2018

Welcome to the

13th Undergraduate Research Spring Symposium

Tuesday, April 17, 2018 | 1:00 - 6:00 pm

Student Center, Third Floor

For more information, visit

urop.gatech.edu/spring-symposium

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

1:00 pm – 1:35 pm	**Introduction and Keynote Address** *Student Center Ballroom*
1:40 pm – 2:40 pm	**Poster Presentations** *Student Center Ballroom*
2:45 pm – 4:00 pm	**Oral Presentations** *Student Center Ballroom and Rooms 301, 319, 320, 321, 332 and*
4:05 pm – 5:05 pm	**Poster Presentations** *Student Center Ballroom*
5:05 pm – 5:35 pm	**Reception** *Student Center Ballroom*
5:35 pm – 6:00 pm	**Awards Ceremony** *Student Center Ballroom*

Welcome to the Georgia Institute of Technology's 13th Annual Undergraduate Research Spring Symposium. The work of our students and their faculty advisors demonstrates a commitment to not only investigate, but also 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!

Allyson Tait

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Oral Presentation Sessions

Student Center, 3rd Floor

Session A: Mechanical Engineering and Materials Science and Engineering

Student Center Room 301

Moderator: Ms. Sally Hammock

2:45 pm **Inorganic Modification of Cellulosic Fibers for Enhanced Oil Sorption Capacity**
Andrew Short
Mentor: Dr. Mark Losego, MSE

2:55 pm **Load Dependent Fatigue Crack Initiation in High Purity Al**
Xueqiao Wang
Mentor: Dr. Josh Kacher, MSE

3:05 pm **Force-Signal Coupling at Single Focal Adhesions**
Nicolas Castro
Mentor: Dr. Andres Garcia, ME

3:15 pm **Path Optimization for Image Deblurring**
Beatriz Fusaro
Mentor: Dr. Jun Ueda, ME

3:35 pm **Techno-Economic Comparison between Conventional and Innovative Solar Thermal Power and Desalination Methods for Cogeneration**
Megan Haynes
Mentor: Dr. Shannon Yee, ME

3:45 pm **Self-Powered Hydraulic Sensing Node**
Max Toothman
Mentor: Dr. Kenneth Cunefare, ME

3:55 pm **Elastic Behavior of Larvae Aggregations**
Joshua Trebuchon
Mentor: Dr. David Hu, ME

Oral Presentation Sessions

Student Center, 3rd Floor

Session B: Biomedical Engineering

Student Center Room 319
Moderator: Mr. Fredrick Holloman

2:45 pm **Volumetric Destruction-Reperfusion Imaging using Arbitrary Beam Focusing and Steering**
Richard Chen
Mentor: Dr. Brooks Lindsey, BME

2:55 pm **MRI-Based Investigation into the Effects of Simulated Microgravity on Vascular Flow**
Stephanie Collins
Mentor: Dr. John Oshinski, BME

3:05 pm **Effect of Surgical valve type and Size on Transcatheter Aortic Valve-in Valve Embolization Risk**
Kaylyn Crawford
Mentor: Dr. Ajit Yoganathan, BME

3:25 pm **An Ex Vivo Model of Trabecular Meshwork Dysfunction for Glaucoma Research**
Rebecca Hardie
Mentor: Dr. C. Ross Ethier, BME

3:35 pm **Computational Modeling of Valvular Heart Diseases: Aortic Stenosis, Mitral Regurgitation, Tricuspid Regurgitation**
Mandy Salmon
Mentor: Dr. Ajit Yoganathan, BME

3:45 pm **Utilizing Microfluidic Devices to Visualize the Formation of Fragmented Red Blood Cells Through Clotting Geometries**
Julia Woodall
Mentor: Dr. Wilbur Lam, BME

3:55 pm **Cathepsin Activation and Purification**
Yuan Xu
Mentor: Dr. Manu Platt, BME

Oral Presentation Sessions

Student Center, 3rd Floor

Session C: Computer Science

Student Center Room 320

Moderator: Mr. Michael Laughter

2:45 pm **Predicting Protein-Protein Interaction via 1D Adaptive Dilated Convolutions**
Diptodip Deb
Mentor: Dr. James Hays, CS

2:55 pm **PopSign: Teaching American Sign Language**
Madeleine Goebel
Mentor: Dr. Thad Starner, CS

3:05 pm **Improved Test Recording and Replay for iOS Applications**
Anushk Mittal
Mentor: Dr. Alessandro Orso, CS

3:25 pm **A Blockchain-Inspired Design for a Modern Academic System**
Alaap Murali
Mentor: Dr. Richard DeMillo, CS

3:35 pm **Scalable Malware Analysis**
Allison Sommers
Mentor: Dr. Manos Antonakakis, CS

3:45 pm **Analysis of Deviant Opioid Addiction Treatment Communities on Reddit**
Francisco Zampieri
Mentor: Dr. Munmun De Choudhury, CS

Oral Presentation Sessions

Student Center, 3rd Floor

Session D: Electrical and Computer Engineering and Civil and Environmental Engineering

Student Center Room 343

Moderator: Dr. Lacy Hodges

3:05 pm **3D Reconstruction of Live Chickens in Poultry Houses**
Aneri Muni
Mentor: Dr. Colin Usher, GTRI

3:15 pm **Specialized Real Time Water Quality Monitoring for Resource-Constrained Areas**
Ann Johnson
Mentor: Dr. Joe Brown. CEE

3:25 pm **Developing a Python Library for Digital Image Processing**
Brighton Ancelin
Mentor: Dr. Ghassan AlRegib, ECE

Session E: Ivan Allen College

Student Center Room 332

Moderator: Mr. Cory Hopkins

2:45 pm **Seeing Red: American Tourism to the Eastern Bloc, 1960-1975**
Kayleigh Haskin
Mentor: Dr. Kate Pride Brown, History and Sociology

2:55 pm **Disinformation Campaigns and Hierarchical Culture: The Soviet Union and Russian Federation**
Sara Morrell
Mentor: Dr. Margaret Kosal, International Affairs

Oral Presentation Sessions

Student Center, 3rd Floor

Session F: College of Sciences

Student Center Room 321
Moderator: Ms. Olga Kotlyar

2:45 pm	**SiRNA Knockdown of BMP2 and HMOX1 to Induce Mesenchymal-to-Epithelial Transition (MET) of Ovarian and Prostate Cancer Cells** Amber Akbar Mentor: Dr. John McDonald, Biological Sciences
2:55 pm	**Characterization of Iron Reducing Microorganisms from Anoxic Ferruginous Lake Sediments** Bianca Costa Mentor: Dr. Jennifer Glass, Earth and Atmospheric Sciences
3:05 pm	**Topological Analysis of Experimental Recordings of Ventricular Fibrillation** Daniel Gurevich Mentor: Dr. Flavio Fenton, Physics
3:15 pm	**Evolution of Binary Stars in the Early Universe** Talha Irfan Khawaja Mentor: Dr. John Wise, Physics

Session G: Interactive Computing

Student Center Room 332
Moderator: Ms. Olga Kotlyar

3:35 pm	**Passive Haptic Learning for Computer Stenography** Timothy Aveni Mentor: Dr. Thad Starner, Interactive Computing
3:45 pm	**Learning to Compose Skills** Farhan Tejani and Saurbah Kumar Mentor: Dr. Charles Isbell, Interactive Computing
3:55 pm	**Synchronous Interfaces for Wearable Computers** Jason Wu Mentor: Dr. Thad Starner, Interactive Computings

Oral Presentation Sessions
Student Center, 3rd Floor

Session H: Chemical and Biomolecular Engineering
Student Center Ballroom
Moderator: Ms. Recha Reid

2:45 pm **Investigating Diffusion Kinetics in the Sclera for Ophthalmic Drug Delivery**
Srishti Gupta and Hannah Gersch
Mentor: Dr. Mark Prausnitz, ChBE

2:55 pm **Cause and Effect of Hyperskin Features on Carbon Molecular Sieve (CMS) Membranes**
Samuel Hays
Mentor: Dr. William Koros, ChBE

3:05 pm **Microfluidic Modulation of Differentiation of 3D Stem Cell Aggregates to Motor Neurons**
Amanda Schaefer
Mentor: Dr. Hang Lu, ChBE

3:15 pm **CO_2 Capture Using 3D-Printed PIM-1 Adsorbents Incorporating MOFs**
Nathan Sidhu
Mentor: Dr. Ryan Lively, ChBE

3:35 pm **Effect of Laser-Activated Nanodroplets on Drug Delivery in Human Cells**
Diana Toro
Mentor: Dr. Mark Prausnitz, ChBE

3:45 pm **Aminosilane-Grafted Self-Pillared Pentasil MFI Zeolite as an Acid-Base Bifunctional Catalyst**
Thomas Wang
Mentor: Dr. Christopher Jones, ChBE

3:55 pm **Understanding Intramolecular Cooperativity in Acid-Base Silica-Supported Organocatalysts**
Jingwei Xie
Mentor: Dr. Christopher Jones, ChBE

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COLLEGE OF COMPUTING

Poster Presentation # 005
OriTrak: Using Relative Orientation Tracking for Activity Recognition

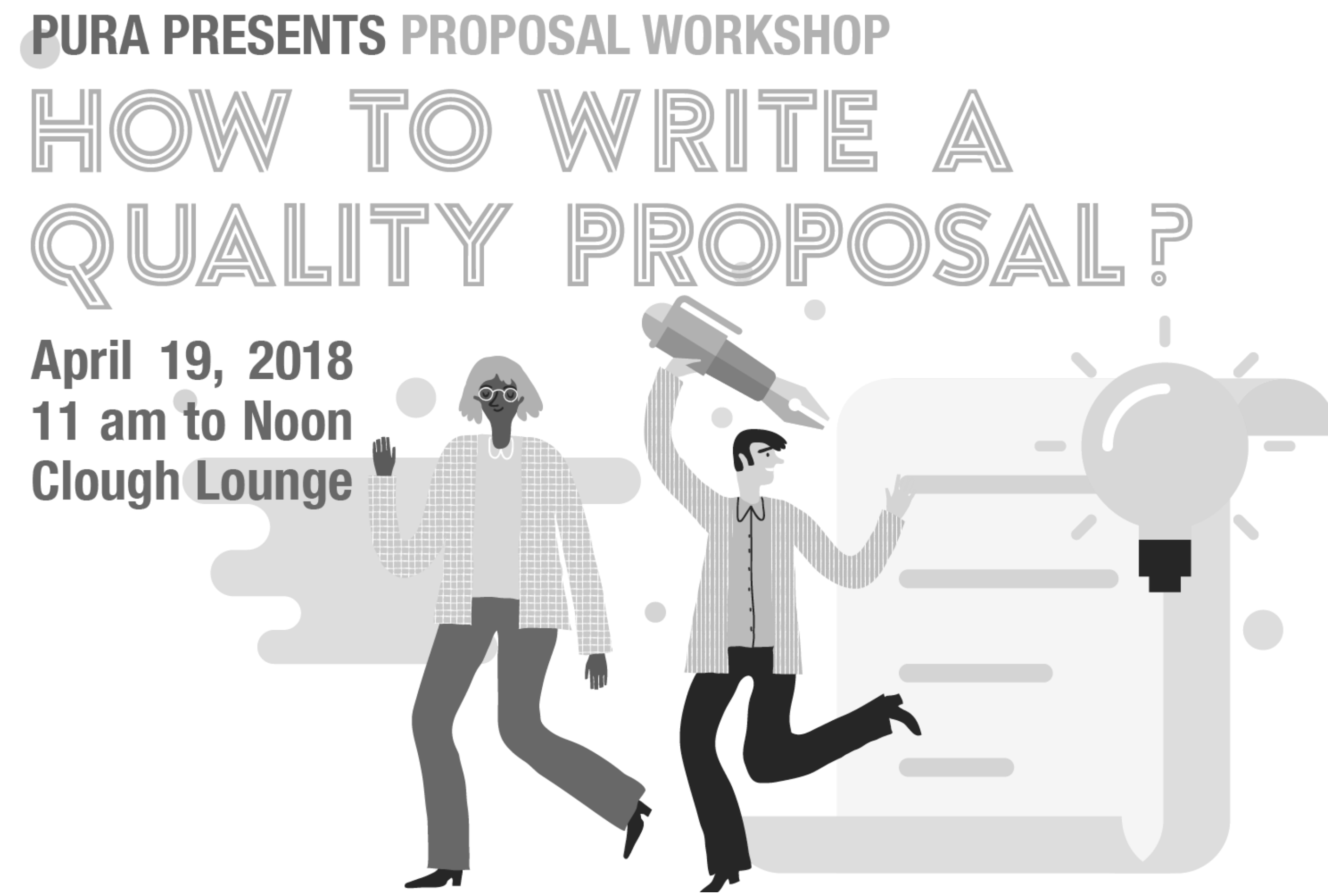
Shaurye Aggarwal
Thad Starner, PhD (Interactive Computing)

OriTrak is a method that can continuously track the three-dimensional angular position (orientation) of a wearable device with respect to some part of the body. It does that by using the relative orientation of two body-mounted inertial measurement units (IMUs), one of which is in a wearable, e.g. a smartwatch or a ring. Currently, OriTrak can be used to interact with wearables. However, by exploiting the relative angular position, more interesting problems, ones beyond mere interaction, can be solved such as Human Activity Recognition. The majority of HAR systems have used gyroscopes or accelerometers, which can, however, only provide information about the relative displacements of the sensor. Such systems have no knowledge of where the movement starts and ends and such information is crucial to detect certain activities. In contrast, using OriTrak, the system has knowledge of the position of one part of the body with respect to the other. Combining OriTrak with previous approaches to HAR, such as detecting eating moments using IMU sensors, might help increase prediction accuracy. Furthermore, given the angular position of the wrist with respect to the head , for example, we might be able to estimate whether the user is looking at the smartwatch or not more accurately which can be used to provide natural interaction experience by detecting the input intention of a user or enabling the user to input using head movements.

Poster Presentation # 015
Robot Navigation in Unconstrained Social Environments

Osvaldo Armas
Sonia Chernova, PhD (Interactive Computing)

The rise robots in consumer, office, and industrial spaces requires robots navigate these spaces in acceptable ways. The definition of acceptable can vary significantly based on the space, culture, and design of the robot. This study seeks to understands these constraints in more depth where a robot will be navigating an office space and approaching people in it.



Oral Presentation
Passive Haptic Learning for Computer Stenography

Timothy Aveni
Thad Starner, PhD (Interactive Computing)

We are investigating the acquisition of computer stenography skills through passive haptic learning. Computer stenography is a chorded input mechanism, where most fingers are responsible for pressing more than one key at a time. With passive haptic learning, we teach skills using haptics without requiring attention. Past applications of passive haptic learning have investigated the acquisition of chorded inputs, and others have tested the acquisition of skills on input mechanisms with multiple responsibilities per finger, but computer stenography is our first attempt to do both at the same time. We are looking to push the limits of passive haptic learning to understand the scope of its potential.

Oral Presentation
Predicting Protein-Protein Interaction via 1D Adaptive Dilated Convolutions

Diptodip Deb
James Hays, PhD (Computer Science)

We propose a deep-learning method for predicting protein-protein interaction (PPI) via 1D adaptive convolutions in combination with dilated convolutions as seen in WaveNet and PixelCNN. Protein-protein interaction is a crucial biological process. Being able to predict when two proteins will interact with each other can be crucial information for developing drug targets or designing a drug. Adaptive convolutions have proven effective at determining some relationship between two inputs in the context of video interpolation, and 1D PixelCNNs have proven effective at under- standing sequence information in the context of audio generation. Our proposed method combines the sequence information from a PixelCNN approach (though without the conditional nature) and uses it to produce an adaptive convolution ker- nel that can then be used to predict PPI. We anticipate that this method will more generally be an efficient approach to any problem requiring sequence comparison.

Poster Presentation # 006
Simplifier for Quantifier-Free Linear Arithmetical Expressions

Mert Dumenci
William Harris, PhD (Computer Science)

In the Trustable Programming Lab's other research projects, the concept of computer-generated logical expressions (specifically, QFLIA formulas) come up a lot. In a specific example, Pequod, "interpolant expressions" generated by an automated theorem prover replace loops in a computation graph, enabling the complex analysis that result in automated proofs of program equivalence. These synthesized expressions are often syntactically convoluted to a degree that they are incomprehensible by the researcher trying to understand the process, and don't play well with the heuristical nature of theorem provers used in the projects. We predict that the syntactic complexity of these formulas contribute significantly to the time that the theorem prover takes in solving given expressions. We observed that these formulas are often only syntactically complex, and can be simplified significantly by a human, keeping the semantics intact. This project aims to automate this process, and simplify generated formulas to a "reasonable degree" (which will be operationally defined). Simplification of first-order logical expressions is a complex problem on its own--hence our decision to balance speed with degree of simplification. We aim to achieve this goal first by defining canonical normal forms for QFLIA, normalizing formulas to these forms, deciding unique subexpressions, and simplifying these structural forms. In addition to these steps, we aim to leverage simple deduction laws in simplifying on a more granular level.

Poster Presentation # 004
mHealth Discovery Dashboard

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

We present Discovery Dashboard, a visual analytics system for exploring large volumes of time series data from mobile medical field studies. Discovery Dashboard offers interactive exploration tools and a data mining motif discovery algorithm to help researchers formulate hypotheses, discover trends and patterns, and ultimately gain a deeper understanding of their data. Discovery Dashboard emphasizes user freedom and flexibility during the data exploration process and enables researchers to do things previously challenging or impossible to do — in the web-browser and in real time. We demonstrate our system visualizing data from a mobile sensor study conducted at the University of Minnesota that included 52 participants who were trying to quit smoking.

Oral Presentation
PopSign: Teaching American Sign Language

Madeleine Goebel
Thad Starner, PhD (Interactive Computing)

More than 95% of deaf children in the United States are born to hearing parents (Mitchell & Karchmer 2004). With the majority of hearing parents having little to no exposure to American Sign Language (ASL) prior to the birth of their deaf child, many struggle to learn sign language while also beginning to use it to communicate with their new infant. The language deprivation experienced by deaf children as a result of their parents' inability to communicate delays their development (Kusche 1984). With the advent of smartphones and the rising popularity of movements such as BabySign, many different portable ASL lessons have been developed. It has been shown that these lessons are more effective at teaching vocabulary than classroom lessons (Lu 2008). However, these lessons struggle with a high attrition rate of students after a few weeks (Summet 2010). Recent developments in student-centered education indicate that incorporating achievement goals leads to a lower attrition rate in language classes (Oberg & Daniels 2013). To reduce the rate of attrition, I used a popular, multi-level game as a framework for the lessons and incorporated ASL phrases into the game play. When tested with subjects over a two week period, it was shown that subjects using the game-version of the lesson had a lower attrition rate and a higher rate of vocabulary acquisition than subjects learning via the control-version of the lessons.

Poster Presentation # 007
A Local Stochastic Algorithm for Separation in Heterogeneous Self-Organizing Particle Systems

Cem Gokmen
Dana Randall, PhD (Computer Science)

We investigate stochastic, distributed algorithms that can accomplish separation and integration behaviors in self-organizing particle systems, an abstraction of programmable matter. These particle systems are composed of individual computational units known as particles that each have limited memory, strictly local communication abilities, and modest computational power, and which collectively solve system-wide problems of movement and coordination. In this work, we extend the usual notion of a particle system to treat heterogeneous systems by considering particles of different colors. We present a fully distributed, asynchronous, stochastic algorithm for separation, where the particle system self-organizes into segregated color classes using only local information about each particle's preference for being near others of the same color. Conversely, by simply changing the particles' preferences, the color classes become well-integrated. We analyze the convergence of our distributed, stochastic algorithm by leveraging techniques from Markov chain analysis and show simulations demonstrating that these algorithms achieve our separation and integration objectives. In the future we hope to prove these dichotomous separation and integration behaviors can both be produced by our algorithm.

Poster Presentation # 008
Automatic Recognition of Dog Vocalization Patterns

Xiaochuang Han
Melody Jackson, PhD (Computer Science)
The purpose of this research is to automatically recognize dog vocalization patterns and see how it could help evaluate human-canine bond. The bond between human and dogs can be described by means of a factor analysis in a 3-dimensional factor space: anxiety, acceptance, and attachment. Since 1998, the way we analyze these factors for dogs has been long and not well quantified. We propose a new experiment to analyze the human-canine bond by automatically detecting dog vocalization patterns, which is significantly shorter than previous experiments and will be able to quantify the result accurately. This is particularly important for evaluating the condition of working dogs trained to search and rescue in emergency situations, since we need a high-accuracy evaluation for them. Also, it could be useful for dog shelters as the officers there could save a lot of time for the routine examinations of stray dogs.

Poster Presentation # 009
Machine Learning with Remote Sensing

Ziming He
Greg Turk, PhD (Interactive Computing)

Using machine learning techniques with texture synthesis procedures such as image quilting, Poisson image blending, KNN, Neural Network to produce "future" remote sensing pictures based on past data such as precipitation, plantation percentage, snow coverage, elevation, altitude and orientation of mountains to illustrate the effects of climate change.

