the context in which they were performed. To understand and differentiate such kinematically similar gestures, the cerebral cortex or deep brain structures might exhibit unique patterns of activations specific to differentiating context. Therefore, the objective in this experiment is to map patterns of neural activation that specifically encode and differentiate context when viewing kinematically similar transitive and intransitive gestures. The participants recruited were 19 young adults between the ages 20 to 30. To map the pattern of neural activation, this experiment employed the use of a neuroimaging technique called functional magnetic resonance imaging or fMRI. fMRI indirectly measures the hemodynamic response that represents the flow of blood to specific regions of the brain that are active in response to the viewing a picture such as a particular type of gesture. Each participant was placed in an MRI machine and exposed to 75 images containing gestures in either a transitive, intransitive, or meaningless context. For the purposes of this experiment, we defined the meaningless context as a gesture devoid of any context. Once the data was collected, a Linux based software called FSL was used to analyze the data. Analysis thus far has displayed activation of visual cortex and portions of the parietal cortex for transitive gestures and activation in the frontal and temporal cortex for intransitive gestures. Further analysis is currently being conducted to identify exact locations of neural activations that specifically differentiate context. Data from this experiment gives insight into the basic neuroscience of how the brain effortlessly recognizes daily gestures and has clinical implications towards ideomotor apraxia, a neurological disorder that is characterized by an inability to recognize gestures.

Oral Presentation
High-Resolution Water Isotope Analysis of Precipitation Events in the Tropical Pacific

Christopher Bosma
Kim Cobb, PhD (Earth and Atmospheric Sciences)

The composition of hydrogen and oxygen isotopes in rainwater (measured as δ18O and δD) provides vital information about present-day hydrological dynamics and water balance, as well as past climate variability. However, a large number of fractionation factors influence precipitation isotope values, making their precise interpretation difficult. To further resolve the nature of these effects in the tropical Pacific, rainwaters from Gunung Mulu National Park in northern Borneo (4°N, 115 °E) were collected at both one-minute and daily intervals throughout multiple rain events in October and November 2012 and analyzed at Georgia Tech via cavity ring-down spectroscopy to obtain sample δ18O and δD values.

Investigation of the water composition within individual events highlight the influence of the "amount effect", whereby isotope values become more negative with increasing amounts of rain. A thorough review of local meteorological conditions and an analysis of HYSPLIT water vapor back-trajectories demonstrate the influence of the initial vapor source in determining the final isotopic composition of precipitation over Borneo. The occurrence of kinetic fractionation due to the evaporation of falling raindrops was found by plotting δ18O vs. δD for each rainfall event. Two-thirds of the rainfall events studied likely experienced evaporative enrichment, based on δ18O vs. δD slopes less that the equilibrium fractionation slope of eight represented by the global meteoric water line (GMWL). Relatively large variance in isotopic composition was noted between events over the sampling period (15‰ in δ18O and 110‰ in δD). Intra-seasonal climate variations, such as the Madden-Julien Oscillation (MJO), can dramatically alter regional weather patterns in the tropical Pacific and are presented as a potential source of this inter-event variability. Further establishment of relationships between small-scale, local rainwater isotopic compositions and large-scale regional and global weather patterns will continue to help illuminate the nature of climate variability in Earth's past, present, and future.

Poster Presentation # 104
Knowledge is Power: Leadership Emergence in Multidisciplinary Multiteam Systems

Morgan Foreman; Erica Richards; Bharathwaj Nandagopal
Leslie DeChurch, PhD (Psychology)

Solving intricate, large-scale problems requires teams from different areas of expertise to work together interdependently. For instance, social enterprise projects such as designing and constructing a well requires teams of experts in construction, engineering, geology, and local politics. Success in these complex multidisciplinary contexts requires multiple individuals to assume responsibility for leadership in order to ensure alignment of the system toward collective goals. This study seeks to understand the factors that predict individuals' emergence as leaders in multidisciplinary multiteam systems (MTSs). In a 12-person MTS laboratory task, we identify the relationships among people that predict leadership nominations. We harness an advanced network analytic approach (exponential random graph modeling) to compare the relative effects of different types of relationships among actors on the emergence of leadership. Results suggest that the degree to which individuals are viewed as sources of valuable information predicts the likelihood that their peers will nominate them as "leaders." Moreover, relationships characterized by providing valuable information were more strongly related to leadership nominations as compared to relationships characterized by a shared vision of the task (i.e., "shared vision ties") and relationships characterized by positive feelings (i.e., "social ties"). Interestingly, whereas 'shared vision' ties were more strongly related to leadership nominations than social ties during initial phases of task performance, during later phases, social ties were more strongly related to leadership nominations than shared vision ties. These findings provide important insight into the nature of the relational processes that give rise to leadership emergence.

Poster Presentation # 098
Selectively Targeting Prostate Cancer with Antiandrogen Equipped Genistein Conjugates

Alex George
Adeboyega Oyelere, PhD (Chemistry and Biochemistry)

Among American men, prostate cancer (PCa) is the second most leading cause of cancer-related death and accounts for nearly 240,000 new cases each year. Genistein, a natural soy isoflavone, is among the most potent phytogestrogens to have beneficial pharmacological effects in animal cells and also exhibit antitumor activity. A growing body of evidence shows that genistein regulates the expression of several genes that control cell proliferation, apoptosis, and survival. With regard to prostate cancer, studies have shown that genistein increases basal and chemotherapy-induced apoptosis in androgen insensitive PC-3 cells as well as androgen sensitive LNCaP prostate cancer cells. As prostate cancer is an androgen-dependent disease, androgen receptor (AR) plays a key role in the progression and proliferation of this cancer. In PCa patients, significantly higher levels of AR are observed. This observation was utilized to design a novel pharmaceutical model that would increase the specificity of drug delivery. An antiandrogen group bound to Genistein via a biocompatible linker could allow for the selective accumulation of Genistein in PCa cell nuclei. The facilitated transport of Genistein into the nucleus via AR binding could lead to more potent effects in multiple cellular pathways and ultimately the specific apoptosis of PCa cells.

