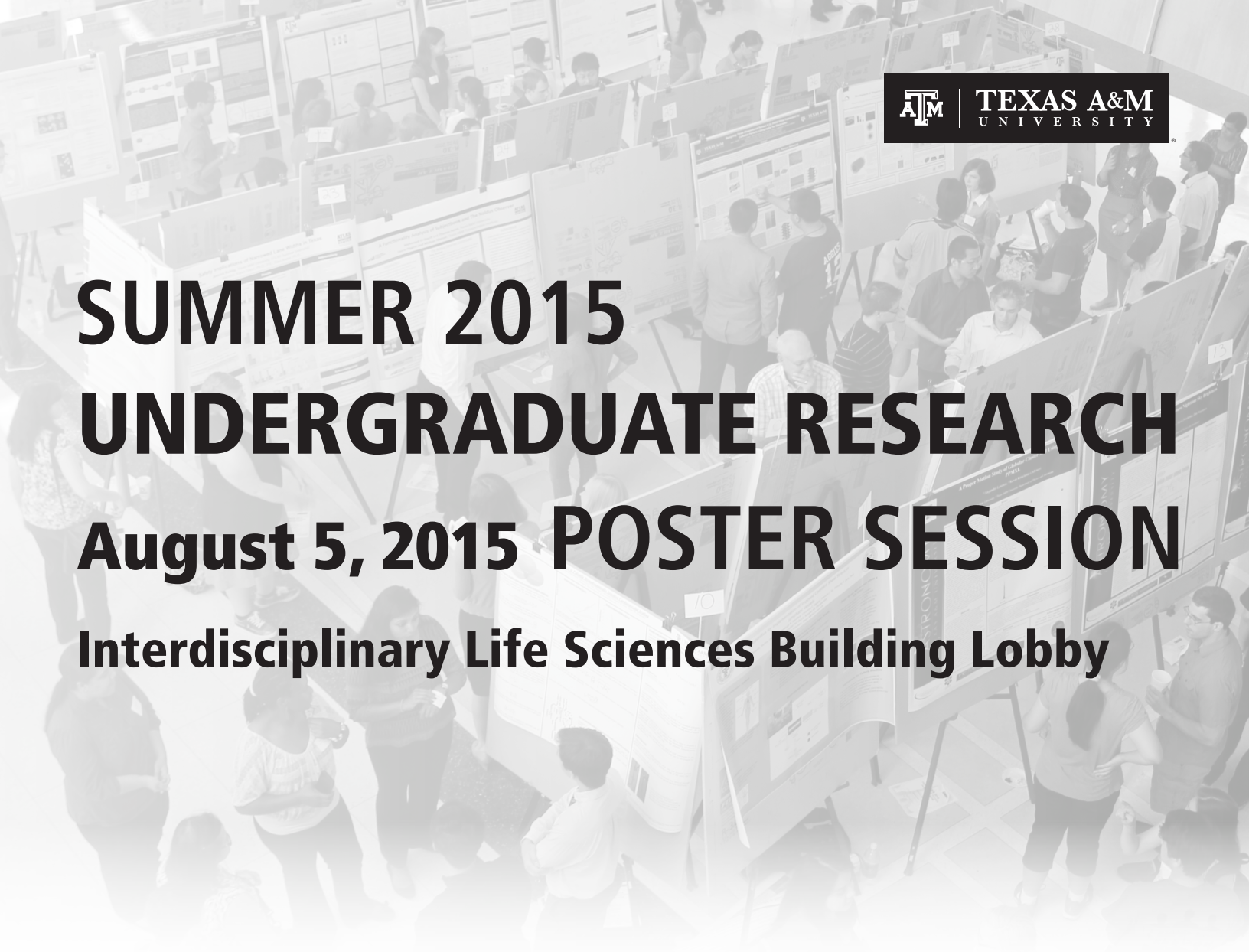

TEXAS A&M UNIVERSITY

SUMMER 2015 UNDERGRADUATE RESEARCH

August 5, 2015 POSTER SESSION

Interdisciplinary Life Sciences Building Lobby

Abstract Book

Session 1: Engineering
10:00 am - 12:00 pm

Session 2: Physical and Life Sciences
3:00 pm - 5:00 pm

Session 1: Engineering
10:00 am – 12:00 pm

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1. Advances in Brillouin Spectroscopy