Poster Presentation # 010
Document Level Language Modeling and Translation

Marc Marone
Jacob Eisenstein, PhD (Computer Science)

Many machine translation systems treat sentences independently, ignoring the larger context of a document. Some translation ambiguities cannot be resolved locally, making context useful in enhancing translation quality. In this work, we investigate the use of document level language models to augment a neural machine translation system.

Poster Presentation # 011
An Efficient Multi-Procedure Equivalence Prover Using Product Programs

Maxim Mints
William Harris, PhD (Computer Science)

The purpose of this study is to develop Pequod, a powerful and efficient implementation of an algorithm capable of proving or disproving partial equivalence of two computer programs, given their source code or compiled code, without running them. This algorithm can also be re-purposed to solve different fundamental problems, such as proving multithreaded security. Here, partial equivalence of two programs, given matching inputs, means that, if both terminate (i.e. do not loop infinitely), they produce matching outputs. Programs are viewed as sets of procedures (a Java function is an example of a procedure). The following inputs are used: two procedures A and B, one in each program, and some mapping relations correlating the inputs and outputs of A to, respectively, the inputs and outputs of B. The algorithm used in Pequod is expected to be far more robust and reliable than any of the currently existing technology for proving partial equivalence, due to being applicable to a far wider range of programs because of the properties of the underlying concept of product programs. This technology would have a wide range of applications: from industry, where it could be used to prove the equivalence of some well-tested implementation with a more optimal replacement, to education, where it could be used to verify correctness of students' solutions to programming problems by verifying their equivalence with a known correct solution. With Pequod, partial equivalence proofs could extend from being usable in select specific cases to a wide range of possible situations.

Oral Presentation
Improved Test Recording and Replay for iOS Applications

Anushk Mittal
Alessandro Orso, PhD (Computer Science)

Mobile internet usage recently surpassed desktop usage and as most internet connected users interact through mobile apps, businesses are adopting a mobile first approach to offer variety of services. However, with an exponential growth in market demographics and supported devices, testing these mobile apps is largely unreliable or too resource expensive with current state-of-the-art technology. To address these issues and to enhance iOS application testing, I adopt a technique to passively record user interactions along with an intuitive GUI interface for enhanced functionality to build device independent test scripts through any regular iOS device. These tests can then be run automatically on multiple devices supporting different iOS versions, screen sizes, localizations, and other possible system configurations. The goal of is to develop a system that makes testing approachable and easy for large corporations and indie developers alike.

Oral Presentation
A Blockchain-Inspired Design for a Modern Academic System

Alaap Murali
Richard DeMillo, PhD (Computer Science)

In this research, I theorize how blockchains can be used to design an academic market which does two things the current market cannot: 1) allows universities and non-traditional educators (MOOCs, Coursera, Khan Academy, etc.) to enter and build value in the academic market without being outcompeted by powerful academic institutions, and 2) makes the value-building process systematic and non-arbitrary using a transaction model. The design implements six major stakeholders: the educator exchange, the employer exchange, miners, learners, educators, and companies. I describe the roles and goals of these six actors and how each one can benefit from a blockchain-controlled academic system.

Poster Presentation # 012
Real-time State Estimation for Aggressively Driving Autonomous Ground Vehicles

Dominic Pattison
James Rehg, PhD (Computer Science)

State estimation is an integral part of many robotic systems. It is particularly important in the realm of high performance ground vehicles where systems must be real-time, robust, and accurate. This project aims to tackle the problem of improved state estimation reliability, robust to GPS dropout, applied to the control of an aggressively driving autonomous vehicle in an unstructured environment. To accomplish this goal, the system combines state of the art components for visual SLAM, wheel odometry, IMU integration, and incremental inference.

Oral Presentation
Scalable Malware Analysis

Allison Sommers
Manos Antonakakis, PhD (Computer Science)

In the realm of this computing age, malware is becoming steadily more prevalent. With the amount of malware samples taken from the wild increasing, malware analysis is becoming increasingly necessary. However, the necessary step of malware analysis is not straightforward, and is often made intentionally more difficult by malware authors. Dynamic sandboxes, often used to analyze wild malware samples, have been used for years as a trusted and necessary component for malware analysis. We expand on the traditional approach to malware analysis by creating a scalable way to analyze hundreds of malware samples in a single day, using a combined approach. Utilizing virtual machine technology, memory forensics, and analysis of network communications in our system, we are capable of analyzing more malware samples a day than conventional methods analyze in a week.

Poster Presentation # 013
Human Robot Interaction with Augmented Reality

Dijon Stowers
Sonia Chernova, PhD (Computer Science)

The way people interact and work with other people is very different from how people work with robotic systems. Often robots take what is optimal algorithmically rather than what is thought to be natural to a human. Because of this, humans may perceive a robot's actions to be hard to immediately understand or even sporadic. To alleviate some of this inherent confusion and give the people interacting with robots a more readily available and natural sense of understanding for what a robot is doing at any moment in time, this research project explores methods for a robot to display its internal state via forms of communication other than use of a monitor with animation.

Poster Presentation # 014
Lie Detection System with BCI

Aatmay Talati
Melody Jackson, PhD (Computer Science)

Deception Detection Tests (DDT) are primarily acknowledged by the supreme court and few other governmental or semi-governmental investigation agencies. The polygraph is the accepted DDT system in the United States, but polygraph has higher failure ratio compared to any other DDT system, which is being used by other countries. In terms of improving the DDT success ratio, I propose the use of P300 P3 along with constant blood pressure measure. The P300 (P3) wave is an ERP component elicited in the process of decision making.

Oral Presentation
Learning to Compose Skills

Farhan Tejani and Saurabh Kumar
Charles Isbell, PhD (Interactive Computing)

We present a differentiable framework capable of learning a wide variety of com- positions of simple policies that we call skills. By recursively composing skills with themselves, we can create hierarchies that display complex behavior. Skill networks are trained to generate skill-state embeddings that are provided as inputs to a trainable composition function, which in turn outputs a policy for the overall task. Our experiments on an environment consisting of multiple collect and evade tasks show that this architecture is able to quickly build complex skills from simpler ones. Furthermore, the learned composition function displays some transfer to unseen combinations of skills, allowing for zero-shot generalizations.

Oral Presentation
Synchronous Interfaces for Wearable Computers

Jason Wu
Thad Starner, PhD (Interactive Computing)

Synchronous interfaces provide a new input modality for wearable devices requiring minimal user learning and calibration. A prototype input system is constructed using an Android smartwatch containing an inertial measurement unit (IMU) to detect user motion and allow for fast, accurate input. To test the accuracy and effectiveness of the system, a user study is conducted to quantify the accuracy, speed, usability, and subtlety of the input system compared to existing methods. Finally, demo applications are developed showing UI elements appropriate for the synchronous interface.

Oral Presentation
Analysis of Deviant Opioid Addiction Treatment Communities on Reddit

Francisco Zampieri
Munmun De Choudhury, PhD (Computer Science)

As the opioid epidemic in the US runs its course, many addicts turn to deviant recovery methods to ameliorate the symptoms of withdrawal. In this study, we analyze discussion on the social media site Reddit surrounding these non-mainstream, clinically unverified treatments. We apply transfer learning methods to train a classifier highly sensitive to recovery-related discussion and discover more of such discussion. Based on the relatedness of Reddit communities (subreddits) and the testimony of opioid addiction experts and subreddit moderators, we generate a list of subreddits where discussion of deviant addiction treatment methods is taking place. We validate drug slang using word-vector embeddings to address the lack of a validated list of such terms for understudied drugs. Topic modelling methods (latent Dirichlet allocation) applied to this dataset reveal user motivations behind pursuing alternative treatment methods.

COLLEGE OF DESIGN

Poster Presentation # 001
Mobility in the Home Environment for Older Adults with Mobility Impairment

Elmer Ivon Zuniga
Harshal Mahajan, PhD (Industrial Design)

The purpose of this study was to understand the challenges faced by older adults aging with long-term mobility impairments. Older adults with mobility disabilities were interviewed about age related changes in activities of daily living (ADLs) and instrumental activities of daily living (IADLs) in their living environment. Participants were asked to describe their daily routine activities, assistive devices used while performing these activities, their fear of falling, and their self-perceived level of challenge and difficulty in completing these activities. The primary aim of this study was to evaluate the relationship between the participant's self-perceived difficulty and challenge with their fear of falling. Secondary aim was to study the environmental barriers that affect mobility while performing these activities. Participants' self-reported fear of falling scores were significantly correlated with the perceived ratings of difficulties during bed transfer ($\rho = .705$, $\alpha = .007$) and toileting ($\rho = .705$, $\alpha = .007$). Fear of falling was also correlated with are related challenges during toileting ($\rho = .716$, $\alpha = .013$), food Preparation ($\rho = .642$, $\alpha = .024$), movement in home ($\rho = .576$, $\alpha = .040$), and entering and exiting the home ($\rho = .645$, $\alpha = .017$). The environmental factors that restricted mobility were: clutter in the door entrances, hallways, and around bed areas and domestic appliances. Overall, the study expressed the need to further research living environments for aging adults with disabilities and their contribution to their fear of falling while performing their daily activities..

COLLEGE OF ENGINEERING

Poster Presentation # 074
Applicability of Cytocompatible ALD Barrier Films as Protective Encapsulation for Biological Implants

Katarina Adstedt
Samuel Graham, PhD (Mechanical Engineering)

The ability of atomic layer deposited (ALD) metal oxide films to serve as protective, encapsulating barriers for biological implants is determined through testing the corrosion resistance and degradation behavior of the films. Using plasma enhanced ALD (PE-ALD), Al_2O_3, TiO_2, HfO_2, and ZrO_2 are deposited at 100 oC onto gold electrodes. Through MTT cell proliferation assay, the films are determined to be cytologically compatible and will not cause harm to the implant host. Using electrochemical impedance spectroscopy (EIS), the films establish their relative chemical stabilities within three different biological environments, phosphate buffer solution (PBS), simulated sweat and simulated saliva. The resulting data from the EIS measurements demonstrates the rate of degradation for the four respective films and exhibits which films are best suited as protective barriers for biological implants. ALD Al_2O_3 is not suitable as an encapsulating layer as it demonstrates no corrosion resistance. Within PBS, ALD TiO_2 is proven to be the most stable film barrier while within simulated sweat and saliva ALD ZrO_2 is the most chemically stable. Using a flexible electronic device used to measure insulin levels, the viability of ALD ZrO_2 as a protective barrier for bioimplants is demonstrated. The viability of ALD films in biological solutions and their enhanced corrosion resistances opens up the possibility for a new class of materials that can be used for the protection of bioimplants and wearable devices.

Poster Presentation # 041
RatCoach: Automated Rat Training Software

Yahia Ali, Dilara Soylu and Valentine Wilson
Chethan Pandarinath, PhD (Biomedical Engineering)

In researching how the brain controls movement, the standard experimental model is to conduct multi-electrode recordings from motor cortex in non-human primates (NHPs) as they perform movements. Among the animals that may also be used for this purpose, rodents have the advantage of being relatively low-cost and low-maintenance when compared to NHPs. Thus, our group, the Systems Neural Engineering Lab, seeks to establish rats as a model for studying neural dynamics underlying movement control. Training rats to repeatedly and consistently perform a prescribed movement can be a time-consuming and personnel-intensive process, and the involvement of human trainers may also lead to undesired variability the training environment. Further, simultaneous training would require a trainer's attention to be directed towards a limited number of rats at a time. As an alternative, we present RatCoach, a distributed rat training system that enables researchers to concurrently train and observe rats in an automated fashion. RatCoach manages behavioral training sessions with minimal researcher intervention, and can automatically progress a behavioral paradigm by analyzing previous training sessions. Ultimately, RatCoach can support data collection on a massive scale, far beyond what is feasible with human-guided training. This enables analyses of motor cortical activity and behavior with a higher degree of confidence and complexity, without additional investment in human labor.

Oral Presentation
Developing a Python Library for Digital Image Processing

Brighton Ancelin
Ghassan AlRegib, PhD (Electrical and Computer Engineering)

Over time, the Python programming language has become increasingly used in the fields of engineering and computer science. Python and its related libraries provide an effective, free-to-use platform for solving problems in mathematics, signal processing, and data science. The ECE 6258 Digital Image Processing course has long been using Matlab, but we hope to soon transition to Python. This semester, I've been working to convert instructional code, develop new utility code, integrate existing libraries, and document the entirety of my work in order to have a myriad of Python resources for the course transition. In this talk, we will discuss the impetus for the transition, the process of integrating existing libraries, how to identify where new code should be developed, and the vision we have for this work.

Poster Presentation # 042
The Effect of Focused-Ultrasound on the Shedding of Cancer-Associated Molecules into Circulation

Anneke Augenbroe
Costas Arvanitis, PhD (Biomedical Engineering)

Glioblastoma is an aggressive and usually fatal brain tumor which is especially hard to treat due to the selective permeability of the blood-brain barrier. Previous research suggests that the use of focused-ultrasound-induced blood-brain barrier disruption is a way to reversibly increase the permeability of this membrane and allow therapeutic agents into the brain microenvironment. In our lab, the mouse glioma 261 (gl261) cell line, which is featured extensively as an animal model for glioma research, is used to monitor the shedding of cancer-associated molecules from the central nervous system into the circulation. In this multi-modal approach, both in vitro and in vivo experiments are conducted to detect DNA fragments in this cell line in the circulation. These DNA fragments are mutations of the p53 and k-ras genes, which are known to be associated with cancer. Additionally, we

have transfected our gl261 cells with Gaussia Luciferase and inoculated these cells in the brains of BL6 strain mice in order to have a bioluminescent property that allows for noninvasive monitoring and detection as the tumors grow. The results of these two methods are compared between control groups and ones with focused ultrasound disruption.

Poster Presentation # 071
Melt-Infiltration of Solid-State Electrolytes into Aluminum Oxide Nanowire Separator Membranes

Dmitry Bondarev
Gleb Yushin, PhD (Materials Science and Engineering)

Lithium-ion batteries (LIBs) have become the dominant means of energy storage in numerous applications due to their unprecedented specific energy and specific capacity. However, there are several significant shortcomings of LIBs that negatively impact their use, such as sudden loss of capacity, various hazards associated with electrolyte and cathode oxidation and the growth of lithium dendrites that may create a short circuit. While dendrite growth may be prevented by using a permeable separator membrane, other problems listed above could be resolved by substituting the liquid electrolytes, that are used in most present-day batteries, with their solid-state counterparts. In this project the solid-state electrolytes (SSEs) of the system MexOyHzXn (where Me is an alkali metal (Na, Li or K) and X is a halogen (Cl, Br or I) and the structure corresponds to Me3AB-type system (x=2y+n-z)), that exhibit superionic conducting properties and have a lower melting point than their analogues, were infiltrated into SSE-compatible aluminum oxide nanowire separator membranes and analyzed by means of scanning electron spectroscopy (SEM) and impedance spectroscopy in order to explore the properties of these SSEs in the context of a real-life battery. The goal of the research was to determine the optimal conditions and the SSE composition to achieve the best conductivity and ionic permeability of the infiltrated membrane, which is crucial for the performance of the final device. This project provides useful information that will assist the development of future solid-state lithium batteries.

Poster Presentation # 043
Distribution of Vestibulosympathetic Input to Spinal Glutamatergic Interneurons

Luke Bumgardner
Marie-Claude Perreault, PhD (Biomedical Engineering)

Substantial progress has been made in identifying the brainstem component of the vestibulosympathetic pathway, however the spinal component of the pathway remains largely unexplored. The goal of the project is to assess the extent to which excitatory Vesicular Glutamate Transporter 2 interneurons (VGLUT2+ IN's) may be involved in vestibulosympathetic control. Genetically encoded transgenic mice and calcium imaging were used to examine the vestibular nerve-evoked responses in thoracic glutamatergic interneurons (IN's). Duties pertaining to the development of the project included: preparing brain and spinal cord tissue for sectioning, followed by sectioning and preserving the tissue, and finally analyzing sections using Neurolucida.

Oral Presentation
Force-Signal Coupling at Single Focal Adhesions

Nicolas Castro
Andres Garcia, PhD (Mechanical Engineering)

Cell adhesion to the extracellular matrix (ECM) is regulated by integrin receptors. Following binding to ECM proteins, integrin clustering occurs to form focal adhesion (FA) complexes, which contain structural proteins that link the cell cytoskeleton to the ECM and signaling effectors that regulate cell division, migration, and differentiation. FAs provide cell anchorage by mechanically linking ECM proteins to the cytoskeleton, and transmitting adhesive forces that drive signaling, proliferation, and tissue morphogenesis. This project involves an investigation on how various cell lines generate adhesive forces though FA force analysis. Specifically, this project will characterice the role focal adhesion kinase (FAK) in human mesenchymal stem cell (hMSCs) force generation. Ultimately, this analysis will reveal novel insights on how FAK structure and activation work together to regulate adhesive force transmission at FAs.

Poster Presentation # 044
A Study of Data Visualization and Bayesian Ontology for Search Optimization of Research Paper Databases

Daphne Chen
Robert Lee, PhD (Biomedical Engineering)

Modern research institutions have large amounts of data to process, organize, and search. Manually searching data is time-consuming and inefficient, so it is necessary to create tools to improve this process. Current search methods raise issues such as yielding results with jargon words or little relation to the query. These methods also frequently lack a useful priority ranking for each result. Furthermore, modern research archives such as PubMed limit their search to title-, abstract-, keyword-, or caption-only text. This widely hinders the depth of the search, leaving multiple potential papers from the results. Even if full-text search were an option, this would still leave the persisting problem of false-positive and false-negative results. This study approaches these issues with a combination of machine learning and data visualization techniques, since we sought to improve not only the results, but also the way the user interacts with them. Through studying data visualization of biomedical research text, we developed two methods of presenting search result data in an intuitive, functional format. Both methods provide an additional data point, the "weight" of the word or phrase, which describes the specified text's frequency. Secondly, this project

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presents the team's ongoing effort to develop an ontology-based mapping structure to enhance the semantic search capability of the biomedical text archive. We investigate this Bayesian network approach to ontology mapping to determine whether it is optimal at reducing the number of jargon results and conveying the results' relevance.

Oral Presentation
Volumetric Destruction-Reperfusion Imaging using Arbitrary Beam Focusing and Steering

Richard Chen
Brooks Lindsey, PhD (Biomedical Engineering)

Dynamic contrast-enhanced ultrasound imaging can be used to quantitatively measure tissue perfusion, enabling non-invasive differentiation between healthy tissues and those with abnormal perfusion rates in a variety of clinical situations including monitoring response to treatment and assessing malignancy. However, quantifying perfusion—an inherently 3D process—using 2D imaging results in the loss of relevant information that could otherwise be used to support a clinical diagnosis. Ongoing research focuses on eliminating this issue by directly taking perfusion measurements over a 3D volume, allowing for more accurate measurements of perfusion rate. Techniques were developed using a matrix transducer to implement destruction-reperfusion imaging, allowing the user to selectively destroy microbubble contrast agents at any location in a 3D volume and measure reperfusion in that 3D sub-volume. Two cavities within an imaging phantom were infused with microbubbles and an ultrasound beam was arbitrarily focused and steered to destroy bubbles in only one well. The resulting volumes were rendered in 3D, and perfusion rates were measured over the volume where bubbles had been destroyed. Results indicated that beam focusing and steering was successful, as 3D renderings of the target well before and after bubble destruction depicted a clear void where microbubbles were destroyed. Microbubble reperfusion was seen when viewing a sequence of reconstructed volumes, allowing for an intensity curve to be drawn over a 3D volume. Together, these results demonstrate a proof-of-concept of 3D dynamic contrast-enhanced ultrasound imaging using arbitrary beam steering in 3D to interactively measure perfusion in any spatial location.

Poster Presentation # 075
Biomimicry of Animal Noses

William Clark
David Hu, PhD (Mechanical Engineering)

The potential applications of machine olfaction technology are vast and varied, be they agriculture, drug and bomb detection, environmental controls, or one of many others. Additionally, sniffing is an important component of the mammalian olfaction process, serving to draw odors into the nose for detection. It has been observed that sniffing frequencies differ among species of mammal, and further that these frequencies are often dependent on the concentration of a given analyte or odor. Sniffing flowrates are believed to influence the ways in which mammals perceive and interpret signals concerning certain analytes, and for many mammals, the duration of a sniff as well as its velocity are both dependent on the concentration of the analyte being detected. Further investigation into the effects of sniff flowrates on sensor response could improve performance of machine olfaction systems. Thus, this project seeks to better understand the ways in which nature and biomimicry can be applied to engineering problem solving. By investigating the effects of modulated flow on machine olfaction sensor response, it may be possible to improve the methods used in this process rather than simply improving the sensors or hardware themselves.