Oral Presentation
Genetics of Captive Naked Mole-Rat Populations

Amy Groh
Michael Goodisman, PhD (Biology)

The evolution of highly social behavior (eusociality) represents one of the major transition points in evolutionary history. Naked mole-rats (NMRs), Heterocephalus glaber, are one of the few known eusocial mammals, meaning that they have a social caste system with a reproductive division of labor. In addition, NMRs show remarkable aging properties and tolerance to pain. Thus NMRs are important systems for studying life history traits. Surprisingly, however, very little is known about the mating systems and habits of NMRs. The goal of this study is to gain a better understanding of the population genetics and breeding habits of NMRs by looking at variable microsatellite marker regions. Microsatellites are highly variable regions of the

genome, which can act as identifiable markers for individuals. We have collaborated with Zoo Atlanta to study the population genetics of NMRs. We examined variation at 19 microsatellite markers that we developed among 16 NMR individuals. Three of these markers showed variability with two possible alleles. Thus we have obtained the first estimates of genetic variation from a NMR population. These markers will be used for variation screenings of NMRs from other captive populations, such as the San Diego Zoo and the Philadelphia Zoo. This information provides insight into the breeding programs among captive NMR populations. In addition, the techniques developed will be useful for studying NMR biology in other contexts and help us understand the development of sociality and variation in health systems.

Poster Presentation # 099
Progress Toward Co-crystallization of the E. coli Membrane Protein Intimin with Engineered Antibody Fragments

David Heaner
Raquel Lieberman, PhD (Chemistry and Biochemistry)

The determination of membrane protein structures by X-ray crystallography is essential for the development of new pharmaceutical agents. Conventionally, membrane proteins are solubilized by the use of mild detergents forming a protein detergent complex (PDC). However, the detergent can interfere in the crystallization of the protein, and/or decrease diffraction resolution of the resultant protein crystal. Membrane protein crystallization is further impeded by the lack of crystal contacts available for the nucleation of the protein crystal. As a means to overcome these crystallization challenges, engineered, peptide-specific, single chain antibody body fragments (scFv) and a Fab fragment have been developed for use as co-crystallization chaperones. The scFv or Fab fragment interacts with the membrane protein of interest via the hexapeptide epitope EYMPME (EE) which is selectively mutated into a hydrophilic loop of the protein by Site Directed Mutagenesis (SDM). To test this novel co-crystallization method, intimin, an E. coli outer membrane protein, has been modified to contain the EE tag (intimin-EE). Through gel filtration and SDS-PAGE analysis, complexation of intimin-EE with an anti-EE scFv or Fab fragment has been shown to occur, from which co-crystallization trials have ensued. Formation of a co-crystal for both the scFv and Fab complexes has proven to be difficult, which can be rationalized in part through molecular dynamics studies of the intimin-EE and Fab protein complex.

Poster Presentation # 103
Star-Disk Collisions in the Galactic Center

Thomas Kieffer
Tamara Bogdanovic, PhD (Physics)

Recent observations of the Milky Way's Galactic Center (GC) have re- vealed a relative paucity of red giant stars surrounding the GC's supermas- sive black hole (SMBH). It has recently been suggested that these 'missing' red giants can be explained by the interaction of red giant stars with the accretion disk that exists around the SMBH (Amaro-Seoane & Chen, 2014). The key idea is that red giant stars can be rendered unobservable if they lose a significant fraction of their tenuous stellar envelopes or are entirely disrupted in such collisions. We set out to test this theoretical prediction with hydrodynamical simulations of star-disk collisions.

Poster Presentation # 087
Deepwater Horizon impacts on the pelagic foodweb: Stable isotope constraints on zooplankton carbon and nitrogen sources

Drake Lee-Patterson
Joseph Montoya, PhD (Biology)

The offshore ecosystem of the Northern Gulf of Mexico is affected by inputs of oil and gas from natural seeps as well as accidental releases, such as the Deepwater Horizon (DWH) incident in 2010, which discharged an unprecedented volume of oil and gas into pelagic waters. We collected zooplankton from the Northern Gulf one month after the DWH wellhead was sealed, and have resampled the system annually. We use stable isotope measurements (δ13C and δ15N) to quantify the incorporation of low δ13C petrocarbon and low δ15N material from nitrogen fixation into the marine food web. Immediately after the spill, we found low δ13C values, particularly in the small size fraction of animals collected during the day in the mixed layer, and a shift to higher δ13C values at night. Small zooplankton from the mixed layer also showed diel shifts in δ15N, with low values predominating during the day and higher values at night. These diel changes reflect the integration of petrocarbon and recently fixed nitrogen fixation into the pelagic foodweb, and imply that incorporation of both petrocarbon and recently fixed nitrogen occurred primarily in the mixed layer. Zooplankton collected in subsequent years do not show consistent diel shifts in δ13C, though surface δ15N values were generally lower during the day than at night. Our data imply that the DWH spill made a measurable contribution to zooplankton production, and that this direct impact was relatively short-lived.

Poster Presentation # 083
Development of a low-cost system to analyze kinetics and kinematics of human locomotion

Emily Littrell
Young-Hui Chang, PhD (Applied Physiology)

In clinics for rehabilitation and prosthetics and orthotics, it can be useful to have a means of measuring gait kinematics in order to determine the effectiveness of treatment. However, it is inconvenient and expensive to install and maintain a full laboratory grade force plate and camera system set up in a clinic. This experiment aims to validate a Wii Balance Board (WBB) in conjunction with an overground walkway, Kinovea motion-tracking software, and ordinary video camera as a portable, low cost gait analysis system. Previous research has validated the WBB for balance, but not during gait. The WBB was placed directly on the force plate and ground reaction force (GRF) and center of pressure (COP) data were validated with known masses and then measured simultaneously during human gait. Kinovea and the camera system were validated by accurately following a trajectory and known angle, and joint angles and step lengths were obtained from gait analysis of a human subject. The low cost system showed similar trends and values for the GRF and COP data as compared to the laboratory grade system during both the validation and human gait experiments. The trajectory experiment and knee angle showed nearly identical results as well, however, there was a slight discrepancy for the ankle and hip angle measurements. The stride length calculated from the Kinovea and camera data were close in comparison. These results suggest that this low cost, portable system may be useful in a clinic to calculate basic gait kinetics, kinematics, and step length.