Mariana Peraza (Texas A&M University)

Program: CANIETI

Advisor: Vladislav Yakovlev, Biomedical Engineering

Elastic properties of cellular and sub-cellular structures are important for understanding cellular and tissue biomechanics. Biomechanics is important for understanding many diseases and for exploring the way those diseases can be treated. Commercial ultrasound can provide elasticity measurements on a millimeter and centimeter scale. Atomic Force Microscopy can assess elasticity properties on a nanoscale. However, no present commercially available technique is available to study elastic properties on a microscopic scale on a time scale of milliseconds to minutes. Our solution is to use optical spectroscopy method based on Brillouin scattering to acquire information on local elasticity non-invasively, microscopically and fast.

2. 3D Bio-Printing Nanocomposite Scaffolds for Tissue Engineering

Adrian Olivera (Texas A&M University), **Elsy Rivero** (Texas A&M University)

Program: CANIETI

Advisor: Akhilesh Gaharwar, Biomedical Engineering

Biomaterial is a substance, which alone or as part of a complex system, is used to control of interactions with components of living systems. 3D Printing is creating a three dimensional object based on a digital model, where the structure is built by a pattern of multiple thin layers. The project developed should be able to print 3D vascular networks, and osteon structures for cell encapsulation.

3. Smart Cap (Air Quality and Ultraviolet Radiation Monitoring)

Javier Anguas (Texas A&M University), **Cristopher Cortes** (Texas A&M University), **Omar Garcia** (Texas A&M University), **Aldo Haro** (Texas A&M University)

Program: CANIETI

Advisor: Tracy Hammond, Computer Science & Engineering

SmartCap is a wearable device that includes four sensors. There are two MOS (Metal Oxide Semiconductor) gas sensors. Both sensors use MEMS (Microelectromechanical systems) to detect gas presence in the air. The cap also has an ultraviolet (UV) light sensor, and a humidity and temperature sensor. The information is obtained by the sensors, and directly sent to the microcontroller, which processes, converts, and transmits it via bluetooth to an Android smartphone. To display the data, an Android App was developed. By checking the app, the user is able to check the UV index (UVI) and the air quality index (AQI).

4. Web-based Platform Designed for Processing, Analyzing and Interpreting Medical Data Based on Machine Learning Techniques

Angel Caamal (Texas A&M University), **Jesus Cervera** (Texas A&M University), **Juan Contreras** (Texas A&M University), **Angel Medina** (Texas A&M University), **Emmanuel Zamora** (Texas A&M University)

Program: CANIETI

Advisor: Sebastian Hoyos, Electrical & Computer Engineering

This web-based platform will be able to process, analyze and interpret data from doctors and patients perspectives and it will statistically display the information using machine learning techniques. The way the platform will work is based on an inductive learning process that will be able to classify data on different classes.

5. 3-D Printing of Three Dimensional Heat Exchangers

Priscila Esquivel (Texas A&M University)

Program: CANIETI

Advisor: Jorge Alvarado, Engineering Technology & Industrial Distribution

A novel 3-D heat exchanger has been designed, fabricated and tested for cooling electronic devices and other applications. The heat exchanger consists of a manifold which can be used with air or liquids to remove heat from hot surfaces. The fluid is forced through an array of orifices to contact a heated surface, and exits through an exhaust port. Due to the configuration of the 3-D heat exchanger, heat transfer can take place at low surface temperature. Previously, several prototypes were designed and manufactured using traditional methods. However, the traditional methods used were time consuming and prone to machinist's error. The quality, speed and cost associated with making 3-D heat exchangers can be reduced by using a 3-D printer.

6. Machine Learning to Improve Performance of Code by Using a Genetic Algorithm to Find Near-Optimal Code Placement

Jorge Ivan Fuentes Rosado (Instituto Tecnológico Superior Progreso)

Program: CANIETI

Advisor: Daniel Jiménez, Computer Science & Engineering

Everybody wants faster programs, but how could the speed of a program be increased? The performance of a program depends on several factors; in the Computer Architecture and Compiler fields the performances depends on four elements: Branch Prediction, Branch Target Buffer (BTB), Instructions Cache (IC) and, Instructions Translation Lookaside Buffer (ITLB). To find a good placement of code that minimizes branch misspredictions, instruction cache misses, and ITLB misses, a genetic algorithm is used to find a near-optimal code placement.