Oral Presentation
MRI-Based Investigation into the Effects of Simulated Microgravity on Vascular Flow

Stephanie Collins
John Oshinski, PhD (Biomedical Engineering)

National Aeronautics and Space Administration (NASA) astronauts have reported decreases in visual acuity due to Microgravity Ocular Syndrome (MOS) after returning from long duration space missions. The leading hypothesis behind the cause of MOS is an increase in intracranial pressure due to a head-ward fluid shift induced by the effects of microgravity. This increase in pressure may cause damage to the optic nerve resulting in visual impairments. Previous studies on MOS have utilized the Head Down Tilt (HDT) technique to simulate the effects of microgravity in subjects on earth, during Magnetic Resonance Imaging (MRI) scans. The HDT technique utilizes the proportionality between posture and intracranial pressure to simulate these effects. The method consists of subjects receiving an MRI scan while lying in the supine position (0°) and comparing it to the same subject's MRI scan while lying tilted (head down) at a specific angle. The lab at the Georgia Institute of Technology and Emory University Hospital utilized MRI scans to analyze changes in arterial and venous blood flow under simulations of microgravity. Ten healthy volunteers underwent two MRI scans: one scan at a HDT of -15° to simulate the effects of microgravity and another scan in the supine position (0°) to serve as a baseline for comparison.

Oral Presentation
Effect of Surgical Valve Type and Size on Transcatheter Aortic Valve-in Valve Embolization Risk

Kaylyn Crawford
Ajit Yoganathan, PhD (Biomedical Engineering)

Aortic stenosis (AS) is a condition caused by the narrowing of the aortic valve leaflets. This disease is prevalent in 2-4% of adults over 65 years of age. Conventional correction involves surgical replacement of the diseased valve with a prosthetic valve. However, over the past decade, transcatheter based approaches have been employed in patients deemed surgically inoperable.

In AS patients with a degenerative surgical bioprosthesis, transcatheter valve-in-valve (VIV) procedures are increasingly being implemented. A common complication with this procedure is valve malpositioning, which if left unmanaged could lead to valve migration (embolization). Given the number of surgical bioprostheses available, questions arise surrounding the impact of surgical valve type and size on embolization risk. Pull-out force testing was employed to quantify relative embolization risk using a 26 mm CoreValve within multiple surgical valves of different sizes (Hancock, PERIMOUNT, Trifecta, and Mitroflow). Force was applied gradually until the valve migrated and the peak force was recorded. Within all valve types, the smaller device size required the most force to dislodge when deployed coincident to the annulus ($p<0.01$). Porcine valves (Hancock) required the greatest force to embolize (~13.5 N), followed by the pericardial valves with internal leaflets (PERIMOUNT) (~9.25 N), and pericardial valves with external leaflets (Mitroflow and Trifecta) (~6.25 N). Differences in valve design and material result in varying risk for embolization. Outlining these differences allows for better patient-specific risk characterizations in efforts to avoid complications following VIV procedures and optimize performance.

Poster Presentation # 045
A Flexible Microparticle Assay for Quantifying Protein Expression Normalized to Total Protein

Alexandra Crowley
Eric Snider, PhD (Biomedical Engineering)

Protein quantitation is a fundamental aspect of biochemistry research that measures the protein present in a sample. In order to improve upon current protein quantitation methods while allowing for comparison of multiple experiments, normalization is necessary. This project describes a highly sensitive, flexible assay that quantifies and normalizes protein presence. The assay utilizes the formation of an avidin-biotin- complex and zero-length crosslinking carbodiimides conjugated to carboxylic acid functional groups. As a result, it allows for the fluorescent staining and high throughput measurement of both total protein and target protein simultaneously. By comparing both measurements, the new assay normalizes the target protein presence with decreased variance in signal-to-noise output. The proposed assay possesses picogram-level protein sensitivity and a coefficient of variation about 25% that of non-normalized results.

Poster Presentation # 076
Mechanically Activated Cationic Currents in Mechanosensitive Cells

Jacqueline Dister
Costas Arvanitis, PhD (Mechanical Engineering)

The purpose of this study is to analyze the effect of ultrasonic pressure on the mechanosensitive channel activity in the N2A cell line. Prior research has indicated that certain ion channels in the cellular membrane can be activated by the application of static pressure. In this project, the patch clamp method is used to apply static positive and negative pressure to the cell to determine a baseline cellular response, and to confirm previous results. Next, focused ultrasound is applied to the N2A cells, and the effectiveness of ultrasonic versus static pressure is analyzed. As these mechanosensitive channels are involved in the generation of signaling pathways in the brain, the stimulation of these channels by ultrasound could provide a therapy to neurodegenerative diseases. In such diseases as Parkinson's or Alzheimer's the degeneration or loss of neurons makes neural communication nearly impossible, however stimulation of these ion channels from ultrasound could help boost weak signals and improve neural performance.

Poster Presentation # 046
Prediction of Heart Transplant Rejection Using Histopathological Whole-Slide Imaging

Adrienne Dooley
May Wang, PhD (Biomedical Engineering)

Endomyocardial biopsies are the current gold standard for monitoring heart transplant patients for signs of cardiac allograft rejection. Manually analyzing the acquired tissue samples can be costly, time-consuming, and subjective. Computer-aided diagnosis, using digitized whole-slide images, has been used to classify the presence and grading of diseases such as brain tumors and breast cancer, and we expect it can be used for prediction of cardiac allograft rejection. In this paper, we first create a pipeline to normalize and extract pixel-level and object-level features from histopathological whole-slide images of endomyocardial biopsies. Then, we develop a two-stage classification algorithm, where we first cluster individual tiles and then use the frequency of tiles in each cluster for classification of each whole-slide image. Our results show that the addition of an unsupervised clustering step leads to higher classification accuracy, as well as the importance of object-level features based on the pathophysiology of rejection. Future expansion of this study includes the development of a multi-class classification pipeline for subtypes and grades of cardiac allograft rejection.

Poster Presentation # 061
Engineering of Physical Aging to Optimize Carbon Molecular Sieve Hollow Fiber Membranes

Nicholas Doss
William Koros, PhD (Chemical and Biomolecular Engineering)

Membranes have the potential to reduce energy use to achieve important gas separations. Even beyond polymeric membranes, Carbon Molecular Sieve (CMS) hollow fiber membranes can surpass the permeability and selectivity upper bounds for important gas pair separations such as CO2/CH4 and C3H6/C3H8. These membranes are made by pyrolyzing asymmetric hollow fiber precursors under inert atmospheres to form amorphously distributed carbon sheets. The amorphous

CMS material contains micropores between sheets and ultramicropores within the sheets themselves. A thermodynamic driving force causes the sheets to arrange themselves into more stable states with smaller micropores, causing a reduction in permeance and an increase in selectivity. These complex changes are henceforth referred to as physical aging and can potentially limit the utility of CMS membranes. Fortunately, physical aging can be minimized by introducing condensable sorbent molecules to the CMS during storage. These temporary molecular pillars allow structural rearrangement of the sheets to form around the pillars, retaining the micropores. Removing the molecular pillars via a purging technique before placing in service provides the CMS with sustained performance. In this poster, hollow fiber properties and several storage techniques of CMS will be discussed, along with the fundamental factors associated with each.

Poster Presentation # 077
Multilayer Slot Die Coating of Cellulose Acetate Filtration Membranes with Enhanced Particle Rejection Properties

Amreeta Duttchoudhury and Lucas Muller
Tequila Harris, PhD (Mechanical Engineering)

Water filtration membranes are subject to the degenerative phenomenon of fouling, which refers to the accumulation of particles on the surface and internal pores of a membrane. This build-up causes a degradation of flux over time, and is not fully reversible with current techniques. The objective of this research is to investigate process-property relationships based on processing parameters and rheological properties of cellulose acetate solutions. To this end, an asymmetric slot die was designed and implemented to explore the impact of membrane layering on flux performance and fouling resistance. Formulations of cellulose acetate solutions of different concentrations were made to make nano filtration and micro filtration membranes. Using the asymmetric slot die, nanofiltration and micro filtration membrane bilayers were simultaneously coated, on a roll-to-roll manufacturing system. To reduce biofouling, silver nanoparticles are added to the nano filtration layer to act as a natural biocide. The membranes were tested for flux, fouling resistance, and structural performance, and were benchmarked against current industry standards. Preliminary results have shown that the bilayers significant increases in filtration rate and effective membrane life over the existing, single layer standard. This result not only impacts the performance of these composite membranes, but also, has the potential to significantly reduce the manufacturing cost, since several processing steps can be eliminated.

Poster Presentation # 078
Photocatalytic Nitrogen Fixation on Iron Doped TiO_2

Carlos Fernandez
Marta Hatzell, PhD (Mechanical Engineering)

Molecular nitrogen has been shown to react with water in the presence of TiO_2 under UV radiation to produce ammonia and nitrates. We tested the photocatalytic activity of TiO_2 single crystals as well as TiO_2 polycrystalline films. Finally, in order to enhance nitrogen fixation, Iron doped TiO_2 films were prepared successfully using a sol-gel method. Iron doped TiO_2 films between 0.1 mol% and 1 mol% were prepared and their photocatalytic activity was compared to that of undoped TiO_2 films. The ammonia yield was enhanced with small amounts of iron doping.

Oral Presentation
Path Optimization for Image Deblurring

Beatriz Fusaro
Jun Ueda, PhD (Mechanical Engineering)

Capturing clear images with fast moving systems is imperative for effective mobile systems. The degradation of the quality of an image is known as motion blur. Three main methods are used to reduce this effect: shortening the exposure time, controlling the camera trajectory and image deconvolution and reconstruction. This research focuses on the second and third aspects of deblurring, analyzing the usability and breakpoints of common image deblurring methods, as well as proposing trajectories capable of reducing image blur in the capture stage. The famous blind deblurring methods developed by Xu, Shan and Cho are tested to find the conditions that cause inaccurate results and used to characterize the improvements made by differing capture trajectories (linear, parabolic and a proposed inverse error trajectory). A deblurring method using the motion data (non-blind deconvolution) is compared to the other blind deblurring algorithms, with the objective of finding an ideal combination of trajectory planning and image reconstruction method.

Poster Presentation # 062
Investigating Diffusion Kinetics in the Sclera for Ophthalmic Drug Delivery

Hannah Gersch and Srishti Gupta
Mark Prausnitz, PhD (Chemical and Biomolecular Engineering)

Glaucoma causes elevated pressure in the eye creating a cupping effect resulting in damage to the optic nerve and loss of vision. Particular agents have been suggested that may be used to stiffen the sclera, the outer layer on the back of the eye, thus reducing this cupping effect. Understanding the diffusion kinetics of such agents in stiffening the sclera around the optic nerve is important for possible use in therapeutic applications for glaucoma. The focus of this research project was to use confocal microscopy to determine the diffusion profile and parameters of one such agent. The study focused on diffusion of agents after in-vivo retrobulbar injections in Brown-Norway rats. Penetration depth and distance from optic nerve were chosen as spatial dimensions. The solution was shown to reach a maximum concentration at 15 degrees 15 minutes after injection and a maximum concentration at 30 degrees 30 minutes after injection. This indicates that solutions injected via a retrobulbar method may be diffusing both laterally and anteriorly through the sclera over time. Understanding diffusion kinetics throughout the sclera will be beneficial to the research field of ophthalmic drug delivery because it presents the opportunity to control delivery of drugs to the eye based on diffusion rates. Further study in this field should focus on how diffusion parameters vary for different solutions based on osmolarity, biological toxicity, viscosity, and other chemical properties.

Poster Presentation # 047
Beta Oscillatory Brain Activity Increases During Reactive Balance Recovery

Nina Ghosn
Lena Ting, PhD (Biomedical Engineering)

Beta oscillatory brain activity (13-30Hz) is associated with maintaining a body posture at the expense of new movements. In healthy young adults (HYA), voluntary movement is facilitated by a preceding reduction in beta activity; in fact, beta cortical electrical stimulation slows voluntary movement. It is unclear if beta activity decreases during reactive balance recovery, which is initially involuntary (~100ms), but can be followed by voluntary movement at longer latencies (~250). We hypothesized beta activity would decrease during reactive balance recovery to facilitate subsequent voluntary balance corrections. We quantified beta activity in electroencephalography (EEG) data previously collected from 9 HYA during recovery of standing balance after sudden movements of the floor. Specifically, we used Fourier analysis to quantify the maximum power between 13-30Hz in 3 consecutive 1-second time bins beginning 1 second before perturbation onset at a central midline EEG electrode (Cz), above motor cortex and supplementary motor area. Maximum beta power across the three time bins was 2.6±1.4, 5.0±2.8, and 5.0±2.7 microvolts2/Hz. ANOVA revealed significant effects of subject ($p=0.0047$) and bin ($p=0.009$). A post-hoc multiple comparison test revealed a significant increase in beta power in the two time bins after perturbation onset, compared to the time bin before perturbation onset ($p<0.05$). The observed increase in beta power was in contrast to our hypothesis. Perturbations may have been too easy, requiring only involuntary balance corrections, or this increase could reflect an attempt to maintain the pre-perturbation posture. One limitation is the use of 1-second time intervals instead of shorter time intervals.

Poster Presentation # 079
The Properties of Take-off in Birds

Catherine Grey
David Hu, PhD (Mechanical Engineering)

During take-off, birds extend both their wings and legs at the same moment. The time of take-off is critical for the birds' survival since it determines their ability to flee from predators. In this experimental study, we are utilizing a high-speed videography to investigate the take-off times from birds at Zoo Atlanta. Our preliminary results indicate that birds with a mass of 5 g to 5 kg take-off in 0.1 seconds, which is independent of body size and take-off angle. Since the take-off period is up until the legs are fully extended, we are able to relate the motion of taking off to a jumping motion. Using that relationship, we have created a model based on relating take-off to a simplified spring releasing motion. We are currently looking into the string properties of birds' legs for a correlation to our model and are testing our model in an experimental setting to prove our theory. We hope that this research aids in the development of more realistic aerial vehicles that have the ability to directly mimic a bird's take-off.

Poster Presentation # 080
Honey Bee Pollen Pellets

Kayla Gronewold
David Hu, PhD (Mechanical Engineering)

Honey bees are responsible for a huge percentage of the food humans eat. Crops like blueberries, cherries, and avocados rely heavily on honey bees for their survival. Why are they so important? Honey bees carry pollen from plant to plant which is vital for crop reproduction. To carry this pollen, honey bees mix it with nectar and affix this "pollen pellet" to their legs, using the hairs on their legs for reinforcement. We use a 3D printed leg model as well as artificial pollen pellets to test how the hairs are affected by forces in every direction, in addition to variations between different species of bees. This work may have practical use for applications of microscopic particle transport, such as aerosol medication delivery and spray painting.

Oral Presentation
Investigating Diffusion Kinetics in the Sclera for Ophthalmic Drug Delivery

Srishti Gupta and Hannah Gersch
Mark Prausnitz, PhD (Chemical and Biomolecular Engineering)

Glaucoma causes elevated pressure in the eye creating a cupping effect resulting in damage to the optic nerve and loss of vision. Particular agents have been suggested that may be used to stiffen the sclera, the outer layer on the back of the eye, thus reducing this cupping effect. Understanding the diffusion kinetics of such agents in stiffening the sclera around the optic nerve is important for possible use in therapeutic applications for glaucoma. The focus of this research project was to use confocal microscopy to determine the diffusion profile and parameters of one such agent. The study focused on diffusion of agents after in-vivo retrobulbar injections in Brown-Norway rats. Penetration depth and distance from optic nerve were chosen as spatial dimensions. The solution was shown to reach a maximum concentration at 15 degrees 15 minutes after injection and a maximum concentration at 30 degrees 30 minutes after injection. This indicates that solutions injected via a retrobulbar method may be diffusing both laterally and anteriorly through the sclera over time. Understanding diffusion kinetics throughout the sclera will be beneficial to the research field of ophthalmic drug delivery because it presents the opportunity to control delivery of drugs to the eye based on diffusion rates. Further study in this field should focus on how diffusion parameters vary for different solutions based on osmolarity, biological toxicity, viscosity, and other chemical properties.

Poster Presentation # 069
Low-Noise Wideband Electric Field Receiver for ELF/VLF Radio Reception

Baris Gurses and Kevin Whitmore
Morris Cohen, PhD (Electrical and Computer Engineering)

ELF/VLF waves are electromagnetic waves whose frequency ranges from 1 Hz to 100 kHz. Due to their long wavelength, they are used in different applications from military communications to atmospheric science. These waves can be emitted by lightning strikes and propagate through the atmosphere by reflecting off the ionosphere and ground. The aim of this project is to develop an electric field receiver to detect these waves emitted by lightning strikes and analyze the received signals for remote sensing of the ionosphere. The receiver will be an ultra-sensitive receiver with an input referred noise spectral density less than 50 nV/√Hz and a bandwidth of 1-100 kHz. Front-end of the receiver will have an antenna and an amplifier to detect the waves and drive them to the back-end. Back-end will have a line receiver for anti-aliasing filtering and GPS timestamping, an analog-to-digital converter and a computer to store the incoming data. Since Low Frequency Radio Laboratory has a back-end specifically designed for ELF/VLF wave reception, this proposed receiver will use the same back-end. However, a new front-end will be developed and integrated to this back-end. The amplifier of the front-end will be implemented on a printed circuit board and connected to a 1.5 m long monopole antenna. After this development process, the receiver will be tested and deployed.

Poster Presentation # 081
Aluminum Melt Scraper for High Speed Tribology Device

Tibor Gyorfi
Richard Cowan, PhD (Mechanical Engineering)

Usage of a high speed tribology device with aluminum armature often results in the deposition of melted aluminum on the conducting rails. An experimental study is conducted to determine the effectiveness of a titanium scraper for the purpose of aluminum melt removal. The study focuses on the design and shape of the scraper as well as the feasibility of such a device in an operational setting.

Poster Presentation # 082
Immobilization of Immunoglobulin G Antibodies Using Bifunctional Microparticles
So-Yun Han and Ye Lim Lee
Todd Sulchek, PhD (Mechanical Engineering)

Immunoassays and immunosensors utilizing immunoglobulin G (IgG) antibodies have been widely implemented in the biomedical field and even in forensics. The key to the production of immunoassays is the isolation of IgG antibodies, but there is no effective technique that can capture and purify IgG antibodies secreted by plasma B cells, the antibody producing cells in the human body. A previous study demonstrated the ability of protein G coated microparticles to detect and collect very low concentrations of IgG antibodies, but there has been no study investigating the bifunctionalization of these particles to effectively target a specific plasma B cell and capture its secreted antibodies. Two options were considered for the application: bifunctionalized protein G particles (mixed particles), which are protein G particles conjugated with cell targeting antibody without spatial separation, and Janus particles, bifunctional microparticles with two physically and chemically distinct hemispheres. The purpose of this study was to compare the capability of mixed particles and Janus particles to bind to plasma B cells and collect the secreted IgG antibodies. TIB (Tumor Immunology Bank) hybridomas, an immortalized plasma B cell line, were incubated with Janus microparticles and mixed microparticles for antibody collection. Through confocal microscopy, mixed particles and Janus particles demonstrated the ability to target B cells and collect secreted antibodies effectively and efficiently. Bifunctional microparticles have a possibility of becoming an innovative and effective tool for isolation and purification of antibodies that can enhance the development of vaccines and antibody therapy.

Oral Presentation
An Ex Vivo Model of Trabecular Meshwork Dysfunction for Glaucoma Research

Rebecca Hardie
C. Ross Ethier, PhD (Biomedical Engineering)

Affecting more than 70 million people worldwide, glaucoma is one of the leading causes of vison loss and blindness. Elevated intraocular pressure (IOP) is a well-established risk factor for glaucoma. IOP is primarily regulated by the trabecular meshwork (TM), a tissue located in the anterior segment of the eye which drain aqueous humor from the eye. The cellularity of the TM is shown to be significantly decreased in glaucoma and this loss of cellularity presumably leads to reduced TM function, increased outflow resistance, and elevated IOP. Consequently, if properly differentiated into TM cells, stem cells may represent a potential therapy for glaucoma. In order to assess regenerative medicine therapies, the damage to the TM observed in glaucoma much be properly modeled. This study demonstrates that oxidative stress caused by hydrogen peroxide can reduce TM cellularity to glaucomatous levels in a porcine anterior chamber organ culture model. The diminished TM cellularity in this model resulted in a loss of IOP homeostasis, however the hydrogen peroxide treatment did not permanently damage the TM. This porcine organ culture model offers an improved platform for assessing regenerative medicine therapies for the TM damage in glaucoma.