Poster Presentation # 100
An Analytical Approach to Soft Matter Materials: Development of Quantification and Characterization Techniques for Cationic Microgels

Anabel Liyen Cartelle
M. G. Finn, PhD (Chemistry and Biochemistry)

The research field of soft matter concentrates on the study of materials that exist between the solid and liquid phase, otherwise known as complex fluids. Of particular interest are temperature-sensitive microgels first prepared through emulsion polymerization utilizing the stimuli- responsive polymer poly (N-isopropylacrylamide) or pNIPAm. These environmentally sensitive microgels can be modified in order to introduce responsivity to factors like heat, pH, ionic strength, magnetic and electric fields, light, ultrasound, etc. Their unique properties allow for the implementation of these polymers in various chemical and biological processes, such as regulated drug delivery, bio-conjugation, tissue regeneration, and chemical separations. In order to make microgels more useful for specific applications, chemical functional groups are often incorporated in the structural matrix through copolymerization. More specifically, the successful incorporation of primary amine functional groups is important as they are useful in binding charged moieties in bio - conjugation. Based off previous work in the Lyon group, a system of amine-containing microgels was developed through copolymerization of poly (N-Isopropylmethacrylamide) (pNIPMAm) and the cationic co-monomer N-(3-aminopropyl) methacrylamide hydrochloride (APMA). These primary amine functionalized microgels were then conjugated to a dye through a standard EDC-NHSS coupling method. The conjugated dye, Rose Bengal, is characterized as having a high extinction coefficient and low quantum yields, and thus was found to be an optimal optical absorption compound for photoacoustic imaging applications. Photoacoustic imaging is a non-invasive imaging modality that relies on the principles of the photoacoustic effect. In this technique, the use of short laser-induced pulses generates local absorption of light, followed by quick heating, and a subsequent thermal expansion. As a result, broadband acoustic waves are produced and by recording these waves with the adequate ultrasonic transducers, the initial absorbed energy distribution can be recovered. Therefore, by making use of both the high contrast of optical imaging and high resolution of ultrasonic imaging, the technique shows the potential to give very high resolution images at depths of 6-7 cm under the skin. These results in image quality differ greatly from traditional fluorescent optical imaging which encounters multiple obstacles such as tissue autofluorescence, limited light penetration depth, and poor spatial resolution. Additionally, the use of dye-conjugated microgels as the absorbent compounds for this system is especially useful because the functionalized microgels can be further conjugated to tumor-specific biomarkers that allow for site-specific binding at nascent tumors, and thus production of site-specific high-resolution images. Along with target specificity, microgels also show significantly lower cell toxicity levels when compared to other materials previously used for this application such as metallic nanoparticles and carbon nanotubes. While the technology is available and has shown relatively positive results in image testing, the microgel synthesis parameters have not yet been successfully evaluated for efficiency in either amine incorporation or dye conjugation. By developing successful analytical assays for the characterization of these gel systems, one can manipulate synthesis conditions to develop microgels that have the highest image quality.

Poster Presentation # 088
The effects of sibling recognition due to habitat loss in coral reef fish

Kathryn Martin
Danielle Dixson, PhD (Biology)

Amphiprion percula, commonly known as the clown fish have shown behavioral avoidance of relatives through chemical cues. This project simulated the loss of habitat due to climate change and siblings being forced to share the same habitat. The sibling pairs were expected to show higher aggression level due to the

olfactory cues and to reduce inbreeding. The related pairs were shown to have much higher aggression levels than non-sibling pairs, even to the extent of decreasing survivorship.

Oral Presentation
Water Droplet Trapping

Brian McMahon
Ken Brown, PhD (Chemistry and Biochemistry)

The confinement of charged particles with electromagnetic fields is an area of physics that has been studied since before the early 1990's. The technique became popular after the publication of the Paul trap. Some of the most common electromagnetic traps are those used in mass detection devices and those in ion trapping experiments. Many of these devices exist to serve the purpose to confine singular atoms or clusters of atoms. However, many applications of this technology to different areas of science have not been explored.
In the Brown Lab of the Chemistry Department at Georgia Tech, I am developing planar ion trapping technology with applications to trap water droplets. These confined water droplets could be made to contain single living cells or other organic matter. I have demonstrated the electromagnetic confinement of saline solution droplets and other cellular supporting media. I am currently working to trap a cell in a droplet of solution, detect the cell via fluorescence measurements, and then move the droplet along the surface trap via DC electrodes into a designated area. This is enough to demonstrate the isolation and sorting of cells based on physical characteristics. This could be used in place of other cell sorting techniques as it has many advantages over other methods.

Poster Presentation # 102
Favia Corals: a new Paleoclimate archive

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

Projections of future climate change contain large uncertainties stemming from our inability to confirm long-term trends in climate models with short instrumental temperature records. Fossil corals are an important archive of past climate changes in the tropical oceans as oxygen isotopic ratios (δ18O) in their skeletons reflect ambient ocean temperature during the time they grew. Most coral-based reconstructions to date have utilized cores from the genus *Porites*. However, as this genus is not evenly distributed across the tropics or continuously available within the fossil record, there is a need to expand the types of coral archives available. Corals from the genus *Favia* may be ideally suited for paleoclimate reconstruction as they are widely distributed across the tropics and are abundant in the fossil record at Kiritimati Island, our research site in the tropical Pacific. Initial measurements made along two main skeletal structures, the thecal wall and the septa, show that δ18O in the thecal wall is more coherent with instrumental sea surface temperature (SST) from our site. δ18O measured along three ~5yr long transects on thecal walls within a single *Favia* coral lie within analytical error and are highly correlated with SST (R = -0.77). Additional work will focus on testing reproducibility of climate signal across multiple *Favia* colonies, after which we will apply this methodology to fossil corals from Kiritimati Island. These preliminary results suggest that *Favia* may be an untapped climate archive that is capable of providing robust constraints on natural climate variability in the tropical Pacific.

Oral Presentation
Imaging Lysosomes and Secreted Cathepsins for Personalized Medicine

Nina Mohebbi
Christine Payne, PhD (Chemistry and Biochemistry)

Cathepsins, members of the papain family of proteases, have been implicated in the initiation and progression of tumors, cardiovascular disease, and osteoporosis. Due to their involvement in multiple diseases, many studies have focused on using cathepsins as biomarkers for disease progression. In addition, cathepsin inhibitors have been suggested as treatments for their associated diseases. Between the years of 2004 and 2010 alone, 50 patent applications were filed for potential cathepsin inhibitors. Unfortunately, due to severe side effects, many inhibitors were terminated at the Phase II clinical testing stage. This suggests that not enough is known about the cellular mechanism associated with cathepsins to ensure successful translation of these inhibitors to clinical applications. Cathepsins are stored in lysosomes, and therefore we propose that lysosomal activity, movement, and secretion will be tied to the level of cathepsin activity. Fluorescence microscopy with custom image analysis is used to track lysosomes within the cell and biochemical assays are used to assess enzymatic activity. These results are used to evaluate potential correlations between lysosome characteristics, such as size and/or cathepsin localization and the level of cathepsin activity. Results from an immunofluorescence experiment showed that cathepsin L present inside of the cell is not exclusive to storage within lysosomes. Results from image analysis also show an increase in lysosome size when E-64, which inhibits cathepsins B, H, and L, is added to cells, which could be a result of cargo which is not being broken down. The long-term implications of this research include providing clinicians and pharmaceutical developers with ways to predict the rate of disease progression on a patient to patient basis, and therefore more personally evaluate risk and designate aggressive or more passive treatment options.