7. Improving Research Impact in Engineering by Introducing Marketing and Communication Strategies

Araceli Lopez

Program: CANIETI

Advisor: Zenon Medina-Cetina, Geomechanics Engineering

Research impact refers to researchers, journals, or specific knowledge areas; in many cases, it is viewed as the reflection of the quality of research. Due to the limited reach and visibility of research in certain engineering areas, emerges the need to create strategies to improve research impact. By introducing marketing and

communication strategies can lead to the improvement of engineering areas using channels such as mobile internet, traditional marketing, and online marketing. Combining marketing and engineering areas, can lead the way to new knowledge, new product development, and new ways of solving problems.

8. Comparison between Local and Cloud-based Storage based on an "Internet of Things" System for Indoor Pet Monitoring

Susana Caballero (Universidad Autonoma de Zacatecas),
Henry Serrano (Universidad Autonoma de Yucatan)

Program: CANIETI

Advisor: Dilma Da Silva, Computer Science & Engineering

The use of technology applied to daily life is a growing trend, which leads to increased comfort and safety. Stored data has become essential in many applications. Thus, making necessary to identify and compare the advantages and disadvantages that the use of different instances to store data provide. Nowadays, most people enjoy having pets. Nonetheless, people's life does not always allow them to give the proper care to their pets. By this cause, it becomes important to have tools capable of letting owners know and monitor what happens with their pets during their absence.A pet monitoring system is constantly gathering data. Knowing the response times between a local-based and a cloud-based server helps to further understand their trade-offs when uploading data. Consequently, it is mandatory to compare them in order to examine and determine their optimal use, identifying in which cases it becomes better to employ each type of system. A case study based on Pet Monitoring applications is then further examined. Consequently, a model behavior was created and synthetic data was generated using this model. Code was developed in order to store this data locally and/or remotely. Performance difference was measured and observed. Concluding that a cloud-based server takes a longer time to connect to than a local-based one. Therefore, data should be uploaded in fewer queries than in a local-based server so as to avoid lag and to optimize resources.

9. Mobile App to Control the Sphero Robot and Help on Breathing Control to Improve Stress Management

Roger Solis Castilla (Texas A&M University)

Program: CANIETI

Advisor: Ricardo Gutierrez-Osuna, Computer Science & Engineering

Stress is an ailment which affects thousands of people even without knowing it. Fortunately, this could be treated with a proper control of involuntary bodily activities such as breathing. Biofeedback techniques provide solutions on teaching how to control these activities, allowing people to visualize physiological signals. The solution proposed uses this technique and combines both the Orbotix Sphero robot and the Zephyr Bioharness. The result is an Android application which through a game consisting of a race against the clock, teaches how to control breath during the gameplay. The results obtained shown a general reduction on the breathing rate when people started to lose control of the robot because they were breathing above the limit. In order have control, they had to breathe slowly. By this way, we expect that continued use of the app will help users to control their breathing rates in stressful tasks.

10. Identifying Patterns of Conformity on a Social Network for Children

Katya Borgos-Rodriguez (University of Puerto Rico at Mayaguez)

Program: CSE@TAMU REU/DREU

Advisor: Tracy Hammond, Computer Science & Engineering

Over the last decade, cyberbullying has become a concern among young citizens of the "virtual world." Usually, the bully is not the only participant; more likely than not, there will be a group of people that will also take part in the bullying. Prior research has shown that an individual's ideas are likely to be influenced by

examples. To explore the conformity effects that these examples can have over children in an online setting, we conducted an experiment with participants between ages 7-12. We asked the participants to go on a digital "quest" in which they sketched details of a story to help the characters succeed in their goals. We presented three activities: one with no examples; one with examples, but no identity markers; and one with examples and identity markers. Our goal was to determine whether participants would be more subject to similar ideas when shown examples versus not being shown examples. Our research team agreed on attributes and themes to include in the first three priming images for each activity. As expected, primed activities resulted in sketches similar to the priming images. The conformity effect increased when identity markers were provided, indicating that conformity factors may be influenced by social relationships. Meanwhile, activities that were not primed resulted in images that were very different in terms of style. This work's analysis of children's patterns of online conformity will inform and inspire the development of algorithms to identify cyberbullying activity and potentially make the Internet safer for children.