Oral Presentation
Techno-Economic Comparison between Conventional and Innovative Solar Thermal Power and Desalination Methods for Cogeneration

Megan Haynes
Shannon Yee, PhD (Mechanical Engineering)

The U.S. Department of Energy (DOE) has determined that solar power coupled desalination could be the next step in helping to resolve the water-energy nexus. Freshwater, which has a salinity of less than 500 ppm, makes up less than 3% of the world's water while salt and brackish water, with a salinity of approximately 12,000 and 40,000 ppm respectively, make up about 80% of the world's water. Desalination is therefore a critical process which can be used in municipal water production, agriculture and industry, and water rehabilitation. For many decades, integration of concentrating solar power (CSP) electricity generation for combined power and water production has typically utilized the conventional method of steam Rankine cycles. Current research focus on an enticing innovative method which combines CSP with Brayton cycles and uses supercritical CO_2(sCO_2) as a working fluid, allowing for a broader temperature range. A power cycle using sCO_2 performs at a higher overall efficiency, up to 57%. The amount of heat wasted by power generation cycles, which is typically in amounts significantly higher than the actual power generated, can be salvaged; one possible use for reallocating waste heat is for thermal desalination of water. This techno-economic study analyzes the power and possible freshwater generation of each cycle and provides a comparison of the techno-economic advantages associated with each technology when applied to desalination processes. The results of this study suggest that a recompression-closed Brayton (RCBR) cycle is likely to have the most significant impact in decreasing levelized cost of electricity(LCOE), almost halving it from combining CSP with the traditional Rankine cycle. Also, to minimize levelized cost of water (LCOW) a smaller scale desalination facility which utilizes multi-effect distillation with thermal vapor compression(MED/TVC) instead of multi-stage flash distillation(MSF) is most applicable. Although the smallest LCOE is wet-cooled RCBR with MSF, in areas where freshwater generation is crucial to be optimized there is only a 0.5 cents/kWh increase for dry-cooled RCBR with MED/TVC. This suggests the best candidate for optimizing freshwater generation while minimizing both LCOW and LCOE is dry-cooled RCBR with MED/TVC desalination.

Oral Presentation
Cause and Effect of Hyperskin Features on Carbon Molecular Sieve (CMS) Membranes

Samuel Hays
William Koros, PhD (Chemical and Biomolecular Engineering)

Carbon molecular sieve (CMS) hollow fiber membranes are advanced separating devices applicable for many types of challenging gas pair separations. CMS is derived from polymeric precursor membranes but is able to transcend the permeability/selectivity trade-off of polymer membranes after pyrolysis under an inert atmosphere. It was previously believed that the CMS structure consisted of two main regions; a dense skin layer that provides the molecular sieving ability to the structure, and the porous substructures that provides support for the dense skin layer. Surprising discrepancies between hollow fiber performance and corresponding performance of CMS dense films reveal another physical characteristic of CMS that has previously been overlooked. This presentation resolves this discrepancy by proposing the existence of a "hyperskin" on the top most surface of CMS material. It is believed that the hyperskin is an ultra-dense, hyper-thin layer on the surface of all CMS structures, that provides additional resistance to the material without affecting the overall selectivity. Hypothesized hyperskin formation and mathematical evidence supporting its existence are discussed, as well as several possible strategies to control hyperskin formation to allow for the CMS to reach its full, unhindered potential.

Poster Presentation # 072
Understanding Potentiometric Biosensor Stability and Variability

Bryce Hitchcock
Eric Vogel, PhD (Materials Science and Engineering)

Potentiometric biosensors are promising devices for portable, point-of-care diagnosis with the results being available in less than an hour. Currently, testing of serological diseases such as HIV, malaria, and hepatitis B requires a centralized lab and a timescale of several days, putting the patient at a greater risk. However, the reliability of potentiometric biosensors is somewhat unknown. In order to gain a greater understanding of the stability and variability of biosensor measurements, we developed numerous LabVIEW programs to work in conjunction with an HP 4145b Semiconductor Parameter Analyzer to experimentally determine conditions under which biosensor systems may degrade or vary in their measurement data. Specifically, we examined how running many experiments degrades the reference electrode which is used across multiple measurements in combination with a sensing surface. The programs that were created and the experimental results laid out in this presentation will be beneficial to the biosensor research community as an example of methods which may be used to empirically determine the reliability of their devices.

Poster Presentation # 048
Proposing a Role of SPHK1's Involvement in Breast Cancer Progression and Metastasis

Roxana Hojjatie
Sunil Acharya, PhD (Georgia Tech Research Institute)

Breast cancer is the second leading cause of cancer-related death in women in the United States, with an estimating amount of about 255,180 new cases expected to arise in 2017.1 The four subtypes of breast cancer, including triple- negative (TNBC), are distinguished by the presence or absence of various hormones and receptors. TNBC comprises roughly 15% of the total diagnosis rates and is characterized as exhibiting more aggressive behavior compared to the other subtypes. The kinase SPHK1 plays a role in TNBC by aiding in the regulation of cell proliferation and migration and enhances cell growth and survival. Thus, it has been thought to play a key role in promoting metastasis. SPHK1 is shown to be overexpressed in triple-negative breast cancer tumors. We hypothesize that SPHK1 may play a role in TNBC progression and metastasis. To determine its role, we generated two TNBC cell lines with SPHK1 knockdown. The objective of this study is to validate SPHK1 knockdown at the mRNA and protein levels to help ultimately determine whether SPHK1 expression can serve as a biomarker in detecting progression and metastasis of breast cancer cells. 435 and Whim3 human breast cancer cell lines were cultured and qRT-PCR and protein extraction were conducted. Our findings show the successful knockdown of SPHK1 expression in both mRNA and protein levels in both cell lines. By conducting similar tests on genes upregulated and downregulated by SPHK1, it can be determined whether SPHK1's role in triple-negative breast cancer is in fact prominent.

Poster Presentation # 083
Group Sensing in Black Soldier Fly Larvae

Michael Hu
David Hu, PhD (Mechanical Engineering)

Black soldier fly larvae possess great potential to recycle industrial organic waste into important organic products, such as cow and chicken feed. We are investigating the feeding behaviors of the black solider fly larvae in order to better understand these larvae and to optimize larvae growth for more efficient nutrients recycling. One aspect of interest is how larvae are able to sense food. Two possible options were considered: the larva's individual sense of smell, or the larvae's collective group actions. Currently, we are observing whether larvae aggregates communicate food locations via tactile signaling. We recorded larvae aggregates in environments with food that were of varying accessibility. Using these recordings, we compared individual frames to each other and calculated the displacements and velocities of the larvae in each environment. By comparing these displacement and velocity data, we hope to further understand how larvae find food.

Poster Presentation # 084
Mammals Maximize Urination Speed Using Proportional Urethra Lengths

Aaron Hui
David Hu, PhD (Mechanical Engineering)

Nearly all mammal species of varying body sizes urinate, and previous studies have shown that the duration of this urination remains unchanged with body mass; however, the exact characteristics of the urinary system that govern the duration remains poorly understood. The aim of this study is to analyze how the roughness, length, and diameter of the urethra influence the flow rate by using 3D-printed models that emulate the physical characteristics of the urethra. The results of the study showed that given a fixed diameter and roughness, the velocity of the urine flow plateaus at a length to diameter ratio above 19.2. With previous study showing the average length to diameter ratio in mammals to be 18, this would suggest that the urethra is optimized to be as short as possible without compromising urination speed.

Oral Presentation
Specialized Real Time Water Quality Monitoring for Resource-Constrained Areas

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

Water-borne pathogens reduce the quality of people's lives globally, and exposure to these unsafe water supplies is the cause of death for 1.7 million people every year [1]. Areas of the world where it is difficult to manage water safety are especially affected. Though there are standardized water quality measurements worldwide, many of these standardized methods are infeasible in the regions that are most affected as they can take up to 24 hours and require specialized, potentially unsustainable equipment and trained operators [2]. Fluorometers eliminate many of these barriers by providing real-time measurement of both presence and number of thermotolerant (fecal) coliforms (TTCs) in water samples. Fluorometers could be an improvement on the current WHO standards, but current fluorometers are too expensive for in-field use, often costing upwards of $20,000 [3]. This thesis presents a low-cost fluorometer that passively and accurately collects real-time water quality measurements. Our device measures a fluorescent signal called tryptophan-like fluorescence (TLF) produced by bacteria when exposed to light at a specific frequency. Our device exploits this phenomenon to compute the quantity of bacteria in the sample from the measured fluorescence. We hypothesize that this device will meet the current WHO standards for water quality measurement accuracy and will be cheaper, easier to use, and more sustainable than the current methods.

[1] WHO, 2002. The World Health Report: 2002: Reducing the Risks, Promoting Healthy Life.

[2] WHO, Ed., Guidelines for Drinking-Water Quality, 4th ed. 2011.
[3] Sorenson, J.P.R., Lapworth, D.J., Marchant, B. P. (2015). In-situ tryptophan-like fluorescence: A real-time indicator of faecal contamination in drinking water supplies J.P.R. Water Research, 81, 38-46.

Poster Presentation # 085
Controlling Interfacial Properties of Solid-State Lithium Batteries Using Atomic Layer Deposition

Kirit Joshi
Matthew McDowell, PhD (Mechanical Engineering)

Solid-state lithium batteries (SSLiBs) are a promising next generation energy storage device for consumer electronics, electric and hybrid vehicles, and alternative energy generation systems. SSLiBs feature a solid electrolyte which serves as the ion conductor between the anodic and cathodic electrodes of the battery. Solid-state batteries provide safer, more efficient electrochemical energy storage compared to their lithium-ion, or liquid electrolyte, counterparts. Solid electrolytes are favorable compared to liquid electrolytes because of their high ionic conductivity and higher energy and power density. Furthermore, the use of solid electrolytes instead of flammable liquid electrolytes in lithium-ion batteries improves safety. Currently, interfacial impedance and instability are the primary obstacles preventing efficient operation of solid-state lithium batteries. This study uses atomic layer deposition (ALD) of thin film oxides to develop protective layers at the interface between ceramic solid electrolytes and lithium metal anodes. It is expected that these protective layers will reduce interfacial instability and impedance by improving wetting properties and preventing detrimental anode-electrolyte interactions. This research entails designing and building a custom ALD reactor, depositing thin film oxide materials, and analyzing structural and chemical changes of these materials when coating solid electrolytes. The coated membranes are electrochemically tested within SSLiBs to determine the effect of protection films on electrochemical behavior and lifetime of the batteries. This research has potential to develop stable, high energy solid-state lithium batteries as the next generation of electrochemical energy storage devices.

Poster Presentation # 063
Synthesis and Topical Delivery of Ionic Liquids for the Diagnosis of Cystic Fibrosis

Nuzhat Kabir
Mark Prausnitz, PhD (Chemical and Biomolecular Engineering)

Cystic fibrosis (CF) is an inherited, progressive disease often characterized by thick, sticky mucus that affects the respiratory and digestive systems, causing repeated lung infections and declining lung functions as well as other medical problems. The disease affects approximately 2,500 babies each year in the US, and if left undiagnosed and untreated, CF can be a fatal disease which is why early detection is vital to the management of the patient's health. Currently, the primary diagnosis test has several major pitfalls, mainly false negative sweat electrolyte results which arise from inadequate sweat collection. The formulations of traditional topical drugs usually have low concentrations of the active pharmaceutical ingredient (API) as well as large chemical compounds which are often blocked by the skin's natural barrier, thus preventing effective delivery of the drug through the skin. However, ionic liquids (ILs) are a novel alternative to these traditional formulations that can enhance the permeability of the drug through the skin due to their increased solubility and bioavailability. We synthesized several room-temperature ionic liquids which have been tested in vitro for their long-term permeability across the epidermis and dermis using Franz diffusion cells, and one of the six ionic liquid candidates showed a five-fold enhancement in permeability over 168 hours compared to the control. This result provides a more reliable and safer alternative to the current methods of cystic fibrosis detection, and paves the way to topical delivery of ionic liquids.

Poster Presentation # 049
Sortase A-Mediated Synthesis of Protease-Sensing Nanoparticles

Justin Kahla and Hassan Fakhoury
Gabriel Kwong, PhD (Biomedical Engineering)

The current chemical toolbox available to immobilize bioactive groups to nanoparticles is limited by a lack of bioorthogonal chemistries. We employ the bacterial transpeptidase Sortase A (SrtA) as a site-selective, high-yield, and biocompatible method for nanoparticle functionalization. We vary this functionalization reaction across multiple axes, including time and reagent concentrations, to identify optimal reaction conditions. Using SrtA, we then selectively conjugate protease-cleavable peptide substrates to the surface of iron-oxide nanoparticles (IONPs) to produce "sortagged" synthetic biomarkers (SSBs). We show that these SSBs can sense the activity of thrombin, a critical protease of the coagulation cascade. We further demonstrate that SSBs can noninvasively detect clot formation in a murine model of pulmonary embolism. By expanding the existing toolbox of bioorthogonal chemistries available for nanoparticle functionalization, this SrtA-catalyzed approach will allow for the increased versatility of potential bio-interfacing nanoparticles

Poster Presentation # 073
Characterizing Growth of Carbon Nanotubes

Tyler Knapp
Jud Ready, PhD (Georgia Tech Research Institute).

Improving and optimizing the process of growing carbon nanotubes has become more and more desirable as they possess many desirable mechanical and electrical properties. Some of their special properties include being conductive, hollow, and stiff along its long axis. The purpose of this experiment is to measure and characterize the height and growth rate of carbon nanotubes (CNTs). This was done across different times, ranging from 30 to 600 seconds, and temperatures up to 800 degrees Celsius. Identifying how the growth rate and final height of carbon nanotubes with varying time and temperature is useful in accurately fabricating the correct height of carbon nanotubes for use in supercapacitors with ionic liquid electrolytes. The CNTs were grown using chemical vapor deposition of acetylene onto an iron catalyst stack resting on a single-crystal silicon wafer. The height of the CNTs were then measured in a scanning electron microscope (SEM). The heights were graphed against the time it took to grow to find a trend of final heights. To find the trend of growth rate the heights were divided by their respective growth times and then plotted against the growth time, effectively finding the derivative

Poster Presentation # 050
Modeling Lymphangiogenesis on a Lymph-on-a-Chip Microfluidic Device

Anagha Krishnan
Krishnendu Roy, PhD (Biomedical Engineering)

Lymphangiogenesis is the process of forming lymphatic vessels from pre-existing lymphatic vessels (in a process similar to angiogenesis); lymphangiogenesis plays an important role in homeostasis, metabolism, and immunity. Lymph-on-a-chip devices are artificial lymph structures that retain physiological structure and function and can be maintained in culture, allowing them to serve as models of lymphangiogenesis and other lymphatic processes. I seek to create a five-channel lymph-on-a-chip device to stimulate lymphangiogenesis in lymphatic endothelial cells (LECs) by placing these cells in close proximity to cells that promote angiogenesis by secreting inducers such as VEGF-C and ephrin-B2. I test the angiogenic properties of three cell types (human lung fibroblasts (NHLFs), human dermal fibroblasts (NHDFs), and mesenchymal stem cells (MSCs)) while the LECs are suspended in two different hydrogels (collagen and fibrin). I then qualitatively measure vascular formation by staining and imaging the devices, and I quantify the images using AngioTool; additionally, I measure expression levels of pro-angiogenic factors using polymerase chain reaction (PCR). If my five-channel lymph-on-a-chip device can successfully model lymphangiogenesis of LECs, future studies will model the migration of dendritic cells to and within the formed lymphatic vessels as well as model the resulting immune response. This will lead to an improved understanding of lymphatic processes, which, in turn, will lead to improved vaccine delivery to the lymphatic system.

Poster Presentation # 086
Automated Detection of Serial Sections for Electron Microscopy

Aditi Kumar
Craig Forest, PhD (Mechanical Engineering)

To study the human connectome, the neuronal circuit diagram of the brain, ultrathin neuronal tissue sections must be imaged using large-scale serial section electron microscopy. Before imaging, sections must be processed, which involves four main steps: (1) section cutting, (2) section transport away from diamond knife, (3) section pick up, and (4) section placement. Only Step (1) has been automated. In Fall 2016, a Capstone Design team with my PhD mentor devised a pick-and-place robot using 3-axis linear actuators for automated section pick up and placement, Steps (3) and (4). However, sections were neither detected reliably nor accurately. In Spring 2017, I designed an Arduino-powered device called the Section Puffer to emit puffs of air at regular intervals to automate Step (2). This device worked with 100% accuracy when sections were removed just after transport. In Fall 2017, I calculated the accuracy and repeatability of manual section pick up and placement and the 3-axis linear actuators. This semester, I wrote a section detection algorithm in MATLAB to reliably detect section centroids for pick up. This algorithm was programmed into the pick-and-place robot and used along with the Section Puffer to automate Steps (2), (3) and (4) and increase accuracy and repeatability of the entire system. The average pick up time and accuracy of the automated system will be compared with manual pick up and placement. The experiments are currently in progress but the results will be ready by the end of March

Poster Presentation # 051
Effects of Magnetic Field and Nanoparticles on Human Mesenchymal Stem Cell Differentiation and Viability

Yinglin Li
C. Ross Ethier, PhD (Biomedical Engineering)

Glaucoma, a leading cause of blindness worldwide, is associated with elevated intraocular pressure (IOP). The trabecular meshwork (TM), a tissue in the ocular anterior chamber, is essential for regulating IOP by filtering and draining aqueous humor. However, in glaucoma, TM cellularity is decreased, leading to elevated IOP. We hypothesize that if TM cellularity can be restored with differentiated mesenchymal stem cells (MSCs), IOP regulation can be restored, inhibiting glaucoma progression. This is only possible if MSCs can be efficiently delivered to the TM. To expedite delivery, we utilized Prussian blue nanocubes (PBNCs), which are magnetic, to steer MSCs to the TM region in the eye. Using porcine eyes maintained in organ culture we previously demonstrated that PBNC-labeled MSCs were more optimally delivered to the TM region than unlabeled MSCs. Here, we look at the effect of PBNCs and magnetic exposure time on MSC viability and differentiation. MSCs were incubated with different PBNC concentrations before viability assessment or exposure to differentiation stimulus. To assess magnet exposure on viability, unlabeled or PBNC-labeled MSCs were placed directly above a magnet or with a spacer gap for various time points. We found that PBNCs do not impact MSC differentiation and viability at any concentration tested. However, the presence of a magnetic field reduced MSC viability, even without PBNC-labeling. In conclusion, MSCs were not affected by PBNC-labeling but magnetic exposure impacted viability. Thus, magnetic field placement and duration must be optimized before delivered stem cells can be utilized as a future glaucoma therapeutic option.

Poster Presentation # 064
Investigating the Effect of Neurotransmitter Mutations on C. elegans Whole-brain Dynamics

Yueyi Li
Hang Lu, PhD (Chemical and Biomolecular Engineering)

Neurons are connected by chemical neurotransmission to form circuits that receive signals and control behavior through neurotransmitters such as serotonin and dopamine. Since studying whole-brain dynamics is highly dependent on advanced microscopes and other recent developments, previous works only showed how a limited set of circuits are affected by abnormal neurotransmissions. The effects of abnormal neurotransmission on the whole-brain dynamics are still unexplored. In our project, we aim to study how neurotransmitter mutation affects the whole-brain dynamics in C. elegans. C. elegans is a useful organism to study for our project because it has only 302 neurons but uses almost every neurochemical found in the vertebrate brain, and it is possible to simultaneously record most neurons' activities. The whole-brain dynamics of strains with certain neurotransmitter mutations will be compared with that of wild-type C. elegans. We have marked the specific circuit of neurons that use the neurotransmitter with a different fluorophore than the other neurons for identification purposes. We will then collect recordings of the whole-brain neuron activities and identify each neuron involved in the neurotransmission using the introduced landmarks. Finally, we will be able to identify how neurotransmitters affect whole-brain activities. Studying the effect of neurotransmitter mutations on C. elegans whole-brain dynamics is beneficial for better understanding human diseases such as Alzheimer's and Huntington's that are caused by an imbalance between different neurotransmitter systems.

Poster Presentation # 052
Quantifying Differences in Joint Coordination between Trained and Untrained Populations and Across Tasks Using PCA

Alix Macklin
Lena Ting, PhD (Biomedical Engineering)

TITLE: Quantifying differences in joint coordination between trained and untrained populations and across tasks using principal component analysis. MOTIVATION: Traditional gait analysis methods compare individuals by directly comparing joint angle time series data, but fail to capture differences in joint coordination. Principal Component Analysis (PCA) can be used to uncover synergistic patterns of joint coordination, and may be useful for discriminating between individuals. We characterized differences between expertly trained ballet dancers and untrained novices using PCA and hypothesized that individuals characterized by similar kinematics could be differentiated by the number of kinematic synergies. METHODS: 3D marker data was previously collected at 120Hz for six experts and six novices in overground and beam walking and used to calculate joint angle kinematics for the hip, knee and ankle of each leg. We compared the joint angle trajectories, averaged over multiple gait cycles, across individuals within each task, and across tasks. To form synergies, we used only the minimum number of PCs sufficient to account for at least 95% of the variability of joint kinematics throughout each trial. RESULTS: Population means for both novices and experts fell within 2 standard errors of each other for all joint angles within each walking task. Within populations, average joint kinematics were different across tasks. More kinematic synergies are required to characterize gait coordination in experts compared to novices. For each population, more kinematic synergies were necessary to explain gait coordination during the beam walking task compared to over-ground walking. CONCLUSION: Our results suggest that training increases the number of coordination patterns available, allowing for additional movement strategies, but the number is dependent on task type. Kinematic synergies may be useful for evaluating the effects of long-term rehabilitation on individuals with distorted or impaired gait..