Poster Presentation # 089
Adaptive radiation's impact on ecosystem functioning

Steven Morrison
Lin Jiang, PhD (Biology)

Adaptive radiations have played an enormous part in creating the

vast diversity of life on earth by shaping organisms to fit a large number of environments (Spiers et al 2002). The purpose of this study is to examine how they can impact ecosystem functions. The first step of the experiment involves measuring the niche and fitness of two strains, SBW25 (fast evolving) and PRB716 (slow evolving), of the bacterium Pseudomaonas fluorescens, to verify that their difference in operons does not have dramatic effects on their performance. In the second part of the study we will evolve SBW25 and PRB716 separately while monitoring their diversification and ecosystem functions. We expect the adaptive radiation they experience will drive their functioning more and more different over time. The final step will involve the introduction of other players to the system such as interspecific competitors and predators, to test the effect of species interactions on the ecosystem functioning of an evolving system.

Poster Presentation # 090
Chemoreception of Aversive Compounds in Predatory Fish

Maeve Nagle
Julia Kubanek, PhD (Biology)

In marine ecosystems, chemical defenses are one method by which prey animals, especially soft-bodied, slow-moving or sessile organisms, can protect themselves from predation. Triterpene glycosides have been previously shown to act as antifeedant compounds in fish feeding assays, but the mechanism by which the fish sense these antifeedant compounds has not yet been elucidated. A membrane co-receptor called RL-TGR involved in sensing these triterpene glycosides has been discovered in zebrafish Danio rerio, but its structure has not yet been detailed. In order to gain further knowledge about this protein, mutants of TL-TGR were created in order to determine the most important residues to the protein's functionality. Understanding the mechanism by which RL-TGR works as well as the extent to which it is found in nature will shed further light on the processes of chemical defense signaling in marine environments.

Poster Presentation # 091
TfoX Regulation in Vibrio Colorea

Siu Lung Ng
Brian Hammer, PhD (Biology)

Natural transformation is the ability to take up the exogenous genetic materials from the environment through the cell membrane by horizontal gene transfer (HGT), which the bacteria are able to incorporate the DNA elements into the chromosome and gain a new ability, such as antibiotic resistance, in order to increase the fitness in different environment. However, only some bacteria can be competent to perform transformation. A waterborne and human pathogen, Vibrio cholerae is one of the examples. It can be competent under certain conditions: Nucleoside starvation, high cell density, and presence of chitin, and they are regulated by CytR, HapR, and TfoX, respectively. This competence regulatory pathway (CRP) is important because it is highly related to HGT, which might have significant impact in the evolutionary history of V. cholerae. In addition, the CRP might conserve amount other species. Although the most of the upstream mechanism of CRP are understood, the most of the downstream pathways are still unknown. This study focuses the unknown regulatory pathways downstream of TfoX. There are two hypotheses; the first hypothesis either is that TfoX directly or indirectly regulates the competence gene. If it is the second case, the next hypothesis is that TfoX can be either an activator or repressor that activates or represses an unknown intermediate regulator, which can be either an activator or repressor as well.

Poster Presentation # 092
Treatment of Infantile Hemangioma by knockdown of the Yes-associated Protein 1 pathway

Dianna Nord
Eric Gaucher, PhD (Biology)

Hemangioma is a type of tumor commonly found in infants that is characterized by heavy vascularization and a disfiguring appearance. Hemangioma, though benign, can sometimes proliferate and be threatening to infants. Current treatments for infantile hemangioma include surgical removal as well as the use of topical and oral medication. However, current therapies are often ineffective at treating lesions and are commonly accompanied by dangerous side effects, creating the need for a new, safer treatment. This study targets the Yes-Associated Protein-1, which has been described as an oncogene, by use of an interfering RNA technique in attempts to mediate tumor growth and progression. Western blotting of treatment and control cells reveals that YAP-1 is knocked down in treatment groups which have been infected with shYAP-1 siRNA genes. By successfully knocking down the YAP-1 protein, a potential for a novel therapeutic target has been established.

Poster Presentation # 093
Determination of the Effects and Mechanisms of Compounds Associated with Various Biological Signaling Pathways on the Regeneration of ßcells in vivo

Deeti Pithadia
Chong Shin, PhD (Biology)

Diabetes is an endocrine disease characterized by abnormally high blood glucose levels. It is caused by destruction of pancreatic ß-cells and a subsequent decline in insulin secretion. Chemicals associated with a variety of biological signaling pathways are known to be effective in alleviating the symptoms for numerous diseases and medical conditions, including diabetes. Recently, an increasing number of studies are analyzing biological

signaling compounds in the novel context of having the potential to directly stimulate regeneration of pancreatic ß-cells. This study tested the effects of various chemicals on the up-regulation of insulin regeneration. The ultimate goal was discovery specific drugs that may treat diabetes by directly increasing the size and insulin-secreting functionality of the ß-cell mass, as well as to determine their mechanisms of action. Approximately 70 small molecules were screened to identify enhancers of ß-cell regeneration using transgenic zebrafish as the model organism. It was discovered that small molecule A*, which is known to inhibit the catalytic activity of the protein kinases of biological signaling pathway X*, is an inducer of ß-cell regeneration following ablation of ß-cells. This compound and signaling pathway X have potential to be involved in the reversal of ß-cell death in diabetes. *Name of compound and signaling pathway have been withheld for the purpose of
confidentiality, as the work is currently on track for publication.

Poster Presentation # 084
Optimization of Air-Filled Cushion Inflation Level

Steven Pubillones
Stephen Sprigle, PhD (Applied Physiology)

Air-filled wheelchair cushions represent the most popular cushions for wheelchair users who are at-risk of developing pressure ulcers. One challenge of using air cushions is the need to optimize its inflation. The objective of this study was to investigate the association of wheelchair cushion inflation, internal air pressure, and compliant buttock model deformation to optimize the cushion for patient use. Data was collected from a ROHO cushion over 5 trials at 7 inflation levels, and 2 loads. The inflation level was determined based upon the immersion of a buttocks model. The buttocks model has a rigid substructure representing the pelvis surrounded by a compliant elastomeric shell. It houses two pressure sensors along the lateral and IT lines, and seven ultrasound transducers to measure the thickness of the model. The cushion was preconditioned for 2 cycles under a load of 53kg for 120s followed by a rest period of 5min between cycles. During the first cycle a dowel was inserted between the fingers of the cushion. The load was applied and the cushion was deflated until the dowel could no longer be turned by hand. This was done to simulate a physician using his fingers to adjust the cushion. After preconditioning, the cushion underwent 5 cycles under loads of 53kg and 61kg for 220s with a rest interval of 2min between cycles. The loads represent the weight applied to the cushion by individuals of two different body weights. The study resulted in pressure on the model ranging from 52.93mmHg to 203.38mmHg over both pressure sensors. The deflection of the cushion ranged from -5.29mm to 6.03mm over all transducers, loads, and inflation levels. This study concluded that the optimal inflation level occurs between both extremes, allowing for some error in human inflation without posing a risk to the wheelchair user.