11. Performance Evaluation of the CORAL Scalable Science Benchmark Nekbone on the Supercomputers

Ruben Gomez (Texas A&M University)

Program: CSE REU Site: Computing for Disasters

Advisor: Xingfu Wu, Computer Science & Engineering

The purpose of this summer research is to evaluate the performance of the Nekbone benchmark on two supercomputers. ADA and EOS, both at Texas A&M University using different configurations (number of nodes and number of cores per node) and different programming models (MPI, OpenMP). Nekbone is one of the CORAL scalable science benchmarks from DoE National Labs used to test performance of full-scale supercomputers. Nekbone solves a standard Poisson equation using the spectral element method with an iterative conjugate gradient solver with a simple preconditioner. To collect detailed performance at application and functional levels, we used the MuMMI (Multiple Metrics Modeling Infrastructure) instrumentor MAIDE to instrument Nekbone and upload the performance data to MuMMI database. ADA is an IBM cluster, which has 792 nodes with 20 cores and 64 GB of RAM per node, and uses FDR-10 infiniband for networking. Similarly EOS is also an IBM cluster, which has 314 nodes with 8 cores and 24 GB of RAM per node, and uses QDR infiniband. The experimental results demonstrated hybrid Nekbone on EOS outperformed its MPI counterpart. On ADA MPI Nekbone outperformed its hybrid counterpart. The runtime for Nekbone is almost constant for the same number of cores per node no matter how many nodes are used. Through this project I learned how to use supercomputer, wrote parallel programs using MPI and OpenMP, and evaluated the application performance on supercomputers.

12. Engaging and Retaining Digital Participation Among Young Girls on an Online Social Network for Children

Angelica Leyva-McMurtry (Mills College)

Program: CSE@TAMU REU/DREU

Advisor: Tracy Hammond, Computer Science & Engineering

Online social networks experience difficulty retaining an audience to their site. For social network sites whose audience is children, retention is especially hard. In order to improve retention rates, a site must attract children through social and exciting activities. After experiencing high inactivity on KidGab, a social network that promotes online safety for girls between ages 7-12, we decided to expand on the fun and exciting activities provided within the site in order to gain and sustain longitudinal participation. To engage users over a long period of time, we needed a reasonable amount of quality activities. One activity that was expanded on was personality quizzes. Our research team hypothesized that by creating personality quizzes for this age group, an age where children are starting to gain self-awareness, our retention rate would increase. In order to appeal to children, quizzes in a variety of interests needed to be created. As a result of introducing quizzes on KidGab, the rate of consistent visitors has risen significantly. The children have also responded positively to the quizzes and many choose to discuss their results amongst friends. Due to the positive feedback from our users, new

quizzes are being added on a twice weekly basis. By satisfying our users, they will motivate others to join KidGab, allowing the site to expand and share its message of online safety across a wider audience.

13. Guiding Semi-Autonomous Vehicles

Brandon Martinez (La Joya High School/South Texas College),
Eli Zamora (La Joya High School/South Texas College)

Program: CSE@TAMU REU

Advisor: Nancy Amato, Computer Science & Engineering

Kinodynamic motion planning is the problem of finding a collision-free path for a robot under constraints e.g., velocities and accelerations. Seeing that this problem is an active area of research, state of the art techniques rely on sampling-based planning. This planning method plots points in a workspace until a valid path is found for a robot. Many sampling-based planners were developed for non-holonomic problems e.g., Kinodynamic Rapidly-exploring Random Trees (KRRT). Although KRRT's computational proficiency is competent, its lack of human problem solving skills renders simple problems intractable. Human-guided planning, combines automated planning and human intuition, allowing greater problem complexity and computational efficiency. A recent human-guided planner, Region Steering, allows sampling to bias or avoid user specified workspace regions, but was designed for holonomic bodies only. Although this method showed promising preliminary results, it has not yet been applied to non-holonomic problems. In this work, we extend region steering to handle such problems with dynamic constraints by combining region steering and KRRT. Our novel method, Kinodynamic Region RRT (KRRRT), allows the user to specify attract or repel regions, then applies KRRT's constraints when solving the problem. We found that utilizing regions, reduced planning time compared to KRRT alone.