Poster Presentation # 065
Developing Globally Interconnected P3HT Networks Through Poor Solvent Modulation

Aarti Mathur
Elsa Reichmanis, PhD (Chemical and Biomolecular Engineering)

Organic electronics as a low cost alternative to traditional inorganic electronics in lower computing applications have become popular due to the solution processability of semiconducting polymers. Charge transport properties are shown to be heavily dependent on the microstructure of these polymers. This project uses the self assembling polymer poly(3-hexythiophene) (P3HT) to study the relationship between process, structure, and properties. Recent advancements in solution processing of P3HT include UV treatment, aging, and sonication. However, optimizing these processing methods for every polymer system is time and energy intensive. Instead, we propose using poor solvents as a solutions processing method that could be generalized for all self assembling polymers. Poor solvents specific to every polymer are known, or easily determined through Hansen solubility parameters. Different combinations of aging P3HT and adding the poor solvent, 2-Methylpentane, to P3HT solutions were explored. Processed solutions were blade coated into thin films on bottom gate, bottom contact transistors to analyze field effect charge mobility. The highest mobility values were found when P3HT solution was aged and then treated with 15% poor solvent, which was attributed to a globally interconnected network. In contrast, it was found that treating P3HT solution with 2-Methylpentane before aging lowered mobility values. This decrease is explained by UV-Vis absorption spectra demonstrating high aggregate fractions outside of the optimal range for P3HT, correlating to precipitation, grain boundaries and diminishing charge mobilities. Atomic force microscopy (AFM) confirmed these results, showing a higher orientation and fiber density with poor solvent treatment post aging.

Poster Presentation # 053
Morphological and Hemodynamic Analysis of the Carotid Arteries in a Sickle Cell Anemia Mouse Model

George McAlear and Shuangyi Cai
Manu Platt, PhD (Biomedical Engineering)

Sickle cell anemia (SCA) is a genetic mutation that causes hemoglobin in red blood cells to polymerize under deoxygenated conditions. Children with SCA have an increased likelihood to develop strokes, but the current pathophysiology is unknown. One marker of stroke risk in children with SCA are elevated cerebral blood velocities, indicating that changes to the vascular morphology may play a key role in stroke development. The goal of this research is to use the Townes sickle transgenic mouse model to investigate the relationship between the morphology and hemodynamics in the carotid arteries to pursue potential therapeutics. This was analyzed by collecting ultrasound and microCT data from heterozygous (AS) and homozygous (SS) sickle mice at various ages: 4, 6, 12, and 24 weeks. Blood flow profiles from the common carotid (CCA) and internal carotid arteries (ICA) were digitized from ultrasound images, where a custom MATLAB script performed spectral analysis on the velocity waveform. These velocities were compared to the morphology of each vessel, through reconstructions created from microCT images of the mouse. It is currently unknown if the pathology observed in humans with SCA also occur in the sickle animal model. Vessels in SS mice appear slightly larger than those in the AS genotype, but no significant changes are seen the velocity profiles when examining the total population. Moving forward, this data will assist in characterizing the cerebral arteries of sickle transgenic mice and provide potential insights into the mechanisms causing increased stroke risk in SCA.

Poster Presentation # 055
Alginate Core-shell Scaffolds for Enhance CAR T Cell Manufacturing

Zahra Mousavi Karimi
Krishnendu Roy, PhD (Biomedical Engineering)

T cell immunotherapies have shown immense promise in treating cancer and other diseases; however, we lack the ability to manufacture them on a large scale. Unlike traditional chemotherapies, cell-based immunotherapies are composed of living entities which can dramatically change in response to small stimuli. This poses unique challenges in producing them at high yields compared to traditional drugs, which are simple chemicals. In the case of T cells, our current manufacturing techniques do not account for the complexity of the lymph nodes, where they expand rapidly in response to disease. Thus we hypothesize that creating a novel microenvironment that can mimic the lymph nodes will enhance expansion of T cells and thus allow this promising immunotherapy to reach more patients in the clinic. To do this we propose using alginate which has been widely used for encapsulating cells. It has many desirable properties such as tunability, non-toxicity, and ease of use; thus it is a promising candidate for cellular processing. In this scenario, we envision that the alginate spheres will function as "mini human lymph nodes" which will keep T cells in close cell-cell contact, enhancing signaling and expansion. Furthermore, the alginate matrix can provide protection against shear and thus will allow these "mini human lymph nodes" to be put into a bioreactor, allowing this technique to be commercialized by companies in the cell manufacturing industry.

Oral Presentation
3D Reconstruction of Live Chickens in Poultry Houses

Aneri Muni
Colin Usher, PhD (Georgia Tech Research Institute).

Poultry houses require daily monitoring to ensure animal health and proper house operation. One task involves observing the average growth rate of the house to adjust the daily feed. In addition to being labor intensive and time consuming, it is difficult for the farm owners to find consistent labor to fill these jobs. This project looks at the possibility of estimating the weight of a chicken based on the volume of the chicken as captured by a 3D model. We present a system capable of reconstructing dynamic scenes, i.e. chickens in a poultry house, by fusing together depth scans captured using a Microsoft Kinect. Like DynamicFusion, our approach involves discretizing the live depth frame into nodes and estimating individual 6D transformations before fusing them together to reconstruct scene geometry. This approach doesn't use any prior model of template, making it applicable to a wide range of dynamic objects and scenes.

Poster Presentation # 056
Amyotrophic Lateral Sclerosis (ALS) is a Neurodegenerative Disease Characterized by the Progressive Degradation of Motor Neurons

Joseph Murphy
Cassie Mitchell, PhD (Biomedical Engineering)

Amyotrophic Lateral Sclerosis (ALS) is a neurodegenerative disease characterized by the progressive degradation of motor neurons in the central nervous system. Inflammation has been cited as a key contributor to ALS neurodegeneration. Little is known, however, about the temporal trends of astrocytic secretions and responses not directly involved in inflammation processes, which can also contribute to the pathology. This meta-data analysis of 140 articles ascertains the temporal changes in astrocyte regulation of glutamate (intracellular glutamate, GTL-1, GluR1, GluR2) and calcium (intracellular calcium, ChAT activity, VGF, TNF-alpha, aspartate, and IGF-1) levels throughout the progression of ALS in the high copy SOD1 G93A mouse model. For each corresponding experimental time point (405 data points from 140 papers), the ratio of transgenic to Wild Type was found. ANOVA and a student's t-test performed to compare disease stages (early, post-onset, and end stage). It was found that intracellular glutamate does not change over time, suggesting that the astrocytes are not responding to the increase in extracellular glutamate. GLT-1 levels were found to be decreased 27% over Wild Type only at end-stage (p=0.036) and decreased 28% from pre-onset to end-stage (p=0.0061). The decrease means GLT-1 treatments could be administered post-onset to increase intracellular glutamate in astrocytes. Additionally, normal intracellular calcium levels correspond with 28% decreased GluR1 levels from post-onset to end-stage (p=0.013), which indicates that lowering GluR1 levels in astrocytes could help improve calcium homeostasis and prolong cell survival. Altogether, this study finds that astrocyte function is failing to protect the motor neuron microenvironment.

Poster Presentation # 040
Methods for Combining Model-Free and Model-Based Reinforcement Learning

Gabriel Nakajima An
Evangelos Theodorou, PhD (Aerospace Engineering)

Despite the recent advancements in reinforcement learning (RL), this field still suffers from multiple challenges that don't allow its algorithms to be widely deployed in industry domains. In particular, model-free RL approaches have been gaining traction with being able to learn extremely complex control policies with powerful representations enabled by deep learning methods; however, they require high sample complexity until convergence to good policies. On the other hand, because model-based approaches have a representation of the dynamics, they require much lower sample complexity; but their policies often don't perform as well due to model bias. We advocate to eradicate this dichotomy and bring forth methods of using the representations of the learned uncertain dynamics to learn complex predictive control policies. These, in turn, reduce sample complexity while still converging to high-performance policies

Poster Presentation # 087
Quantitative Analysis of iPSC-based in vitro Models of the Osteogenesis and Chondrogenesis of JOCD

Catriana Nations
Robert Guldberg, PhD (Mechanical Engineering)
Juvenile osteochondritis dissecans (JOCD) is an increasingly common condition predominantly affecting adolescent and young adults that progresses to early onset osteoarthritis. It involves the formation of an osteonecrotic lesion in the subchondral bone with secondary effects in the overlaying articular cartilage, which could lead to the division of this osteochondral fragment from the parent bone. Previous research has focused on retrospective clinical studies, providing limited insight into JOCD pathophysiology. Moreover, difficulty of harvest and limited proliferation ability of skeletal tissue-specific and stem cells has further limited research of JOCD cellular pathomechanisms. Therefore, the objective of this project is to develop iPSC-derived in vitro models of JOCD chondrogenesis and osteogenesis in order to elucidate its pathology. We hypothesized that the models will show protein dysfunction and accumulation in the rough endoplasmic reticulum as a hallmark of the disease, similar to familial and equine OCD. We have shown that we are able to successfully create in vitro models of JOCD patient-specific chondrogenesis and osteogenesis. We are unable to detect differences in protein production in either model when comparing to normal patients. This finding may suggest that there is an epigenetic component to JOCD that may be lost when patient-specific cells are reprogrammed into iPSCs for the use of these models.

Poster Presentation # 070
Open Circulatory Model

Jacob Owens
A. Faith Sarioglu, PhD (Electrical and Computer Engineering)

For my undergraduate research, I am creating a prototype that models a human heart and it's open circulatory system. I have built a machine that prevents blood from coagulating while ensuring the blood is constantly moving. To simulate the human circulatory system the machine encapsulates blood in a test tube and subjects the blood to consistent oscillations while maintaining a constant pressure. The blood escapes through the bottom facilitated by a 3-D printed cylinder and a micro drip adapter. The test tube oscillates within the range of 45 degrees to 135 degrees at a constant speed which can be set to the rate of .5Hz to 1Hz. A small stepper motor drives these oscillations. Additionally, the constant pressure comes from a series of interconnected test tubes that lead to pressure regulators (allowing for two different test tubes to have a constant pressure ranging from 1-35psi), a pressure monitor (allowing for precision pressure), and a pneumatic source that drives the compressed air throughout the system. The motor, pneumatic source, and power source are connected to an Arduino board that allows (by the flip of one switch) to start the entire process. Through the Arduino board we have ability to change certain aspects of the system (oscillations in the motor or its speed) easily and effectively. The prototype is used to model realistic test conditions for blood as it is being run through a biomedical micro device and will be used for early detection of cancer.

Poster Presentation # 088
Development of an EPIC-microCT Imaging Method for the Evaluation of Novel Osteoarthritis Therapies

Kaley Parchinski
Robert Guldberg, PhD (Mechanical Engineering)

Osteoarthritis (OA), characterized by debilitating joint pain, is a degenerative disease caused by the breakdown of cartilage in joints and adjacent bone. It is the most common type of arthritis, affecting 10-12% of the US adult population, and currently has no cure (Lawrence, et al.). Cartilage contains specialized molecules called proteoglycans (PGs). PGs are vital suppliers of swelling pressure that enable cartilage to withstand compressional forces applied by adjacent bones. A decrease in cartilage PG content can signal the subsequent onset of osteoarthritis. Current methods of OA therapy evaluation are destructive, however due to the degenerative nature of OA the longitudinal evaluation of therapies is crucial. EPIC- µCT (equilibrium partitioning of ionic contrasting agent – microcomputed tomography), is a volumetric, non-destructive imaging method. This method utilizes a contrast agent (Hexabrix 320 30%) that yields an equilibrium distribution that is inversely proportional to the density of PGs (Palmer, et al.) allowing for the quantification of PGs in neocartilage constructs. An EPIC- µCT method for analyzing proteoglycan content in neocartilage constructs would allow for the longitudinal evaluation of novel osteoarthritis therapies.

Poster Presentation # 057
Optimization of 3D Culture System for Astrocyte Mechanobiology Study

Priyasha Pareek
C. Ross Ethier, PhD (Biomedical Engineering)

Glaucoma is an optic neuropathy that results in vision loss due to the progressive loss of retinal ganglion cells (RGCs) in the optic nerve head (ONH). Astrocytes, mechanically sensitive glial cells in the ONH, are believed to play a role in initiating RGC damage. Currently used 2D culture systems result in baseline astrocyte activation, and thus limit the ability to study astrocyte mechanoreactivity. A 3D, hydrogel-based culture system is being developed in the Ethier lab and requires additional optimization and validation. The student will learn to culture astrocytes (both an immortalized cell line and primary cells) in 2D and using the 3D system being developed. Mechanical properties of the hydrogels, including hydrogel stiffness and accuracy of the displacements in the hydrogel loading device, will be assessed. Astrocytes seeded in the 3D culture and subjected to mechanical forces will be examined using fluorescent microscopy, PAGE/western blots, and possibly flow cytometry to access hypoxia and astrocyte activation.

Poster Presentation # 089
Effects of Nasal Pathway Shape on Odor Detection in Machine Olfaction System

Jasmine Pillarisetti
David Hu, PhD (Mechanical Engineering)

Sniffing is an important component in mammalian olfaction, serving to draw odors into the nose for detection. Reviewing past studies on animal olfaction, certain aspects such as the sniffing frequency have been found to be common among macrosmotic animals. We compared the airflow velocity, volumetric flow during inspiration, and the cross-sectional area of the nasal cavity for various mammals. We find that bigger animals sniff at a lower frequency and each sniff has a higher airflow velocity. Looking at these aspects of sniffing in more detail and understanding the significance of these common values in animal olfaction informed the design of a pre-concentrator to improve performance in machine olfaction. In addition to frequency and air flow velocity, studies have shown that the orientation of the nasal pathway in certain mammals has an effect on airflow dynamics and particle deposition in the nose. By curving the air flow pathway surrounding sensors in a machine olfaction system, the system can possibly be able to more accurately recognize a given scent.

Poster Presentation # 090
The Fluid Properties of the Honey Bee Pollen Basket

Suraj Puvvada
David Hu, PhD (Mechanical Engineering)

Honey bees transport pollen by mixing it with nectar and carrying it as a pellet on their hind legs. This pellet is a concentrated suspension that can reach a packing fraction of 0.64, the maximum for random close packing of spheres. We study the fluid properties of this suspension. We obtain pollen pellets from honey bees at the hive and measure their viscosity using a squeeze film test. The viscosity of the suspension is approximately 10,000 times greater than the viscosity of nectar alone. The pollen suspension is shear thickening at high shear rates, and shear thinning at low shear rates, which is consistent for what is known for other concentrated suspensions of spheres. We investigate how the viscosity of the suspension depends on time, and the significance of the fluid properties of the suspension for a honey bee. This work will increase our understanding of how honey bees pollinate flowers.

Poster Presentation # 091
Effects of Input Shaping on Impact Loads During Collisions Involving Flexible Robots

Prachi Sahoo
William Singhose, PhD (Mechanical Engineering)

Collaborative robots are designed to work autonomously with little to no guidance and interact with humans in a shared workspace. Such applications pose safety concerns for the human. In recent years, the design and control of soft robotics in shared environments has received increasing attention due to their inherent flexibility and improved safety characteristics. Because co-robots work among humans, they must produce low impact forces upon collision with the human body. To design effective compliant robots, impact forces must be understood. Cranes can be considered as simple flexible robot arm. The flexible arm consists of the vertical suspension cables and the attached payload. This pendulum can have significant swing. To simulate impact effects between this flexible robot arm and the human body, a complaint arm model was constructed. The effect of input shaping on impact loads was then evaluated.

Oral Presentation
Computational Modeling of Valvular Heart Diseases: Aortic Stenosis, Mitral Regurgitation, Tricuspid Regurgitation

Mandy Salmon
Ajit Yoganathan, PhD (Biomedical Engineering)

Valvular heart disease is a major problem for the aging U.S. population. Computational models can be used to improve understanding of heart valve hemodynamics and biomechanics, enabling clinicians to better plan procedures, improve outcomes, and optimize device design. Application to Aortic Stenosis: Transcatheter aortic valve replacement (TAVR) is a minimally-invasive option for high surgical risk patients. While TAVR has many advantages, adverse events such as valve thrombosis are not uncommon. A parametric model for TAVR leaflets was developed using Rhino3D™. This model can be dynamically manipulated to simulate commercial TAVR devices. The model will be used with patient-specific aortic CT scans to study the relation between thrombosis presence and associated hemodynamics. Application to Mitral Regurgitation: A plethora of surgical and percutaneous techniques exists to attempt to restore proper valve geometry and function. A computational platform exists for simulating percutaneous repair of mitral regurgitation, however, a limitation of this model is its zero-displacement boundary at the annulus and papillary muscles. Therefore, the modeling paradigm was improved by coupling the mitral valve with a left ventricle. Application to Tricuspid Regurgitation: Functional tricuspid regurgitation (FTR) remains significantly undertreated despite its substantial clinical symptoms, including right heart failure. An in silico model of a regurgitant tricuspid valve is being developed, for investigation of the feasibility and efficacy of percutaneous repair techniques. This involves excision of an ovine valve, micro-CT imaging, 3D segmentation and smoothing, meshing, assigning material properties and applying boundary conditions. The resulting model will be validated against in vitro data.

Oral Presentation
Microfluidic Modulation of Differentiation of 3D Stem Cell Aggregates to Motor Neurons

Amanda Schaefer
Hang Lu, PhD (Chemical and Biomolecular Engineering)

Pluripotent stem cells can be differentiated as 3D aggregates into specific cell types. Current culture methods include microwells, petri dishes, and spinning bioreactors but are often unable to reproducibly control the culture environment, track samples longitudinally, and image in situ. To address these challenges, we developed a microfluidic platform that provides a controlled environment for culture and differentiation of mouse embryonic stem cell (mESC) aggregates. Using this platform, we observed how media exchange affects mESC aggregate differentiation to motor neurons. The microfluidic device is fabricated from polydimethylsiloxane (PDMS) replica molded from a silicon master mold and plasma bonded to glass coverslips. Devices are loaded with Olig2-GFP mESC aggregates formed by forced centrifugation of cells in microwells in a neural induction media overnight. In a cell culture incubator, devices are connected to a syringe pump that delivers media at a set flow rate. Aggregates are cultured in batch stirred suspension culture as a control. We hypothesize that the residence time of media components and cell-secreted factors impacted by the media perfusion flow rate affects cell growth and proportion of cells that differentiate to neural cell types. Results showed continuous perfusion was detrimental to generating large populations of motor neurons because cell-secreted factors were swept away. Discontinuous perfusion and increasing the concentration of small molecules in the media increased the percentage of Olig2+ cells on chip. Cells better protected from flow were observed to have better differentiation. This asymmetric patterning could be used to study mechanisms of tissue patterning in the future.

Poster Presentation # 092
Bubble Stability in Underwater Sniffing

Benjamin Seleb and Anviksha Busa
David Hu, PhD (Mechanical Engineering)

Star-nosed moles sniff for prey underwater by blowing bubbles and quickly sucking them back in before the bubbles can float away. The appendages that create the moles' iconic star-shaped nose seem to contribute to the stability of these bubbles. We investigate the effect of the star-shaped geometry in delaying bubble pinch-off by analyzing high-speed videos of the moles' behavior and replicating this bubble generating behavior in lab experiments. The objective of this project is to use sniffing to improve electronic chemical sensing devices, and thus develop an electronic nose that can smell odors underwater.

Poster Presentation # 058
Control of Antibiotic Resistance in Bacterial Biofilms through Nanoparticle Spacers

Olivia Sergent
Kyle Allison, PhD (Biomedical Engineering)

According to the National Institutes of Health, around 80%

of bacterial infections in humans involve biofilm-associated microorganisms. Bacterial biofilms are formed when planktonic, free-swimming bacteria attach to a substratum in moist environments. As a biofilm, sessile bacteria have an increased tolerance for antibiotics. The cells in these biofilms are closely packed, which makes it harder for antibiotics to flow through the biofilm and treat bacteria. Also, multiple species of bacteria can grow in one biofilm, making it more resistant. The purpose of this study is to determine whether controlling the intercellular distance between bacteria in a biofilm could decrease the biofilm's tolerance to antibiotics. Nanoparticles of equal size, Dynabeads, will be used as "spacers" that bind to bacteria and create equal separation between the cells. To allow binding to occur, the spacers will be hybridized with an "effector," DNA with a Cholesterol attachment.