Poster Presentation # 094
Developing a system to analyze apoptosis in polygenic multicellular snowflake yeast

Jennifer Rattray
Will Ratcliff, PhD (Biology)

The advent of multicellularity is arguably the most important evolutionary transition life has seen. When defined as an aggregation of cells, multicellularity has evolved multiple times in at least 25 lineages under different circumstances and conditions, indicating that this complex system of selective pressures and tradeoffs has proven favorable. However, life is not just dominated by easily defined multicellular or unicellular organisms and conforms to no simple formula. Plasmodial slime molds such as Physarum polycephalum exist as one large cell with thousands of independent nuclei originating from the fusion of individual ameboids. Their cellular slime mold relatives, such as Dictyostelium discoideum, usually exist as single-celled ameboids, but under low nutrient conditions aggregate into a swarm to form a multicellular organism. Single-celled organisms currently dominate their multicellular progeny not only in terms of species richness, but also in abundance, indicating that strong selection is required for multicellular evolution. Despite the enormity of this transition, the details and genetic basis for the foundational morphological characteristics are largely ambiguous and unknown. This study uses a novel multicellular "snowflake" yeast system to target the three foremost morphological features of experimentally evolved multicellular yeast, roundness, apoptosis, and cluster size, and aims to determine their genetic basis in order to provide a basis for further research and to demystify the complex system of tradeoffs and selective advantages that enabled an individual single cell to form an individual composed of many cells. Understanding this transition has implications that echo millions of years.

Oral Presentation
Mechanism of Protein-Mediated PEDOT:PSS Synthesis

Jessica Richey
Christine Payne, PhD (Chemistry and Biochemistry)

Poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS) is a transparent, water-soluble polymer mixture that is conductive. Due to these properties, this polymer can potentially be utilized as a flexible, organic conductor in a variety of applications from light emitting diodes to regenerative medicine. An advantage to using PEDOT:PSS is the ability to tune its conductivity through doping concentration. This can be done post-polymerization through secondary doping or during polymerization by changing the oxidant used. The two proteins that this study focuses on are catalase and hemoglobin. Hemoglobin-mediated PEDOT:PSS had a higher conductivity than the catalase-mediated polymer. This difference arises due to the difference in charge carrier species. When the "free"

iron in catalase was the active oxidant, polarons dominated, but when the heme groups in hemoglobin were active during synthesis, bipolarons dominated. Now that this correlation has been established, we propose a way to predict the dominant charge carrier species by measuring the free iron released from proteins. To do this, we manipulated an already established iron assay, to run in PEDOT:PSS synthesis conditions. In order for PEDOT:PSS to polymerize, the pH must be around 1.1, compared to the current pH of the iron assay, pH 4.7. In the future, we hope to use this test to select proteins as oxidants for the synthesis of PEDOT:PSS with tunable conductivity.

Poster Presentation # 095
Cultivation of Sphagnum Moss Microbiome

William Sexton
Joel Kostka, PhD (Biology)

The northern peatlands are one of the largest stores of terrestrial carbon on the planet making them an important part of the global carbon cycle (Turunen et al 2002, 2004). These areas are a major player in global climate change due to their ability to serve as sinks of atmospheric carbon (Yu et al 2011). Most northern peatlands are dominated by Sphagnum mosses which contribute to their carbon sink characteristics by sequestering carbon in biodegradation-resistant phenolic compounds, retarding microbial growth by making the soils acidic and anoxic, and inhibiting the growth of vascular plants (Verhoeven and Liefveld 1997, Malmer et al 2003). Sphagnum mosses are able to grow in the nitrate-poor soils of the northern peatlands by forming mutualistic relationships with bacterial diazotrophs that fix atmospheric nitrogen into forms usable by the mosses and synthesize fungicides to fight off fungal pathogens (Opelt et al 2007). Global climate change is expected to drastically alter the northern peatlands in the near future, so we must have a complete understanding of the relationship between Sphagnum mosses and their microbiomes if we are to accurately predict how they will respond to the changes in their environment. In order to do this the diazotrophs and other bacteria partnered with Sphagnum mosses must be cultivated and characterized.

Poster Presentation # 096
Mutations that Increase the Efficiency of DNA Repair When Using Transcript RNA as a Template

Aly Skulskaya
Francesca Storici, PhD (Biology)

All living organisms contain genetic material encoded in DNA or RNA, which are the building blocks for the composition and function of the body. The genome is compromised of genetic material and contains both genes and non-coding sequences of DNA and RNA. A genome's stability is compromised of its ability to maintain integrity and prevent future discrepancies from proceeding to new generations [5]. Interaction with various chemicals and environmental agents, however, can promote errors in the genome, which can cause damages or mutations in the DNA. In addition, DNA replication is prone to error during cell division [1]. Several factors such as proofreading enzymes, checkpoints, and cellular arrest exist to prevent mutations or double-stranded breaks (DSB) from occurring during replication, however some are able to survive them. The surviving mutations or DSB are usually repaired using similar or identical molecules of DNA as a template for repair, this process is known as homologous recombination. Although this method is commonly used, RNA viruses have shown to perform homologous recombination using RNA molecules [2]. With this knowledge, researchers questioned whether RNA molecules could be used to repair the DNA of an organism.
The purpose of this study is to determine other types of mutations that can improve the efficiency of repair. As seen in the study described above, altering the genes SPT3, RNH1, and RNH201 allowed DNA to use transcript RNA as a template. With the yeast genome containing 5,770 genes the likelihood of finding mutations that can improve the efficiency of repair is high. The results from this study can potentially be used to treat diseases, caused by DNA damage, in a more efficient way. The abundance of transcript RNA in our cells can now be put into use"...RNA may have a marked impact on genomic stability and plasticity"[2].