14. Problem Solving with STAPL Algorithms and Views

Diego Martinez-Garcia (Universidad Autonoma de Yucatan)

Program: CSE REU Site: Computing for Disasters

Advisor: Lawrence Rauchwerger, Computer Science & Engineering

We describe an implementation of a parallel algorithm to find the sum of all numbers, less than a given number. It was implemented using "Standard Template Adaptive Parallel Library (STAPL)." The purpose is to show the scalability of the solution using STAPL.

15. Motion Planning

Jessica Eugenia Morales Rojas (Universidad Latino)

Program: CSE REU Site: Computing for Disasters

Advisor: Nancy Amato, Computer Science & Engineering

Motion planning is the problem of finding a valid path for an object from a start configuration to a goal configuration. It has applications in robotics, games/virtual reality, computer-aided design/virtual prototyping, and bioinformatics. Exact solution for high dimensional problems was computationally intractable using earlier planners. Sampling-based planning addresses this issue with solution which is probabilistically complete. Sampling based planners can be grouped in two different families: those which use Probabilistic Random Method (PRM) and those using Rapidly explore Random Tree (RRT). In general both the methods try to capture the connectivity or topology of the solution space in form of a graph or tree. The nodes in the graph are randomly sampled feasible configurations and the edges represent the local path to move from one configuration to another. Random sampling of the configurations provides fast solutions for complex high-dimensional problems. However, the solution path is widely considered to be sub-optimal. Sampling uniformly in the solution space will result in fewer samples in narrow passages. This issue is commonly known as narrow-passage problem. Hence, various sampling strategies issues (such as Obstacle-based, Gaussian, Bridge)

have been devised to address such and provide additional benefits such as high clearance (for example, Medial axis based sampling methods). To summarize, sampling based planners are efficient and the state-of-the art.

16. Object Identification Using Neural Networks

Melina Várguez (Texas A&M University)

Program: CSE REU Site: Computing for Disasters

Advisor: Daniel Jiménez, Computer Science & Engineering

The main goal is to find out what the neural network is "thinking," how the neural network is learning and what its interpretation of an object is. In order to do so, the neural network must be trained to recognize a specific object. For the purposes of this research, the object will be an apple. By using many training sample images of apples and not apples, the network will eventually be able to learn how to differentiate the specific object from others. Regardless of how similar they might be. The result should be an input vector that will show the Neural Network's interpretation of the object. Graphically it should look like an ideal apple.

17. Computation of Multi-resolution Brain Connectivity Maps using Seed Voxel Regions

Kianna Brevig (Rensselaer Polytechnic Institute)

Program: Mechatronics, Robotics, and Automated System Design REU

Advisor: Jim Ji, Electrical & Computer Engineering

With the aid of brain connectivity maps physicians can obtain a better understanding of the human brain, allowing them to provide improved treatment options for patients and study more closely the neurological effects of certain diseases and trauma. Data from functional Magnetic Resonance Imaging (fMRI) scans is used to create these individual brain maps, however an outstanding issue in the Single-seed correlation analysis (SCA) method of fMRI is the high processing time it takes to complete a full map. With close to a million individual voxels in a brain to correlate, the number of calculations becomes extensive for modern applications, and thus creates the need for a faster computational method. Using data from the Human Connectome Project, this research proposes a new method which correlates averaged regions containing many seeds as opposed to the standard seed-by-seed method. These regions become progressively smaller, and use previous region correlations to cut down the number of required calculations. Through implementing this new method along with parallel computing, time required to create full connectivity maps went from 64 days to roughly 15 hours with 83% accuracy. The results from this research show that region based correlation analysis can serve as an extremely faster tool for aiding physicians while still retaining nearly the same accuracy as SCA.