Poster Presentation # 066
Analysis of Uncertainty in Machine Learned Density Functionals

Karan Shah
Andrew Medford, PhD (Chemical and Biomolecular Engineering)

Density Functional Theory(DFT) is one of the most popular and successful methods for quantum mechanical simulations of matter. While it is formally exact, approximations of eXchange Correlation(XC) functionals have to be made. These calculations are highly time consuming and scale poorly with system size. The prospect of combining computer vision and deep learning is a fundamentally new approach to designing these XC functionals. This approach combines the intuitive power of physical insight with the flexibility of machine learning and high-quality training data in order to develop new routes to approximating exchange-correlation energies. A parameterized function is first fit on the data and the resulting residuals are used for bootstrap aggregating via an ensemble of neural networks. This two stage method provides robust uncertainty quantification on the predicted XC energies and can be automated for many systems without significant manual intervention.

Oral Presentation
Inorganic Modification of Cellulosic Fibers for Enhanced Oil Sorption Capacity

Andrew Short
Mark Losego, PhD (Materials Science and Engineering)

Atomic layer deposition (ALD) of Al_2O_3 on organic fibers can modify the substrate's surface energy. In this study, Al_2O_3 ALD applied to cellulosic fibers results in high hydrophobicity (WCA ~160°) and oleophilicity at a low cost, allowing raw cotton to be transformed into an ideal material for oil spill remediation. The ALD-treated cellulose floats on water without becoming saturated for over 6 months, but easily adsorbs oil, whereas untreated cellulose preferentially adsorbs water. ALD-treated cellulose has a significantly higher oil sorption capacity (e.g., 20 g g-1 vs. 0.11 g g-1) than raw cotton across a range of experimental conditions approximating those encountered in real-world oil spill remediation efforts. While studies in literature in this field report ultra-high oil sorption capacities (~200 g g-1), this study finds that reporting oil sorption capacity in terms of g g-1 can be misleading, and recommends this measure be reported in tandem with the material's oil sorption capacity in terms of g cm-3, because this per-volume sorption capacity better represents the economic factors contributing to an oil sorption material's cost-effectiveness. This talk will detail the advantages of testing oil sorption capacity in real-world conditions, and explain the efficacy of Al_2O_3 ALD applied to cellulosic fibers as a scalable, cost-effective method for creating superior materials for oil spill remediation.

Oral Presentation
CO_2 Capture Using 3D-Printed PIM-1 Adsorbents Incorporating MOFs

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

Rising atmospheric CO_2 concentration has exceeded nature's carbon recycling capacity and caused severe environmental hazards. To capture CO_2 from point sources and from atmospheric air, various solid CO_2 adsorbents, including zeolites, metal organic frameworks (MOFs) and immobilized amines, were developed. While this has been a promising development, the discrete nature of the solid adsorbents limits their applications without the use of a substrate. To reduce energy cost of direct air capture, it is important to develop a structured adsorbent with both high adsorbent efficiency and low gas pressure drop. In this work, we proposed a 3D printing technique to manufacture a structured CO_2 adsorbent, in which a solid adsorbent is supported by a highly permeable polymer with intrinsic microporosity (PIM-1). This method of adsorbent development allows for customizable substrate patterning and sizing, thereby allowing for the transport properties through adsorbent to be tuned. Compared with existing 3D printing techniques for structured adsorbent manufacture, our technique features mild activation condition and low internal mass transfer resistance. The MOFs selected for the study include Mg-MOF-74, HKUST-1, and Zeolite 13X. Kinetic CO_2 adsorption and CO_2 breakthrough experiments were conducted to compare with traditional adsorbent configurations like packed beds and fiber sorbents.

Poster Presentation # 059
Optimizing Deep Learning Models for Limited Precision Architectures

Dilara Soylu
Chethan Pandarinath, PhD (Biomedical Engineering)

Modern deep learning techniques rely on large matrix operations requiring significant amount of computational resources. Graphics Processing Units (GPUs), processors specialized in large matrix operations, are therefore commonly used in deep learning. Recently, there have been progress in high throughput limited precision GPUs, which can provide 2-8 times speed up in the training of deep learning models. It has been shown that common deep learning tasks do not require high precision computations; counterintuitively, limited precision may even help models become less prone to overfitting (a phenomenon of relying too much on a particular dataset as opposed to learning the transferable general features required to perform well in a task). However, while it is feasible to train models with limited precision data types, several challenges must be overcome. In this work, we share the challenges encountered and our solutions to them while optimizing a variational autoencoder model consisting of recurrent neural networks, Latent Factor Analysis via Dynamical Systems (LFADS), for 16-bit architectures, without compromising the model accuracy. Important steps included gradient casting, loss scaling, adjustment of the optimizer and its settings, and detecting precision sensitive operations in the model and allowing higher precision when needed. Although we focused our work on LFADS, the challenges and their solutions apply to most deep learning models. Optimizing deep learning models with limited precision data types allows the models to be trained on recently released fast NVIDIA GPUs.

Oral Presentation
Self-Powered Hydraulic Sensing Node

Max Toothman
Kenneth Cunefare, PhD (Mechanical Engineering)

The current market demand to connect everyday objects via the "internet of things" (IoT) has fueled significant advances in low-power sensing and communication technology. One aspect of these connected products that still needs attention, however, is the means by which they are powered. Most IoT products today are powered by physical wires or through a battery, solutions that can be costly and difficult to maintain. An attractive alternative to these methods is the use of energy harvesting from acoustic fields. Past efforts in this area have been stymied by the low energy densities that are present in ambient sources such as light and vibrations, but pressure fluctuations in hydraulic systems offer a much denser energy source. Previous work to develop a piezoelectric energy harvesting device has generated 13mW of power from pressure changes in a hydraulic test rig. This hydraulic pressure energy harvesting (HPEH) device could allow sensing networks to be completely self-powered wherever hydraulic systems are present. This project describes the implementation of a HPEH device used to power a hydraulic sensing system that transmits its measurements over Bluetooth Low Energy. Following this is a discussion of the levels of power that are produced by the energy harvester and consumed by the communication components. Additionally, an evaluation of the wireless data transmission rates that can be supported by a power output on the scale of 10's of milliwatts is included.

Oral Presentation
Effect of Laser-activated Nanodroplets on Drug Delivery in Human Cells

Diana Toro
Mark Prausnitz, PhD (Chemical and Biomolecular Engineering)

Studies have shown that laser-activated carbon-black nanoparticles can be used to deliver therapeutic agents into the cell while maintaining high cell viability. After laser irradiation, these nanoparticles produce gaseous bubbles and cavitational shockwaves that perforate the cell membrane in a process called the photoacoustic effect. Drugs can be delivered through these temporary holes; however, there are limitations for clinical application. The gaseous bubbles produced are relatively large (1-10μm) with a limited lifetime (a few minutes), and cannot be used to target specific sites for drug delivery. We propose using laser-activated perfluorocarbon (PFC) nanodroplets instead of carbon-black nanoparticles to deliver a fluorescent molecule, calcein, into human prostate cancer cells. After pulsed laser irradiation, PFC nanodroplets convert from liquid to gas, producing a photoacoustic signal. Vaporized PFC nanodroplets are smaller, more stable, can remain in aqueous solution longer, and their lipid shell can be modified for targeting tumor cells. We hypothesize that PFC nanodroplets will increase drug uptake more than carbon-black nanoparticles. We synthesized PFC nanodroplets each with a liquid PFC core and Epolight 3072 dye encased in a lipid shell. We harvested the DU145 cell line, prepared samples of nanodroplets, cells, and calcein, then exposed the samples to pulsed laser irradiation at 1064 nm. We followed cell wash procedure and conducted drug delivery analysis via flow cytometry. By exploring the therapeutic applications of PFC nanodroplets, we can develop more effective localized drug delivery with minimal damage to surrounding tissue and pursue the promising goal of translation into the clinical field.

Oral Presentation
Elastic Behavior of Larvae Aggregations

Joshua Trebuchon
David Hu, PhD (Mechanical Engineering)

We study the pressure exerted by aggregations of Black Soldier Fly larvae, including the contributions of the elastic pressure of the larvae bodies and the unique “swim pressure” exerted by active particles due to their individual motion. We find a non-linearity in the stress vs. strain curve for active and dead larvae as well as other elastic spherocylinders in randomly packed aggregations. Whereas the elastic stress exerted by a homogenous solid is generally linear with respect to the strain applied to the solid, we find that the stress exerted by aggregations of elastic spherocylinders is linear at small strains, but "jumps" as the strain increases before leveling off into a second linear curve with a different Young's modulus. We attribute this disjointed curve shape to the particles realigning as strain increases, until reassortment is no longer possible and particles bend. We compare this reassortment to phase changes in liquid crystals, which exhibit similar behavior albeit without the same deformation of individual crystals. Finally, we use these findings to improve models for the pressure exerted by active matter aggregations.

Poster Presentation # 093
Elucidating the Effects of Prolonged Leukocytic and Metastatic Cell Exposure to P-Selectin and ICAM-1 on Cell Survival

Joselyne Umubyeyi
Susan Thomas, PhD (Mechanical Engineering)

Immune system has been well studied for its importance in protection against pathogens and healing of inflamed human tissue. The immune system is known to intervene in chronicle inflammation of diseases including cancer. Although much attention has been given to its role in protection against disease, emerging research show that the immune system contributes to the development of some cancers like the colon carcinoma. The purpose of this research is to analyze what signaling mechanism cancer uses to manipulate the immune system to survive and metastasize. The study looks at the first process of immune intervention by analyzing the process of monocyte recruitment. Cell adhesion molecules located in the endothelium initiates the rolling and firm adhesion of monocytes, P-selectin and ICAM-1 respectively, near the location of inflammation. Apoptosis, a voluntary cell death, is a mechanism this research analyzes for monocytes activation after interacting with cells adhesion molecules. Recent work from the lab has shown that monocytes have more interaction with P-selectin than colon carcinoma, indicating a potential critical point of avoiding being attacked by the immune system. Results in this study shows that P-selectin does increases the number of Phosphatidylserine (PS)in form of apoptosis in both monocytic THP1 cells and colon carcinoma LS174T cells. In addition, current study shows that co-incubation of P-selectin with intracellular adhesion molecule-1(ICAM-1) decreases the number of PS exposure. These results might be crucial in understanding the underlying mechanisms in which cancer cells survive.

Poster Presentation # 060
Dipping & Drying Mechanism

Ankita Verma
Jaydev Desai, PhD (Biomedical Engineering)

The project revolves around creating a machine that allows for the creation of replicas of arteries to use in testing of medical devices. Using 3D printed phantom arteries, silicon to recreate artery walls, and a machine to facilitate the process, the Dipping & Drying mechanism allows for an external environment of testing. It eliminates the need for cadavers and can be combined with a pulsatile flow system to mimic blood flow within the vascular system.

Oral Presentation
Aminosilane-Grafted Self-Pillared Pentasil MFI Zeolite as an Acid-Base Bifunctional Catalyst

Thomas Wang
Christopher Jones, PhD (Chemical and Biomolecular Engineering)

My research will explore new options of acid-base bifunctional catalysts for aldol and nitroaldol condensation reactions. Self-pillared pentasil (SPP) MFI zeolite, first reported in literature in 2012, would be the target of my research as the structure of the material incorporates not only mesopores which would be the sites the reaction would take place but micropores that could have implications in the selectivity of the reaction. In the process of my research, I would synthesize the SPP zeolites with a purely silicate gel composition, with aluminum and possibly boron heteroatoms and graft aminosilanes to the zeolite structures after they can be characterized to have crystallized well. Arrhenius analysis of aldol and nitroaldol condensations for those catalysts would then be conducted to reflect the overall catalytic potency and whether any differences in selectivity arise due to micropores or incorporation of heteroatoms.

Oral Presentation
Load Dependent Fatigue Crack Initiation in High Purity Al

Xueqiao Wang
Josh Kacher, PhD (CMaterials Science and Engineering)

Fatigue crack initiation sites and mechanisms in metals and alloys have long been investigated, as metal components are often subjected to cyclic loading and fatigue cracking is one of the major causes of failure. Therefore, understanding the dominant cracking mechanism under different conditions is essential for tailoring the composition and microstructure of metal components for better fatigue resistance under various loading conditions. Load dependent fatigue response in high purity aluminum (Al) is investigated. In low cycle fatigue, extrusions and intrusions are found to form on grain boundaries (GBs), especially prevalently at triples junctions. However, contrary to theories on extrusion formation from persistent slip bands (PSBs), no slip bands are observed in these specimens. Dislocation cells, on the other hand, are observed to form in higher densities and smaller sizes as stress amplitude increases.

As extrusion formation occurs only after a threshold number of cycles, it might be a result of the progression of dislocation cell formation. In high cycle fatigue, no extrusions are observed at GBs, while microcracks form within grains. Therefore, high cycle fatigue life may be controlled by mechanisms other than dislocation cell formation, and involves transgranular, rather than intergranular, fracture.

Poster Presentation # 067
The Use of Selective Polymerization of Poly(Methyl Methacrylate) for Oxide Deposition onto Nanowire Heterostructures

Trent Weiss
Michael Filler, PhD (Chemical and Biomolecular Engineering)

Nanowire transistor research has intensified in the past two decades due to the need for a novel idea to improve upon shortcomings associated with the modern transistor. A prevailing shortcoming in conventional transistor fabrication is limited throughput due to top-down fabrication steps, most importantly lithography. One solution of interest is the silicon-germanium nanowire heterostructure transistor that is fabricated in a bottom-up approach. This method leverages selective surface chemistry to controllably mask specific segments of the structure and eliminates the need for lithography. The purpose of this work is to use polymers for selective surface chemical treatment on semiconductors, enabling selective masking for the deposition of the gate stack for the transistor. Prior research has indicated that polymers can prevent various molecules from reaching a substrate surface due to their dense network. In this study, atom transfer radical polymerization is utilized to create a soft mask that is selective to silicon over germanium. The polymer of interest, poly(methyl methacrylate), is grown on initiating groups anchored to a silicon surface to attain a desired thickness. The polymer is then subjected to atomic layer deposition with aluminum oxide to determine the stability of the polymer and its practicality as a mask for oxide deposition. These experiments may elucidate a method for gate oxide formation on a nanowire heterostructure via a bottom-up process. Success would be the next step to attaining functioning nanowire transistors for use in everyday devices.

Poster Presentation # 094
Fingolimod Treatment of Reactive Mucolipidosis Type IV Astrocytes Effects Microglial Phagocytosis and Lysosomal Storage

Alexis Wilkinson
Levi Wood, PhD (Mechanical Engineering)

Background: Mucolipidosis Type IV (MLIV) is a neurologic childhood disease that results from a loss-of-function mutation in the MCOLN1 gene and the accompanying lysosomal storage dysfunction. Astrocytes, glial cells that provide metabolic support and general immune activity in the central nervous system, are highly reactive in MLIV and other CNS disorders, which can have detrimental effects on the function of microglia, the primary neural immune cells. Controlling astrocyte activation may therefore be a promising therapeutic strategy for MLIV. Fingolimod, an FDA-approved drug for MS, is an S1P functional antagonist that we showed broadly suppresses pro-inflammatory astrocyte signaling. Here we investigated whether the addition of fingolimod to MLIV astrocytes can modulate astrocyte cytokine secretion that then restores microglial phagocytosis and activation levels. Methods: Mcoln1+/- and Mcoln1-/- astrocytes were collected and each was treated with control medium or fingolimod. The media from the astrocytes was collected after 24 hours in culture. Healthy microglia were then treated with astrocyte-conditioned media for 24 hours. Phagocytosis assays were performed using pH sensitive beads, neuronal progenitor cell debris, and live neuron cultures. The assays were run for set times (1 – 24 hours), then the cells were fixed, immunocytochemically stained, and imaged. Results: The treatment conditions show variable responses across the different phagocytosis assays. However, across the assays, fingolimod treatment of Mcoln1-/- astrocytes alters phagocytic uptake or lysosomal accumulation in astrocyte-conditioned microglia. Using pH sensitive pHrodo beads, fingolimod treatment altered bead uptake in Mcoln1+/- astrocyte- but not Mcoln1-/- astrocyte-treated microglia. In assays using neuronal debris and live neurons, fingolimod treatment did modulate Mcoln1-/- groups, decreasing debris accumulation and leaving increased synaptic density on neurons.

Oral Presentation
Utilizing Microfluidic Devices to Visualize the Formation of Fragmented Red Blood Cells Through Clotting Geometries

Julia Woodall
Wilbur Lam, PhD (Biomedical Engineering)

Red blood cells (RBC) circulate in a dynamic fluidic environment. During hematologic processes like clotting, blood cells interact biochemically and biophysically with a myriad of vascular matrices like fibrin networks. While the biochemical aspects of these cellular processes have been extensively characterized, there is a significant gap in knowledge as to how biophysical cues of the mechanical microenvironment impact the structure and functionality of RBC. These biophysical cues are of particular relevance in procoagulant disorders like disseminated intravascular coagulation (DIC), whereby uncontrolled clotting throughout the blood blocks small vessels and results in the deformation of RBC into fragmented morphologies such as schistocytes. To decouple the biophysical effects in the vasculature, we developed various PDMS microfluidic devices to allow for real-time visualization of red blood cell interactions with geometric features. These features were created using electron beam lithography (EBL), and their dimensions ranged from hundreds of nanometers to single microns to recapitulate the biological dimensions of fibrin diameter and microvascular constrictions. Through these microfluidic experiments, RBC were found to elastically deform through a array of micropillars, suggesting that mechanical forces must be maintained over a distance in order to cause long-lasting deformation. RBC were then flown through 2x3 um cross-sectional gaps forming microcanals of varying lengths. We found that as these gap lengths increased, more RBC emerge progressively fragmented as well as RBC from patients with sickle cell disease (SCD) fragmented more readily than RBC form healthy donors.

Oral Presentation
Understanding Intramolecular Cooperativity in Acid-Base Silica-Supported Organocatalysts

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

Carbon-carbon coupling reactions are essential steps in pharmaceutical synthesis and biomass valorization toward chemicals and fuels. Often, complex homogenous transition-metal catalysts are required for highly selective carbon-carbon coupling reactions, but they are expensive and not recyclable and thus unfeasible for large scale production. Inspired by enzymatic catalysis, heterogeneous organocatalysts can be designed for controlled selectivity and can utilize multiple functionalities, such as acids and bases, to achieve specific catalytic function. Mesoporous silica provides a weakly acidic solid phase with high surface area to allow for good dispersion of catalytic functional groups. This project studies how the linker length between the amino and alcohol moieties affect the intramolecular cooperativity of basic amino alcohol silanols and the acidic surface silanols. The functional groups are grafted using a two-step method and HMDS was used between the steps to remove the silanol groups to create a control demonstrating exclusively intramolecular interactions. Batch liquid-phase kinetics studies utilizing these catalysts in acid-base catalyzed aldol condensation reaction of 4-nitrobenzaldehyde and acetone were performed to determine relative activities and site-specific rates. We hypothesized that longer spacer length between the amine and alcohol moieties on the functional groups would provide increased intramolecular activity. Compared with simpler aminosilane-silanol cooperative catalysis systems, the results of this study would suggest whether the design of an intramolecular bifunctionality provides justifiable benefits. A future direction would use the optimized catalysts from this project to test on more industrial relevant reactions such as upgrading of furfural into a longer chain diesel fuel precursor.

Oral Presentation
Cathepsin Activation and Purification

Yuan Xu
Manu Platt, PhD (Biomedical Engineering)

Cathepsins are cysteine proteases found in and associated with the lysosome. Cathepsins have been implicated in many diseases, such as, cancer, sickle cell disease, stroke, etc. In the process, lysosomal exocytosis, cathepsins can be secreted and participate in the degradation of extracellular materials, which contributes to metastasis in a tumor. To determine how cathepsins play a role in the process, purified cathepsins are required. The project that I have been working on is to activate and purify specific cathepsin types (cathepsin K, L, and S) from transfected HEK cells for further experiments.