Poster Presentation # 097
Nitrogen Sources in the Gulf of Mexico found through Dissolved Inorganic Nitrogen (DIN)

Anna Taylor
Joseph Montoya, PhD (Biology)

Sources of nitrogen in the Gulf of Mexico were investigated using the ammonia diffusion method to measure levels of dissolved inorganic nitrogen. This study builds on past studies that have referenced nitrogen isotope levels in zooplankton and phytoplankton. Samples were taken at different sampling locations at multiple depths throughout the Gulf of Mexico. The goal of this study is to map the different sources of nitrogen throughout the entirety of the Gulf of Mexico.

Poster Presentation # 101
Total Synthesis of a Chemical Inducer of Dimerization for the Vitamin D Receptor

Shengyuan Wang
Donald Doyle, PhD (Chemistry and Biochemistry)

The copper-catalyzed alkyne-azide cycloaddition (CuAAC) reaction describes a combination reaction of a molecule with an alkyne functional group and another molecule with an azide functional group (shown in scheme 1). This reaction is very useful due to its bioorthogonal, efficient, stable product, and environmental friendly properties1,2, however there are limited

vivo options for the CuAAC reaction, and these options face difficulties in designing reactants or reaction conditions.
The overall goal of this project is to discover an enzyme catalyzes the CuAAC reaction in vivo. The target enzyme will be detected through gene expression in yeast with thevitamin D receptor / vitamin D3 ligand pair and the streptavidin / biotin ligand pair. The two receptors are used due to their high sensitivity. The ligands will be modified to contain alkyne and azide functional group to serve as reactants of the CuAAC reaction. The project goal is the synthesis of vitamin D3 derivative.
Previous semesters' efforts on this project through functionalizing the tertiary alcohol in Vitamin D3 structure center concluded that route is not possible, and a new total synthesis scheme is proposed. The new scheme attempts to build a side chain containing an alkyne functional group on carbon 21 position, final product (compound 4) shown below. C-23 - C27 chain as well as the alkyne group chain will be built from compound 1, the resulting compound 2 will couple with compound 3 to yield the final product.

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Oral Presentation
Cramer-Rao Lower Bound Assessment When Using Bistatic Clutter Mitigation Techniques

Marsal Bruna
Kristin Bing, PhD (Georgia Tech Research Institute)

A bistatic receiver allows for passive measurements of target locations and velocities. In other words, the transmitter can function independently of the receiver. In addition to typical radar transmitters, a broadcast or communication signal can be used as a transmitter of opportunity. In many bistatic geometries, clutter becomes non-stationary with range and, thus, clutter mitigation strategies must be adapted accordingly. Space-time adaptive processing (STAP) algorithms may be used to mitigate clutter and reduce signal-to-interference-plus-noise ratio (SINR) loss for better detection of slow-moving targets; however, steps must be taken to address the clutter stationarity assumptions inherent in traditional, monostatic STAP. Adaptive angle-Doppler compensation (A2DC) is one method to address the clutter non-stationarity.

In this research, the performance of STAP algorithms is assessed in a novel way for surface targets. The range, velocity, and angle estimation accuracies are efficiently calculated for a grid of possible target locations using the Cramer-Rao Lower Bound (CRLB). The accuracies of different STAP algorithms may also be compared for an area of target locations by calculating SINR loss in a higher fidelity simulation and then applying it to the appropriate CRLB inputs. This new technique allows for the performance comparison of STAP algorithms at different receiver and transmitter locations without seeding targets in a time-consuming, physics-based simulation. This new technique is of use in determining the optimal placement of the receiver and transmitter in the presence of clutter when using STAP algorithms.

Poster Presentation # 085
Activity Tracking Technology Catalyst Project

Kendall Burton
Cara Fausset, PhD (Applied Physiology)

The purpose of this research is to expand feedback available for five activity tracking devices used among older adults to help progress current and emerging technology towards becoming more compatible with the aging population. Through the use of five different activity trackers and eighty participants, this study builds upon the already existing knowledge regarding the aging population's attitudes toward technology, specifically activity tracking devices. The five different activity-tracking technologies include the Fitbit Charge, Misfit Flash, Withings Pulse, Spire, and Jawbone UP. Each activity tracking device was run with 16 participants split into each of the following age ranges: 50-59, 60-69, 70-79, and 80+. Over the course of four to six weeks users gave feedback on devices, using daily diary entries, including details about the device design as well as the ease of use and compatibility of the device with their lifestyles. This newly found knowledge identifies gaps in products that are currently available to the older population to give companies producing these technologies, and others, the opportunity to create devices that will be user friendly, effective, and valuable to the aging population in the future.

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Poster Presentation # 111
Particle Image Velocimetry for Collapsing Toroidal Droplets

Eric Berger
Malavika Shetty, PhD (Literature, Media, and Communication)

The goal of this study is to explore the mechanism by which unstable toroidal droplets collapse inwardly. As such, particle image velocimetry methods will be employed in obtaining an experimental picture of the velocity field inside of unstable toroidal droplets as they collapse. The inward collapse exhibited by unstable toroidal droplets is unique to the geometry of the torus and is therefore physically interesting. There is currently not an available experimental picture of this collapse, so this study will attempt to fill that void. Ultimately the results of this study will be compared against the currently accessible theoretical pictures of collapsing toroidal droplets, leading to further refinements in the field.

Oral Presentation
Challenges in the Translation and Commercialization of Cell Therapies

Brittany Dodson
Aaron Levine, PhD (Public Policy)

Background: Cell therapies are an emerging form of healthcare that offer significant potential to improve the practice of medicine and provide benefits to patients who currently have limited or no treatment options. Ideally, these innovative therapies can complement existing small molecule, biologic, and device approaches – forming a so-called fourth pillar of medicine and allowing clinicians to identify the best treatment approach for each patient. Despite this potential, cell therapies are substantially more complex than small molecule or biologic interventions. This complexity poses challenges for scientists and firms developing cell therapies and for regulators seeking to oversee this growing area of medicine.
Results: In this project, we retrospectively examined the development of seven cell therapies – including three autologous interventions and four allogeneic interventions – with the aim of identifying common challenges and promising strategies to help scientists, firms, and regulators successfully bring new cell therapies to market. We complemented this analysis with a series of qualitative interviews with experts in various aspects of regenerative medicine, including people working in academia and industry as well as those working in relevant portions of the financial sector. Through our analysis—developed through a review of extant literature collected from company documents, newspapers, journals, analyst reports and similar sources, and then refined through analysis of the qualitative interviews—we identified several common challenges that cell therapy and regenerative medicine firms must address in both the pre- and post-market stages. Key pre-market challenges included identifying and maintaining stable funding to see firms through lengthy developmental timelines and uncertain regulatory processes. These challenges are not unique to cell therapies, of course, but the novelty of cellbased interventions complicates these efforts compared to small molecule or biologic interventions. The atypical nature of cell therapies also led to post-market difficulties, including challenges navigating the reimbursement process and convincing medical providers to adopt innovative treatment approaches. In addition, managing the cost of producing, storing, and distributing cell therapies at scale were challenges that started pre-market and continued into the post-market phase.
Conclusions: Our analysis highlights several interrelated challenges hindering the development of cellular therapies. Identifying strategies to address these challenges may accelerate the development and increase impact of novel cellular therapies. Numerous challenges must be addressed nearly simultaneously and with the understanding that actions taken to address one challenge may potentially exacerbate other challenges. The most straightforward recommendation arising from this research would be to focus on commercialization early. This recommendation reflects the reality that seemingly innocuous decisions made early in the development process, perhaps in an academic research environment, can greatly complicate later translation and commercialization efforts. A second best practice would involve focusing on the efficient use of capital. In addition to informing industry, our study of the challenges associated with bringing cell therapies to market also offers lessons for government officials working to oversee the development of and determine reimbursement levels for novel cell therapies.