18. Image Stitching for Panoramic View Using Optical Flow

Nick Chehade (Ohio State University)

Program: Mechatronics, Robotics, and Automated System Design REU

Advisor: Dezhen Song, Computer Science & Engineering

Vision-based robotic navigation can be used to explore interiors of structures. Along with a teleoperator, a robot can successfully navigate through an unknown environment. In order for a teleoperator to provide input to the robot, an on-line visualization of the environment must be provided. In this study, a 360° panoramic view of the environment is constructed to further enhance the 3D awareness of the teleoperator. To provide an online panoramic image from a video feed, an efficient feature detection and matching method should be used without compromising the quality of the panorama. We detect corner features and use Optical Flow to track features among frames. Once the feature correspondence is established, the image transformation is calculated and used to stitch the images together. Thus, our system is able to read in a video, detect its features, select key frames, stitches the key frames, and projects the panorama for 3D visualization. We compare our method against Scale Invariant Feature Transform feature detection and Fast Library for Approximate Nearest Neighbor matching. Our results show that our method can generate panoramic views efficiently without losing stitching quality.

19. Planar Control of Robotic Arm Using EMG Signal Analysis

Patrick Cummings (University of Wisconsin)

Program: Mechatronics, Robotics, and Automated System Design REU

Advisor: Reza Langari, Mechanical Engineering and Engineering Technology & Industrial Distribution

A robotic arm in conjunction with electromyography (EMG) signal processing can be used as a means of assisting humans. Currently, there has been extensive research on EMG signal processing as well as considerable work on implementing EMG signals for use in robotic prosthetics and rehabilitation for amputees. However, there is little research on implementing this technology for non-amputees. This project uses the current knowledge to develop a system for controlling a six degree of freedom robotic arm with wireless EMG sensors for use by non-amputees. Multiple features are extracted from the raw EMG data and a naive Bayes classifier is used to associate the extracted features with specific motions, which are used to move the robot. This project achieves rudimentary control of the robotic arm in the two dimensional plan. Once fully implemented, this system will act as an intuitive method of robotic control. Intuitive robotic control using EMG signal analysis will allow non-amputees to take advantage of existing technology to increase productivity and performance.

20. Methodology for Plug and Play Automation of CNC Machining

Kevin Fisher (Miami University)

Program: Mechatronics, Robotics, and Automated System Design REU

Advisor: Jyhwen Wang, Engineering Technology & Industrial Distribution

Traditional manufacturing processes such as machining have been continuously enhanced with automation to increase efficiency and repeatability for decades. However, significant human interventions are still required to operate these automated Computer Numerical Control (CNC) systems. Despite recent advances in plug and play technology in computer science and engineering, a comprehensive automated manufacturing system is still lacking. To address this problem, a methodology is proposed to combine cyber manufacturing and plug and play automation to create a new system with low labor requirements and high accessibility and adaptability. To develop this methodology, detailed steps for the entire CNC milling manufacturing process were recorded for sample parts. These steps were categorized based on their potential to be automated and then analyzed based on technological demands. The result shows both the potential for new applications of current technology as well as the additional technology that is necessary for the system to work. If implemented, this system could be comparable to the versatility and automation of 3D printing. This would provide a more efficient and accessible method for designers and manufacturers and open up a new set of opportunities for a vast range of companies to participate in manufacturing.

21. Design and Evaluation of a Climbing Robot with Treaded Locomotion and Automatic Thrust Angle Control

Ryan Howard (Missouri University of Science and Technology),
Jorge Montañez (Modelo University)

Program: Mechatronics, Robotics, and Automated System Design REU, Texas Center for Undergraduate Research in Energy and Propulsion REU

Advisor(s): Alex Stockton, Engineering Technology & Industrial Distribution, Shen-Jen Hsieh, Mechanical Engineering

Applications for climbing robots are vast including civil inspection, surveillance and cleaning. The major requirement for these applications is the need to adhere to a variety of surfaces, be it concrete, brick or glass. With the addition of treaded locomotion, static friction coefficient, μ, was increased 34% from 1.02 to 1.55 for concrete. Pneumatic adhesion is often catastrophic when encumbered with a crack or crevice. The robot was given a horizontal trench on a vertical wall starting at 25mm wide. After each successful crossing, it was widened 10mm until failure. Force required to traverse the trench easily was measured to be 50% operating

power without a need for increase as the gap increased. The CR3 routinely required an increase in operating power to barely traverse the maximum gap of 55mm.