Poster Presentation # 068
Nanoporous Sorbents for Organic Solvent Separations

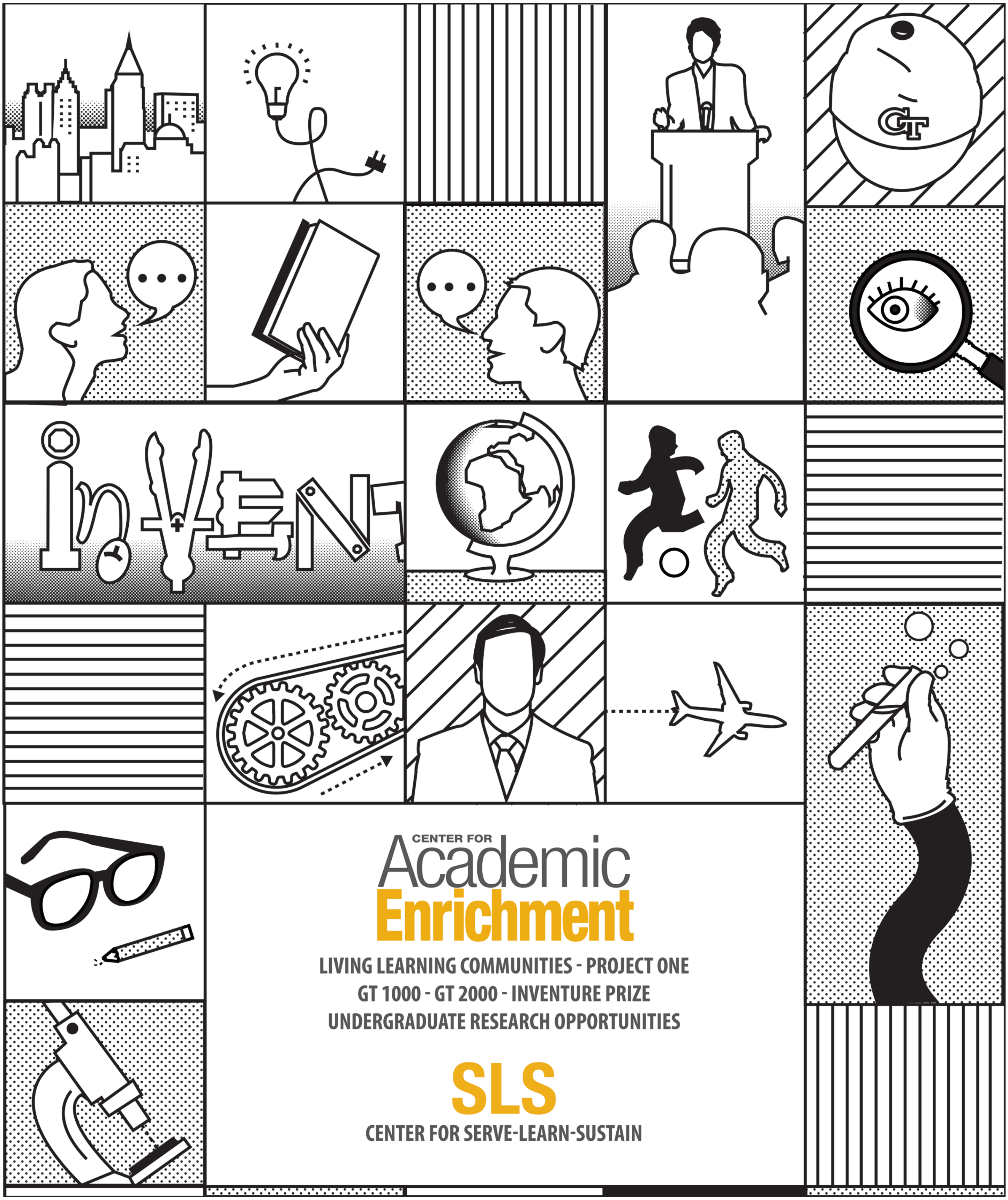
Jimin Yoon
Christopher Jones, PhD (Chemical and Biomolecular Engineering)

Industrial separation processes make up 10-15% of the total global energy demand. The core reason for this high energy usage is the pervasive reliance on energy-intensive thermal processes such as distillation, absorption, and crystallization. Developing energy-efficient organic separations will greatly help reduce the energy use worldwide. Nanoporous materials provide one such alternative as they avoid the usage of energy-intensive phase change during the separation. Especially, Zeolitic Imidazolate Frameworks (ZIFs) are nanoporous crystals which show their merits in difficult separations of similarly sized and shaped organic molecules. It is possible because of the tunability of their aperture size and ultrahigh surface area. ZIFs also demonstrate great thermal and structural stabilities. This research will discuss the synthesis of ZIF-77 nanoporous material. ZIF-77 has studied to show a remarkable selectivity for alkane isomer mixtures and amyl alcohol isomer mixtures whose separations are highly required in industry but also entail high energy cost. In order to understand the material's separation performance, being able to tune the crystal size is important. This research includes studying the effects of temperature and reaction time on the crystal size, and the material's applications in energy-efficient separation of various organic solvents. Ultimately, this research envisions the development of separation platforms using nanoporous materials and understanding the host-guest interactions in organic molecule separations.

Poster Presentation # 095
Wombats and Cubic Feces

Alice Zhang
David Hu, PhD (Mechanical Engineering)

Wombats, as opposed to most other animals, have strangely uniform, clean cut, and 1-centimeter cubic feces, which help the feces stay in place for territorial purposes. However, the physical process of forming the shape is unclear. In collaboration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with the University of Tasmania and Memphis Zoo, here we show that the shape is a result of the morphology and material properties of the GI tract. The intestines from a 26-kg wombat average 8 meters, longer than those dogs and dik-diks of similar sizes, which average 3 meters. We found that compared to the feces of other animals, wombats tend to have drier feces with an average water content of 45%, compared to cylindrical and spherical feces, with water contents of 71% and 57% respectively. Our results show that the water content and GI tract length of wombats differ from other animals, however that alone may not create the shape. Since the feces is already cubic while still within the intestines, the properties of the intestine produce the cubic feces. We plan to perform tensile testing on different sections of the intestine to determine the elasticity. Our findings help with the development of more efficient packing that could be recreated at a larger scale.

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Poster Presentation # 032
Centralization of Motor Control as a Variable of Terrain Roughness

Philip Aden
Simon Sponberg, PhD (Physics)

My work is focused on understanding how the centralization of a cockroach's motor control varies as the roughness of the terrain beneath it changes. I hypothesize that there exists a degree of roughness that forces the insect to transition between a very centralized, feedforward system architecture to a more responsive, decentralized one with higher feedback. I postulate that this transition point operates like a threshold, and sees the insect exhibit a very rapid increase in decentralized behavior. To examine this, I will be attaching electromyography electrodes to the coxa of two of the insect's legs before inducing an escape response. The specimen will run over a floor of pillars that has a Gaussian distribution of a set standard deviation while being recorded from above by a high speed camera. By comparing the phase of the EMG spikes and the kinematic movements of the legs, I can examine patterns across varying standard deviations, representing the behavior across varying terrain roughness. Through this, we will be able to better understand how locomotive systems are altered in response to their environment.

Poster Presentation # 033
Saffman-Taylor Instability in Charged Toroidal Droplets

Aaron Aizenman
Alberto Fernandez-Nieves, PhD (Physics)

We show that charged toroidal droplets can develop fingerlike structures as they expand due to SaffmanTaylor instabilities. While these are commonly observed in quasi-two-dimensional geometries when a fluid displaces another fluid of higher viscosity, we show that the toroidal confinement breaks the symmetry of the problem, effectively making it quasi-two-dimensional and enabling the instability to develop in this three-dimensional situation. We control the expansion speed of the torus with the imposed electric stress and show that fingers are observed provided the characteristic time scale associated with this instability is smaller than the characteristic time scale associated with Rayleigh-Plateau break-up. We confirm our interpretation of the results by showing that the number of fingers is consistent with expectations from linear stability analysis in radial Hele-Shaw cells.

Oral Presentation
SiRNA Knockdown of BMP2 and HMOX1 to Induce Mesenchymal-to-Epithelial Transition (MET) of Ovarian and Prostate Cancer Cells

Amber Akbar
John McDonald, PhD (Biological Sciences)

MicroRNAs have been shown to play an important role in cancer progression and metastasis. Here we were interested in understanding the genetic and molecular basis for mesenchymal-epithelial transition (MET) in ovarian and prostate cancer cell lines, where both cancers are highly metastatic, by overexpressing microRNAs that have previously been shown to induce MET in a single prostate or ovarian cancer cell line. We performed a transfection to overexpress miR-429, miR-203a, and miR-205 in HEY and PC3 cell lines. After determining which genes in each cell line were differentially expressed following microarray analysis, we did further narrowing of the gene list to determine genes involved in MET across both cell lines. Functional enrichment analysis of the gene expression obtained from microarray on the transfection experiment was used to determine gene candidates for future siRNA knockout to attempt to recapitulate microRNA overexpression experiments and further our understanding of MET mechanism in multiple cancer cell lines. The two gene candidates we identified were HMOX1 (heme oxygenase 1) and BMP2 (bone morphogenic protein 2). These two genes are involved in heme catabolism, and secreting ligands for TGF-β receptors for recruitment of SMAD family transcription factors, respectively. Based on previous research we do expect siRNA knockdown to recapitulate the microRNA's effects on both cell lines to some extent, but these final conclusions are pending future siRNA knockout.

Poster Presentation # 034
Magnetic Properties of Triangular-Lattice Materials Li_4CoTeO_6 and Li_4NiTeO_6

Darian Bender
Martin Mourigal, PhD (Physics)

In this poster, I will discuss two materials, Li_4CoTeO_6 and Li_4NiTeO_6, in which Ni and Co ions with effective spin-1 and spin-1/2 each occupy a triangular lattice. We performed thermodynamic and magnetization measurements which indicate a possible exotic magnetic ground-state in both materials. We then performed elastic neutron scattering, providing additional evidence for exotic magnetism in these materials. The next step of our research will be to perform inelastic neutron scattering on powder samples to probe the nature of the magnetic correlations.

Poster Presentation # 016
Peripheral Targets of Chemotherapy

Rachel Boutom
Timothy Cope, PhD (Biological Sciences)

Chemotherapeutic agents are known to disrupt biological systems in the short term, however they can also lead to chronic deficiencies. When one such symptom is the loss of proprioception a rational target of study would center on the receptors that transduce and encode these sensory signals. The objective of this study is to determine the effect of chemotherapy on sensory receptors. Rats treated with clinically relevant levels of chemotherapy and vehicle control will be used as models. Muscles from the hind-limb will be sectioned and evaluated for immunoreactivity intensity differences between experimental groups by confocal microscopy. Preliminary results support the hypothesis, with down-regulation seen in one of the proteins of interest, however full confirmation is dependent on further testing.

Poster Presentation # 035
The Effect of Geometry on Multicellular Group Traits

Alexander Bukharin
Peter Yunker, PhD (Physics)

The evolution of multicellularity transformed life on earth, setting the stage for more complex organisms. These simple multicellular clusters are comprised of individual cells; and yet, consistent group traits emerge. The emergence of group traits is a key step in the transition to complex life, because it enables multiple cells to act as one. Snowflake yeast, developed by Prof. Ratcliff, allow this major transition to be studied in the lab. As snowflake yeast clusters grow, they eventually fracture, limiting their size. Cell geometry rapidly impacts size at fracture--a critical group level trait. David Yanni, a graduate student in the Yunker lab, has developed a model of stochastic snowflake yeast growth that predicts how geometry impacts cluster size at fracture. This formula is R = Vsc/((pi) * y * B^2), where R is radius, Vsc is the volume of a single cell, B is the bud scar size, which is the size of the scar left by the daughter on the mother cell, and y is the volume fraction, the volume of cells divided by the total volume of the cluster. This non-equlibrium statistical mechanics model allows us to predict something hard to measure with things that are easy to measure. This model predicts how clusters can evolve larger size, a vital step in the evolution to multicellularity. To test this formula, I have investigated the characteristics of multiple strains of Snowflake Yeast, and I plan to investigate the characteristics of a wide variety of additional strains.

Poster Presentation # 036
Development and Characterization of a Superconducting Qubit

Piero Chiappina
Martin Mourigal, PhD (Physics)

We live in an age where quantum computing is transitioning from a theorist's dream to a reality that is fast approaching. Remarkable progress has been made toward the development of scalable, programmable, universal quantum computers. One popular architecture that is currently being investigated is quantum computing with superconducting circuits. We propose to develop one such superconducting circuit and fully characterize its properties using quantum tomography techniques. Due to the anharmonicity of superconducting qubits, a common source of error when performing computations is "leakage" to undesirable quantum states. It is a key requirement for any superconducting qubit lab to be able to detect and correct these errors. Current tomography techniques, while robust and accurate, are costly and unable to fully describe leakage to other quantum states. We will investigate single qubit tomography techniques that are better suited for imaging qubit leakage to undesirable states and compare to current techniques such as gate set tomography.

Poster Presentation # 017
Effects of Autogenic Length Feedback Removal from Knee Muscles on Hindlimb Walking Kinematics

Noah Cho and Daniel Zuniga
Boris Prilutsky, PhD (Biological Sciences)

One of the consequences of peripheral nerve injury is a loss of stretch reflex mediated by muscle spindles. This sensory input contributes to limb position sense and its loss might explain poor functional recovery after peripheral nerve injury. The functional consequences of lost position sense at specific joints on walking kinematics are not known. The aim of this study is to analyze the effects of stretch reflex removal from knee muscles on hindlimb walking kinematics in cats. Hindlimb kinematics will be assessed prior to surgical transection and repair (self-reinnervation) of muscles and after full motor recovery (6-9 months). In a preliminary analysis of the data, there is a decrease in the range of motion of both the affected and unaffected hindlimbs. The unaffected, left hindlimb exhibits a drastic change in the ankle and hip joint profiles. Analyzing data from additional animals that have undergone the same self-reinnervation procedure will help reveal any patterns in altered position sense that occur as a result of the peripheral nerve injury and loss of stretch feedback.

Poster Presentation # 018
Effects of Diagnostic Antibiotic Treatment on Pseudomonas aeruginosa Resistance and Evolutionary Escape

Kira Combs
Sam Brown, PhD (Biological Sciences)

This study attempts to examine the effects of diagnostic treatment with antibiotics on the resistance and evolutionary escape of Pseudomonas aeruginosa. Diagnostic treatment could be a useful tool in preventing development or persistence of resistance, and treating resistant bacteria only when they are known to be susceptible to a certain drug could help in curbing resistance. Because of rising levels of multidrug resistant bacteria, testing the effectiveness of diagnostics and studying how Pseudomonas develops strategies to survive treatment would be useful for the future of antibiotics. Here, we seek to develop treatment strategies and methods that explore the evolutionary and ecological limits of such strategies.

Oral Presentation
Characterization of Iron Reducing Microorganisms from Anoxic Ferruginous Lake Sediments

Bianca Costa
Jennifer Glass, PhD (Earth and Atmospheric Sciences)

Lake Matano, Indonesia is a well-known ancient ocean analogue as its anoxic ecosystem in the subsurface sediments allow the growth of microorganisms capable of mediating anaerobic oxidation coupled to iron reduction. The objective is to characterize the organisms in the sampled sediment. To achieve this purpose, the inoculum will be grown in a continuous flow bioreactor to mimic the anoxic conditions of the source ecosystem. The parameters of the bioreactor for biological growth will be recorded and the inoculum will be sampled to explore its genomic data and compare it to its phylogenetic analogues (Geobacter. Sulfurreducens), CARD-FISH microscopy will be performed in the incubated samples to look for particle association. Characterizing these microorganisms opens a broad range of possibilities for wastewater treatment (strip mining groundwater contamination), use in bioelectrochemical systems and biofilms (due to external electron transport pilA) and understanding the importance of this microorganisms in Iron cycling.

Poster Presentation # 026
Investigating the Interactions Between Gold Nanoparticles and Biological Systems

Sarah Ghalayini, Arusha Siddiqa, Kamaria Dansby, and Cecily Ritch
Mostafa El-Sayed, PhD (Chemistry and Biochemistry)

The drastic changes in the properties of gold when reduced to the nanoscale allow for diverse optical properties, making them incredibly useful in bioimaging. One of the greatest attributes of gold nanoparticles (AuNPs) is their chemical inertness. Because of its low toxicity, gold is often used as the standard in biological systems. Their ability to be conjugated to a wide array of target molecules, while still maintaining their own optical properties without disrupting the properties of the conjugates, allows for its wide application in disease diagnosis and treatment. The advantages of this characteristic are especially noted in clinical applications, in which AuNPs are often used as vehicles for drug delivery and cell imaging in tandem. Because of this revolutionary technology, this study builds on those of the past by further investigating the efficacy and toxicity resulting from the interactions of AuNPs in various forms within biological systems, including in vitro experiments on cancer cells, and in vivo experiments on C. Elegans. This was done by synthesizing homogenous batches of AuNPs through ionic reduction techniques and conjugating them with specific ligands to enable selective targeting and ensure biocompatibilty. The results have demonstrated that AuNPs modified with biocompatible peptides are safe and effective to treat and diagnose in cancerous cells and potential neurodegenerative diseases. Further research was conducted to understand the recent progress of using gold nanoparticles in single cell imaging and sensing, to discuss technique developments, and to address fundamental questions regarding bio-nano interactions.

Poster Presentation # 019
Co-Contraction of Antagonistic Muscles is Correlated with Postural Instability

Simran Gidwani
Minoru Shinohara, PhD (Biological Sciences)

Synchronized low-frequency oscillations from the brain to the antagonistic leg muscles are used for the muscles to remain balanced in their contraction to be able to maintain postural control; however, if one is standing in a position in which there is a high level of co-activation between these muscles, these low-frequency oscillations may contribute to unsteadiness by causing fluctuations in joint stiffness (Ahmar and Shinohara 2017). The objective of the study is to clarify which aspects of the neural signals to the leg muscles are correlated with a greater displacement and postural unsteadiness. The research question is how much sway is correlated with amplitude coherence and phase correlation between the antagonistic muscle signals, and the power of the individual muscle signals. Electromyography (EMG) and sway data was collected during multiple trials of the subject standing in a position inducing high co-activation of the tibialis anterior, gastrocnemius, and soleus muscles. Data was analyzed to extract the amplitude coherence, phase correlation, and power of only the low-frequency oscillations during this time. This was measured for correlation with center of pressure velocity, a measure of sway extracted from force

plate data. Data collection is still occurring with multiple subjects. Expected conclusions are that there is a positive correlation between sway and coherence between antagonistic muscles. These conclusions would lead to future studies of ways to control these synchronized low-frequency oscillations, and the conclusions of these future studies could impact rehabilitation for neuromuscular deficits.

Poster Presentation # 027
Antibody Targeted Delivery of Pro-Drug Converting Enzymes Using Virus-Like Particle Platform for Cancer Therapy

Sophia Guldberg
MG Finn, PhD (Chemistry and Biochemistry)

Targeted chemotherapy is essential for safer cancer therapies. Current cancer therapies are non-targeted and are reliant on the rapid growth rate of cancerous cells to mediate drug uptake. Because these therapeutics are administered systemically, they negatively affect a large number of healthy cells in addition to the tumor, resulting in a lower quality of life for patients receiving treatment. Virus-like particles (VLPs) are a useful scaffold for engineering next-generation drug delivery platforms and can be modified through genetic methods due to their base nature as proteins. Known antibody-binding domains, such as the Z-domain from Staphylococcus aureus, have been successfully displayed on VLP platforms and shown to mediate antibody-directed targeting against different cellular antigens. Since VLPs form a structure with a hollow interior, the inside of the particle can also be loaded with therapeutic cargoes, including pro-drug converting enzymes. These enzymes can convert non-toxic pro-drug compounds into their toxic bioactive form, which occurs only in site where the VLP is localized. By confining the toxic effects to the targeted cell population, these therapies can be less detrimental to the overall health of the patient. Here, we describe the preparation and in vitro testing of a targeted VLP platform against HER2+ breast cancer using antibodies arrayed on a VLP platform. The VLP-antibody conjugates were extensively characterized and their cell targeting abilities were evaluated by flow cytometry and fluorescence microscopy against cell lines expressing varying degrees of HER2. The results of this study represent promising progress towards safer, targeted cancer therapy using VLPs as a drug delivery platform.

Oral Presentation
Topological Analysis of Experimental Recordings of Ventricular Fibrillation

Daniel Gurevich
Flavio Fenton, PhD (Physics)

Spiral wave breakup caused by dispersion of tissue refractoriness has long been believed to play a key role in maintaining complex cardiac rhythms such as atrial and ventricular fibrillation. To test this hypothesis, we have developed a level-set based method that can accurately and reliably extract the temporally and spatially resolved positions of wavefronts, wavebacks, and phase singularities from noisy optical mapping data. The utility of this method was illustrated by analyzing optical mapping voltage data during ventricular fibrillation in a Langendorff-perfused pig heart. A recent topological analysis of a two-dimensional model of atrial tissue has shown that there are four distinct mechanisms that increase the complexity of the excitation pattern (wave breakup being one of them) and two distinct mechanisms that decrease its complexity. This analysis predicted that wave coalescence plays a more important role in maintaining fibrillation than wave breakup. A similar topological analysis of our experimental recordings provides supporting evidence for this theoretical prediction in ventricular tissue as well, which is essentially three-dimensional.