Oral Presentation
Emerging Threat of ISIS: Insurgency Strategies

Shaudie Fassih
Margaret Kosal, PhD (International Affairs)

As the world enters a fourth generation of warfare, this research study assesses the evolution of non-state terrorist organizations in the Middle East. Currently, ISIS (Islamic State of Iraq and Syria) is identified as a foreign terrorist organization by the United Nations, United States, Saudi Arabia, etc. Lieutenant Colonel David Kilcullen, former senior counter-insurgency advisor to General David Petraeus and special advisor to Secretary of State Condoleezza Rice, concurred "ISIS is the most dangerous terrorist group in the world because they combine the fighting capabilities of al Qaeda with the administrative capabilities of Hezbollah…it's clear that they have a state-building agenda and an understanding of the importance of effective governance." Given an investigation on the four conditions of geography, motivation, strategy, and capability, ISIS ought to be classified as

an insurgency group utilizing terrorist tactics to develop its own Islamic state. Subsequently, these results are challenged against Mao Tse-Tung's China insurgency model to verify the capability of ISIS to function as an insurgency group. The ability of ISIS to accumulate supporters from across the globe and distribute power similar to a state government illustrates the evolution of insurgencies to the international community.

Poster Presentation # 108
Chikungunya

Tanner Hendrick
John Tone, PhD (History, Technology, and Society)

My poster is on the disease Chikungunya, a disease that just last year arrived in the US. I give general stats, and explain via infographic how it is transmitted, prevented, and treated. I gathered data from the CDC and WHO websites to create a map showing what states it is most prevalent in, and in what manner it manifests itself. I include a section on how we can expect Chik to proceed—is it something we should fear here in the US—by reading studies of its' course in other countries, analyzing US state environments, and interviewing experts of the disease by phone.

Poster Presentation # 105
Jevons Paradox: A Microeconomic Approach

Shannon Kehoe; Heather Yutko
Shatakshee Dhongde, PhD (Economics)

For the last few decades, energy and climate policy have been high on the global agenda. The main objective of these complementary policy branches has been to reduce energy usage, often by promoting energy efficiency in existing technologies. Some economists, however, postulate that increased technology efficiency actually leads to greater energy consumption. The savings generated by increased output per unit of energy could result in increased use of energy through several routes, including direct consumption of more energy via the income effect, increased consumption of other goods requiring high quantities of energy via the substitution effect, or economic growth because of productivity gains, which in turn causes increased energy consumption. Such rebound effects are predicted by the scenario known as Jevons' Paradox. Our study examines the possible effects of Jevons' Paradox at the microeconomic level by carrying out a series of multiple linear regressions to determine whether or not the increased usage of Energy Star appliances—appliances complying with high government efficiency standards—leads to an increase in energy consumption by households. We then use our results to assess the effectiveness of the Energy Star program in decreasing energy consumption and discuss the wider policy implications of our study.

Poster Presentation # 109
Students of the Edge of Society: The Intersection of Poverty, Mental Health, and Education

Erica Louise Richards
Jennifer Singh, PhD (History, Technology, and Society)

This paper investigates the relationship between signs of poor mental health and the academic success of high school students in socioeconomically marginalized communities. Although numerous studies have been done on issues of posttraumatic stress disorder among innercity/urban youth, not many have addressed the prevalence of similar factors in racially-homogenous, rural communities. Furthermore, this research considers the impact that those students' behaviors have on their learning environment. A group of educators from a predominantly low-income, rural Georgia public high school were surveyed to evaluate academic achievement trends of consistently disruptive students as well as the correlation between their most common, problematic behaviors and symptoms of adolescent posttraumatic stress disorder. The responses to these questionnaires were cross-analyzed with census data to determine the socioeconomic status of the population studied. Public information about the high school was used to compare the school's rankings and standardized test scores with those of the more affluent schools in the district. The findings of this research support the theory that adolescents in distressed, low-income communities are likely to exhibit symptoms of posttraumatic stress disorder, which negatively influence their academic achievement. Disruptive students of low-socioeconomic status in underserved, rural communities tend to receive punishment for inappropriate actions instead of treatment for the sociological/psychological causes of their disruption. Further research should seek to address the ways in which a highly disruptive mental health disorder of that nature can exacerbate issues of social stratification if left untreated in students of marginalized populations.

Poster Presentation # 106
Effects of gasoline price levels on GDP of countries

Anupama Sekar; Lindsay Purcell
Shatakshee Dhongde, PhD (Economics)

The effects of the current fall in gas prices across the world are already being hypothesized. This paper attempts to establish the effects of gas price on gross domestic product (GDP) in the year 2002 in 183 different world economies, with the hopes of isolating gas prices' overall effect on GDP. This paper attempts to specifically isolate these two variables and then examine complementary factors that account for why certain periods of gasoline price changes affected the world in the ways that they did and what can be expected in the future with forecasted changes in those prices.
First, the relationship between these two variables was

examined in a simple linear regression. In addition to gas price, the independent variables consumption, savings, government expenditure and exports (all as percentages of a country's GDP), were also examined in a multiple regression analysis, which allowed the relationship between gas price and GDP to be further isolated. While this paper is based in economic theory and is related to the subject's previous literature, the paper also provides a unique view by focusing on the global effect of gas prices in a single year through cross-sectional analysis.

Poster Presentation # 107
On foreclosure rates and the house price index: A cross-sectional analysis

Shivang Sullere
Shatakshee Dhongde, PhD (Economics)

This paper attempts to firmly establish the dependence of house price index on foreclosure rates, a prerequisite to substantiating "let-sink" foreclosure policy. In our paper, we first examine a simple linear regression model to show that there are omitted variables in the model, and therefore, more variables other than just foreclosure rates have to be considered. We then continue with the multiple linear regression model by looking at the influence of foreclosure rates, education, property tax, income tax, stimulus, and legal system upon house price index. By using this model, we show that most variables do not have statistical significance, individually or jointly, except for foreclosure rates and legal system. Finally, we reject the null hypothesis and conclude that house price index is significantly dependent upon foreclosure rates and the state legal foreclosure system.

Poster Presentation # 110
Prescription Direct-To-Consumer Advertising Reinforcement of Gender Stereotypes in Magazines with Highly Gendered Readership

Elizabeth Warden
Jennifer Singh, PhD (History, Technology, and Society)

The media has the power to influence what gender norms people internalize. When prescription direct-to-consumer advertisements use gender stereotypes to market and sell drugs, dominant gender notions of what is appropriate are reinforced. This study is based on a content analysis of 152 prescription product advertisements from January 2014 to December 2014 in Cosmopolitan, Family Circle, WIRED, and Popular Mechanics, four magazines whose readership is highly gendered. Based on this primary data, this project examines the types of prescription products being advertised to women as compared to men and how gender stereotypes are portrayed in these advertisements. The results of this study indicate that prescriptions directed at young women were predominately for preventing pregnancy. However, prescription products directed at older women were for a diverse range of prescription products, which implies that older women have influence over not only their own health but also the health of other family members. Mental health advertisements were advertised exclusively to women target audiences, which may reinforce stigmas associated with men seeking psychiatric help and the proneness of associating women to emotional problems. In contrast, prescription drugs marketed directly to men have a higher percentage of sexual lifestyle products than any other type of prescription. The findings indicate that the types of prescription drugs advertised to men reinforce stereotypical notions of masculinity through assertions that the medical maintenance of sexual prowess should be valued over other divisions of healthcare. The way in which the characters in these advertisements were presented also support traditional gendered divisions of labor by more often including men as working professionals and women as parents. The implications of these findings are discussed.

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Wail Falath
Shaghayegh Fathi
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Kate Fu
Daichi Fujioka
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James Hite
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Brandon Kenwood
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Hye Kyung Kim
Purva Kodlekere
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Salimah LaForce
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Daniel McGrail
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Kelsey Merlo
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Jillian Walker
Zhen Wang
Linda Wills
Paul Winget
Shuman Xia
Saman Yarmohammadi
Nazia Zakir
Chong Zhou
Keenan Zhuo
Alexander Zook

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Banerjee, Shurjo	D	2:10 PM	SC 320
Basunia, Sumia	C	1:20 PM	SC 321
Blacker, Aaron	E	2:50 PM	SC 343
Curtis, Maxwell	E	2:50 PM	SC 343
Bosma, Christopher	C	1:40 PM	SC 321
Bruna, Marsal	D	2:30 PM	SC 320
Burton, Jasmine	F	2:50 PM	SC 319
Carithers, Jaci	A	1:00 PM	SC 301
Crawford, Kaci	I	4:10 PM	SC 320
Culbertson, Preston	J	3:30 PM	SC 343
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Krishnaswamy, Vikram	I	3:30 PM	SC 320
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Richey, Jessica	G	3:00 PM	SC 321
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Si, Alvin	J	3:50 PM	SC 343
Smith, Ana	B	1:00 PM	SC 319
Song, Won Sup	I	3:30 PM	SC 320
Stockslager, Max	I	3:50 PM	SC 320
Turbyfield, Cory	I	4:10 PM	SC 320
Votaw, Nicole	H	3:50 PM	SC 301
Wang, Yijie	B	1:20 PM	SC 319
Wang, Christopher	D	1:30 PM	SC 320
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Yoon, Hee Young	J	4:10 PM	SC 343

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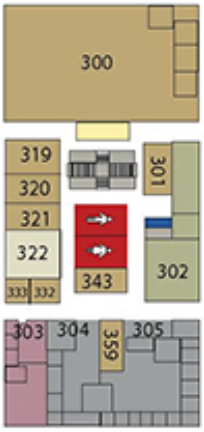
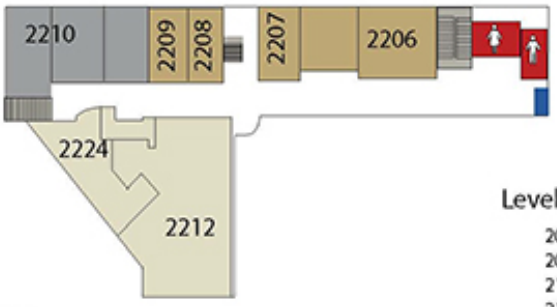
Level 3 - Student Center

300 Ballroom
301 Meeting Room
302 Ferst Place Restaurant
303 Craft Center
304 GT Dining
305 Student Center Offices
319 Meeting Room
320 Meeting Room
321 Meeting Room
322 BSO Suite
332 Meeting Room
333 Meeting Room
343 Meeting Room
359 Board Room



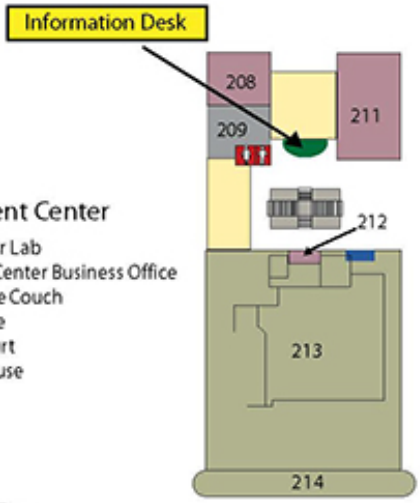
Level 2 - Commons

2206 Crescent Room
2207 Cypress Room
2208 Spring Room
2209 Pine Room
2210 Auxiliary Services - IT
2212 Student Involvement
2224 WREK Radio



Level 2 - Student Center

208 Computer Lab
209 Student Center Business Office
211 Under the Couch
212 Box Office
213 Food Court
214 Greenhouse



Level 1 - Commons

1100 Chick-fil-A, Subway, Taco Bell
1101 Tech Optical Express
1102 Jacket's-featuring Wow! Café
1103 Burdell's
1104 Midtown Stage
1105 Copy Center
1106 Piedmont Room
1108 Student Government
1118 Einstein's Bros Bagels
1120 Kaplan Test Prep Center
1124 BuzzCard Center
1126 Famous* Hair
1128 Juniper Room

Restrooms
Lounges
Elevators

Level 1- Student Center

100 Post Office
115 Student Center Theater
116 Pizza Hut
117 Tech Rec
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