Oral Presentation
Evolution of Binary Stars in the Early Universe

Talha Irfan Khawaja
John Wise, PhD (Physics)

The first stars in the universe were entirely composed of primordial gas left over from the big bang, containing mostly hydrogen and helium with trace amounts of lithium. This primordial population of massive stars is called Population III, and is responsible for producing the heavy elements (metals) which seed the formation of future star formation, not unlike the stars that exist in our Milky Way.. We investigate the evolution of these low-metallicity stars, mainly focusing on binary systems. Using the stellar evolution code MESA alongside existing simulations of similar systems, we simulate a grid of stellar models with 25 values of mass, ranging from 10 to 300 times the mass of the Sun, 5 different mass ratios from 10:1 to 2:1 and 5 different metallicity values from 1/10 to 1/10000 of the solar metal fraction. These models are used to tabulate a range of time-dependent characteristics from individual properties such as mass and temperature to combined properties of the system, such as ionizing luminosities. Our results provide an invaluable resource for future use in simulations of the first generations of galaxies and further studies of the first billion years of the universe.

Poster Presentation # 030
Using Electrodialysis and Reverse Osmosis to Optimize Organic Matter Recovery from Saltwater Samples

Elise Koepke and Evelyn Chen
Ellery Ingall, PhD (Earth and Atmospheric Sciences)

Marine dissolved organic matter (DOM) plays an integral role in the global carbon cycle. Detailed chemical characterization of DOM composition is vital for understanding its sources and cycling in natural systems. Unfortunately, the extremely high salt content of seawater makes such detailed chemical characterizations impossible for the majority of analytical approaches. In order to chemically characterize DOM, it

must first be isolated from other inorganic molecules. This research utilizes electrodialysis and reverse osmosis with a system designed for 2-10 L samples to efficiently isolate DOM from artificial seawater and coastal seawater samples. Using this technique, salt is removed from a sample by pumping the fluid through an alternating series of positive and negative ion-exchange membranes under the influence of an electric potential, while simultaneously reducing the sample volume with RO. So far in preliminary lab experiments using electrodialysis alone, over 90% of glucose was recovered from an artificial seawater test sample where 95% of the salt had been removed. Additional samples will be collected, processed and analyzed as part of a March 2018 research cruise with scientists from the Skidaway Institute of Oceanography.

Poster Presentation # 028
Crystallization of an Enzyme Involved in Poly-Brominated Aromatic Compounds

Andrew Lail
Vinayak Agarwal, PhD (Chemistry and Biochemistry)

The Bmp biosynthetic pathway is a group of enzymes that transform basic substrates into poly-brominated aromatic compounds. A species of marine bacteria, Marinomonas mediterranea, is known to possess the gene cluster and generate poly-brominated compounds. This is noteworthy, since compounds like these are often quite toxic to humans, and can persist in the environment. In order to understand their synthesis, the enzymes of the Bmp pathway are being thoroughly investigated. Bmp4 is an important proline adenyltransferase molecule which attaches the initial substrate, proline, to a thioester moiety for further modification. Bmp4's function is well studied, but it has not been crystallized. The study's goal is to crystallize Bmp4 to understand the structure and function of its active site. This will allow the pathway to be engineered for other potentially useful applications in drug design or biotechnology, in addition to increasing the understanding of its ecological role in the creation of poly-brominated natural products.

Poster Presentation # 020
Modulation of DNA Methylation Through Efficient Differentiation of Neural Stem Cells

Leyla Larsson
Yuhong Fan, PhD (Biological Sciences)

Epigenetic mechanisms are very important for gene regulation and transcription, because they are crucial to the central nervous system (CNS) functioning properly. Numerous neurological and psychiatric diseases are caused by malfunctions in the CNS. Because epigenetic modulations do not affect DNA sequencing and are reversible, it is advantageous to treat neurological diseases with epigenetics. DNA methylation is an essential process for the CNS and is pivotal to gene expression. DNA methyltransferases (DNMTs) catalyze this process. Due to DNMT's importance, I am studying the impact of DNMT modulation on neural stem cell (NSC) differentiation into the different types of neural cells, (neurons, astrocytes, and oligodendrocytes). Based on previous studies, I hypothesize that modulating DNA methylation effectively regulates NSC differentiation. So far, results have indicated that DNA methylation inhibition, through the addition of 5-azacytidine to the medium, leads to stronger neural networks. In the future, I aim to study the effects of DNA methylation promotion and perform RNA sequencing for more quantitative results.

Poster Presentation # 031
Earth's Oxygen Cycle and the Evolution of Animal Life

Xinyi Liu
Christopher Reinhard, PhD (Earth and Atmospheric Sciences)

The purpose of this study is to reconstruct an environment for the emergence and expansion of early animal life during the Middle to Late Proterozoic in consideration of spatially and temporally evolving Earth surface ocean oxygen level impacted by carbon dioxide and nutrient levels. We will exploit the cGENIE model, which is a reduced physics 3-D ocean circulation model coupled to a 2-D energy-moisture balance model of the atmosphere and a dynamic-thermodynamic sea-ice model. The anticipated outcome of this lab is an modelized evolutionary oxygen landscape for early metazoan life. By understanding the factors that led to the emergence of complex life on Earth, the findings may help find out if we can expect to discover complex life throughout the universe.

Poster Presentation # 037
Improving Performance of Astrophysical Code Through Hybrid Parallelization

Carlos Llorente
John Wise, PhD (Physics)

Enzo is a cutting-edge open source astrophysical simulation software suite used by the research group of Dr. John Wise to study the formation of the first galaxies and stars. These simulations are vast and complex, spanning millions of cubic parsecs of space, and requiring extremely high-end supercomputing resources and hundreds of thousands of CPU hours to run. It is essential to be able to parallelize the work done by the simulation effectively in order to maximize the computational efficiency and minimize the time taken to complete. Enzo has already been outfitted with multi-process capability, which allows it run on multiple supercomputing cores by splitting into multiple separate processes. However, the large memory requirements of Enzo's data grid prevent it from effectively utilizing larger numbers of cores. This can be sidestepped by adding multi-threading capability to Enzo alongside the multi-processing. Multi-threading allows separate cores to work on Enzo together, while sharing the memory space and eliminating the overhead created by copying the grid to multiple processes. Adding hybridized parallelization has been shown to reduce the runtime of Enzo's main loop cycle by a factor of 2 for hardware configurations of 32 cores and a factor of 3 for 64 cores.

Poster Presentation # 021
Exposure to Anti-Aging Drug Therapies Results in Extended Lifespan and Healthspan in the Brachionus Manjavacas Rotifer

Amelia Matthews
Terry Snell, PhD (Biological Sciences)

One of the most recent hypotheses behind the causes of aging relates the changes in gene transcription and cell regulation to the loss of strength, mobility, and energy. This theory, when paired with modern knowledge of and technology relating to genetics, opens the possibility of manipulating the associated cell signaling pathways to either lessen or prevent altogether the negative effects of aging. Taking advantage of the fact that drugs can interact with more proteins than they are designed to target, it is possible to use drugs that are already available for anti-aging purposes. This experiment computationally identified and studied six FDA-approved drugs that were likely to interact with these genetic and cellular pathways to produce an anti-aging effect: naproxen, ivermectin, erythromycin, carglumic acid, capecitabine, and pravastatin. The drugs were used in a series of lifespan and healthspan assessments measuring lifespan, reproductive success, cellular activity, and animal mobility. Future work extending from this experiment could eventually see these drugs being applied in human anti-aging therapies and aiding the development of personalized medicine.

Poster Presentation # 022
Indirectly Targeting Cancer Genes Through Nuclear Receptors

Jonathan Mitchel
John McDonald, PhD (Biological Sciences)

Targeted therapies are a relatively new class of drugs that are being developed for a wide variety of diseases. In cancer, the targets of these drugs generally include mutated or overexpressed proteins, known as oncoproteins. Here, it is proposed that targeting non-oncogenic nuclear receptors (NRs) in order regulate the levels of a downstream oncoprotein can be just as effective as direct targeting, widening the number of readily targetable proteins. Nuclear receptors are good candidates to enact this type of indirect targeting because they regulate the transcription of many different genes, show cell type specificity, and contain dedicated ligand binding domains. To identify drugs that can bind nuclear receptors and induce the desired effect, a computational model was developed. This model uses known NR-target interactions along with a ligand-protein binding prediction algorithm called FINDSITE. This model was used to find a drug that could indirectly target the cancer gene Epidermal Growth Factor Receptor (EGFR). The results identified a drug called Spironolactone that was predicted to repress EGFR via inhibiting the Mineralocorticoid and Androgen Receptors. Spironolactone was tested in the HEY ovarian cancer cell line, and significant antiproliferative effects were observed along with a 34-fold decrease in EGFR mRNA levels. This result validates the computational prediction and signifies that this method may be effective for treating many cancers. Indirect targeting also offers potential benefits unattainable by traditional therapies such as repressing drug-resistant proteins or increasing expression of downregulated tumor suppressor genes, which will be investigated in future work.

Poster Presentation # 023
Media-Dependent Bacteria Warfare in Vibrio Cholerae

Holly Nichols
Brian Hammer, PhD (Biological Sciences)

Vibrio cholerae, well known as the the causative agent of cholera, has a non-pathogenic life cycle in freshwater and marine ecosystems. In its environmental phase, cholera interacts with many other bacteria. Like many gram negative bacteria, V. cholerae is equipped with a type VI secretion system, a harpoon-like protein structure that delivers toxic effector loads and kills neighboring bacteria. Much research has gone into discovering the regulatory scheme and functional dynamics of this antagonistic behavior. However, the vast majority of research on the type VI secretion system is done in the nutrient-rich media LB, a poor analog for conditions found in nature. We propose that assays of type VI-mediated killing in LB may be inducing phenotypes which are never expressed in nature. This study identifies a promising environmental isolate which kills Escherichia coli in the standard nutrient-rich media LB, but is impotent in M9 minimal media. This unique phenotype may give clues as to how V. cholerae regulates its killing behavior in the nutrient-poor conditions it may find in nature. With this strain, we can endeavor to find potential signals in LB media that induce type VI-mediated killing.

Poster Presentation # 024
Chronic Inflammation Alters Forebrain Vasopressin Expression

Shivany Patel
Geert J. de Vries, PhD (Neuroscience) (Georgia State University)

Vasopressin, a neuropeptide, regulates stress, anxiety, and social behavior, partially via the paraventricular nucleus (PVN), suprachiasmatic nucleus (SCN), bed nucleus of the stria terminalis (BNST), and supraoptic nucleus (SON). The purpose of this project was to experimentally determine the effects of low-dose, chronic inflammation on vasopressin expression in the forebrain as a measure of the neuronal expression of sickness. Male and female mice were injected bi-weekly for four weeks with 0.25mg/kg LPS or sterile saline as a control. Vasopressin mRNA expression was labeled using fluorescent in situ hybridization, and quantified by fluorescent intensity. Vasopressin expression was altered by LPS administration in a sex-, region-, and time of day-dependent manner. In the PVN, vasopressin expression was increased during the night in both males and females. Similarly, vasopressin expression increased at night in the female SCN. In contrast, vasopressin expression in the male SCN was decreased during the day. Treatment did not affect vasopressin expression in the BNST. The effects of induced chronic inflammation were insufficient to elicit behavioral signs of sickness, but did alter vasopressin gene expression. Future work will involve comparing this expression to the effects of acute inflammation, and understanding the role of vasopressin in these regions in regulating sickness.

Poster Presentation # 038
Expression of Affect in Older Adults with Mobility Impairments

Ahmad Rathor
Tracy Mitzner, PhD (Psychology)

The aim of this project was to explore the expression of affect by older adults with mobility impairments in response to questions about the challenges and successes that they have experienced as they age. To begin with, 56.7 million people living in the United States have some type of disability (US Census Bureau). Over 28% of adults ages 55-64 have a disability, and over 70% of them have a severe disability (US Census Bureau). Those aging with a disability likely experience additional challenges due to age-related declines. Little is known about their affective responses to these challenges and their affective responses when they successfully overcome these challenges. As part of a larger interview study, we asked participants questions regarding their emotional responses to both challenges and successes experienced while aging with an impairment. We used a bottom-up, top-down analysis approach to assess the frequency of affective language present in the participants' responses. Both positive and negative constructs were identified. The positive constructs were positive well-being and resilience, and the negative constructs were depression and anxiety. Existing literature has demonstrated that these positive and negative constructs are opposing factors that are inversely related. From our analysis, we will gain a better understanding of the emotional responses of older adults with disabilities that can be used to help better assess the support needs of this group. Furthermore, our findings can be used to elucidate how older adults have managed to effectively cope with living with significant adversity.

Poster Presentation # 029
Probing Heme Trafficking Factors and Kinetics Using Genetically Encoded Fluorescent Heme Sensors

Arushi Saini
Osiris Martinez-Guzman, PhD (Chemistry and Biochemistry)

Heme is an essential protein cofactor and signaling molecule that plays diverse roles in biological systems. The hydrophobicity and cytotoxicity of heme necessitates that it is transported and trafficked in a regulated manner. However, the molecules and mechanisms responsible for mediating heme trafficking remain poorly understood. Herein, we report a new class of genetically encoded fluorescent heme sensors and a protocol we developed that enables us to watch heme trafficking from its site of synthesis in the matrix side of the mitochondrial inner membrane to the outer matrix, cytosol, and nucleus over time. Our preliminary studies reveal that mitochondrial contact points play central roles in regulating heme availability and trafficking. Altogether, the tools and approaches we report have the potential to be adapted to more comprehensive compartmental analyses, and our findings about contact points may illumine potential mechanisms for heme trafficking.

Poster Presentation # 039
Older Adults' Use of Everyday Memory Strategies

Aiman Waris
Christopher Hertzog, PhD (Psychology)

Questionnaires about memory in everyday life focus on the strategies people use to achieve everyday goals, including mnemonic devices and external aids, but do not capture how effectively these methods are implemented or conceptualized. We used a tailored interview approach with 26 older adult participants ages 62-83 (M=69.5, SD=5.72) about their daily routines as well as the ways in which they remember to accomplish everyday activities. These interviews explicitly targeted memory-related strategies, focusing on the processes involved in everyday remembering. Our qualitative analysis focused on identifying instances where older adults had memory complaints and concerns, memory failures, inefficient strategy use, used strategies as memory support, and made attributions about remembering and forgetting. Specifically regarding strategy process and implementation, we found that reported strategy use was often mismatched with respect to an everyday goal, being either ineffective or inefficient -- leaving the individual susceptible to forgetting. This was the case in examples including grocery lists, pill organizers, and calendars. Overall, we found that older adults often do not approach cognitively demanding goals with optimal self-regulatory strategies. These qualitative data provide valuable information about how and why everyday memory fails in healthy older adults that is not obtained by traditional questionnaires that merely query measures of internal and external memory strategies.

Poster Presentation # 025
A Novel Vibrio cholerae Type Six Secretion System Gene Cluster is Involved in Interbacterial Competition

Kenneth Williams
Brian Hammer, PhD (Biological Sciences)

Vibrio cholerae is Gram-negative bacteria capable of inhabiting both a human host and a natural marine environment. All sequenced isolates contain genes encoding for a Type Six Secretion System (T6SS), a harpoon-like apparatus capable of delivering toxic effectors into neighboring cells and conferring a competitive advantage. T6SS genes in V. cholerae are found on a main cluster encoding structural and regulatory components. Additional Auxiliary (Aux) clusters are found in the genome and encode for effector toxins and cognate immunity proteins to avoid kin or self-intoxication. Through extensive sequencing and application of predictive algorithms, a novel Aux cluster, which we named Aux5, was found in the genome of an environmental isolate. Due to limited genetic amenability of the strain, the Aux5 cluster was moved onto the chromosome of a clinical V. cholerae reference strain by natural transformation. The transformed strain was then shown to kill the parental reference strain in a T6SS-dependent manner. Disruption of the Aux5 effector gene removed the transformed strain's ability to kill the reference strain, confirming the toxicity of the novel Aux5 effector.

IVAN ALLEN COLLEGE OF LIBERAL ARTS

Poster Presentation # 002
Blockchain Consensus using a Deliberative Framework: Rethinking Byzantine Fault Tolernace Algorithms

John Golden
Michael Hoffmann, PhD (Public Policy)

The standard blockchain consensus algorithm, proof of work, often contains unwieldy designs and problems with the massive expenditures of energy it has required. While new cryptocurrencies have started to use other consensus designs and mechanisms such as proof of stake, modified proof of work, and other algorithms for byzantine fault tolerance, there are still problems with cryptographic security, quantum resistance, and other metrics that provide security to the blockchain. The goal of this research is to utilize existing and presently developed consensus philosophy research and synthesize the ideas into a mathematical distributed consensus mechanism. The research also attempts to find rationale for features of current cryptocurrencies that have succeeded and to create a predictive model for success in cryptocurrencies using network effects and econometric methods. The long term development of the blockchain and blockchain based platforms depends on the success of distributed consensus mechanisms to be both comprehensible to the general public and capable of building trust in the long and short term.

Oral Presentation
Seeing Red: American Tourism to the Eastern Bloc, 1960-1975

Kayleigh Haskin
Kate Pride Brown, PhD (History and Sociology)

The Eastern Bloc opened to American tourists in the late-1950s, ultimately enjoying a steady flow of visitors even with the high geopolitical tensions of the Cold War period. Despite their eagerness to visit, the views that Americans held of these countries were not significantly changed by their experiences within them, going against the notion that tourism served as a form of cultural diplomacy between the East and West. Using tourism articles from 1960-1975, this paper discusses how American newspaper publications contributed to the opinions tourists held of the countries they visited. The framing of the articles within the current state of political relations led to overall negative views of countries portrayed as radically different than the US in terms of politics, culture, and economics. Using Hungary and the Soviet Union for the case study, this paper concludes that this portrayal served as a barrier to positive experiences of American tourists behind the Iron Curtain, thus contributing the lack of opinion change.

Poster Presentation # 003
Venezuelan Science Fiction

Sammi Hudock
Lisa Yaszek, PhD (Literature, Media, & Communication)

This project concerns the current political and economic situation in Venezuela and how it has influenced the science fiction (SF) coming out of the country. The project takes an overlook at Latin American SF, the history of the fantastic (including SF) in Venezuela, and the impact of socialism on SF across the world. All other information for the project is coming directly from sources in Venezuela, who are helping to add more contacts to my network. These contacts are giving me stories to translate, analyze, and eventually publish, as well as their personal stories to give context to what life really is like in Venezuela right now.

Oral Presentation
Disinformation Campaigns and Hierarchical Culture: The Soviet Union and Russian Federation

Sara Morrell
Margaret Kosal, PhD (International Affairs)

The aim of this work is to contribute to an understanding of how culture and warfare might be interrelated by tracing hierarchical culture and the cohesion of disinformation campaigns through the history of the Soviet Union and Russia. Three periods are considered: 1941 through 1945, 1979 through 1989, and 2014 through 2017. Each of these periods aligns with Soviet or Russian engagement in an armed conflict. Disinformation campaigns from each period are selected as case studies to provide an estimate of their cohesion, while the impact of culture on behavior is determined for the entirety of the period based on contemporaneous primary documents. This analysis reveals that hierarchical culture may aid in the development and conduct of cohesive disinformation campaigns. However, there is not enough evidence to support the assertion that hierarchical culture inevitably leads to cohesive disinformation campaigns.

Name	Session	Time	Room
Akbar, Amber	F	2:45 PM	SC 321
Ancelin, Brighton	D	3:25 PM	SC 343
Aveni, Timothy	G	3:35 PM	SC 332
Castro, Nicolas	A	3:05 PM	SC 301
Chen, Richard	B	2:45 PM	SC 319
Collins, Stephanie	B	2:55 PM	SC 319
Costa, Bianca	F	2:55 PM	SC 321
Crawford, Kaylyn	B	3:05 PM	SC 319
Deb, Diptodip	C	2:45 PM	SC 320
Fusaro, Beatriz	A	3:15 PM	SC 301
Goebel, Madeleine	C	2:55 PM	SC 320
Gupta, Srishti	H	2:45 PM	Ballroom
Gurevich, Daniel	F	3:05 PM	SC 321
Hardie, Rebecca	B	3:25 PM	SC 319
Haskin, Kayleigh	E	2:45 PM	SC 332
Haynes, Megan	A	3:35 PM	SC 301
Hays, Samuel	H	2:55 PM	Ballroom
Johnson, Ann	D	3:15 PM	SC 343
Khawaja, Talha Irfan	F	3:15 PM	SC 321
Mittal, Anushk	C	3:05 PM	SC 320
Morrell, Sara	E	2:55 PM	SC 332
Muni, Aneri	D	3:05 PM	SC 343
Murali, Alaap	C	3:25 PM	SC 320
Salmon, Mandy	B	3:35 PM	SC 319
Schaefer, Amanda	H	3:05 PM	Ballroom
Short, Andrew	A	2:45 PM	SC 301
Sidhu, Nathan	H	3:15 PM	Ballroom
Sommers, Allison	C	3:35 PM	SC 320
Tejani, Farhan	G	3:45 PM	SC 332
Toothman, Max	A	3:45 PM	SC 301
Toro, Diana	H	3:35 PM	Ballroom
Trebuchon, Joshua	A	3:55 PM	SC 301
Wang, Thomas	H	3:45 PM	Ballroom
Wang, Xueqiao	A	2:55 PM	SC 301
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