22. Design and Analysis of a Halbach Array Motor

Bradley Kaufman (University of Rochester)

Program: Mechatronics, Robotics, and Automated System Design REU

Advisor: Won-jong Kim, Mechanical Engineering

Motors that employ a specific permanent magnet configuration called a Halbach array have superior performance in a variety of areas when compared to many other motor designs. The presence of the Halbach array both eliminates the need for back iron and mitigates cogging torque, endowing Halbach motors with both high efficiency and abilities to execute exceptionally precise motion. To explore these properties, an external rotor, nine pole Halbach motor is in the process of being constructed. The rotor and stator of the motor were fabricated with a 3D printer. The 3D printer was also used to manufacture the parts of a magnet insertion device, designed specifically to insert magnets into the rotor. To measure the motor's position, an analog-to-digital converter (ADC) based on the Arduino Due microcontroller was developed. The ADC is to be fed data from Hall Effect sensors positioned on the stator. Finally, a relationship between the motor's angular position, torque, and stator coil current was established. The relationship was found by using torque versus force data generated by a finite element analysis simulation of the motor. In the future, this relationship can be used to develop a feedback control system for the motor's position, based on adjusting the current in the stator coils in response to changes in the output of the Hall Effect sensors.

23. Closed-Loop 3D Printer Position Control Using Optical Encoders and Machine Vision

Yizhe Liu (University of California, Berkeley)

Program: Mechatronics, Robotics, and Automated System Design REU

Advisor: Sheng-Jen Hsieh, Engineering Technology & Industrial Distribution

Fused deposition modeling (FDM) is an additive manufacturing technique where plastic filament is melted and deposited layer by layer to form a 3-dimensional (3D) print. This allows the manufacturing of objects that might otherwise be impossible or highly impractical with traditional machining techniques. The technology has developed and dropped in price enough such that hobbyist 3D printers are on the market. Their main downsides is the time it takes to print. Excessive speed will lead to skipped steps and misaligned parts, especially since current hobbyist printers are open-loop control and thus have no way of correcting for mistakes. The focus of this study was to add closed-loop position feedback to a hobbyist 3D printer employing step motors. This would allow the print to maintain integrity in the event of the motors skipping steps. We employed both and encoders and machine vision to track the position of the print nozzle.

24. Control of a Single Actuator Magnetic Levitation System

Han Pham (Syracuse University)

Program: Mechatronics, Robotics, and Automated System Design REU

Advisor: Won-Jong Kim, Mechanical Engineering

The complex remote control has lately gained the interest of researchers and engineers as the advance automation industry grows. The increase of industry size and geographic separation between processes make the control system become difficult. Functional agents such as sensors, actuators, and controllers are geographically distributed and are applicable in large scale modern industry. Central controllers are being developed because of the convenience and cost effective. The central controllers, interacted with the distributed sensors and actuators, are located at various locations. And the Internet helps to connect those functional agents together. The controller network system becomes attractive for its features such as easy installation, reconfiguration, and reduce the setup and maintenance costs. The magnetic levitation ball system, which was designed by Paschall II, is beneficial to study the central controller. The design and development of

the magnetic levitation system helps to study and experiment the central controller. Magnetic levitation has fascinated people over a century. Its phenomenon of eliminating friction or physical contact make it capable of numerous application and suitable for the need of reducing cost and integrate various place. Using of low cost and low precision components of this magnetic levitation system makes it capable and applicable for studying advance and complex central controllers. And this goes along with the objective of reducing cost, increasing the accessibility of the control system. Thus, Engineers will be able to install and run the controller in harsh environments such as deep sea or exploring space.

25. Radiation Detection and Visualization Payload

Gino Chacon (LeTourneau University)

Program: CSE REU Site: Computing for Disasters

Advisor: Robin Murphy, Computer Science & Engineering

Nuclear treaty verification and nuclear disaster recovery have presented a need for a platform capable of providing real time data to nuclear inspectors and first responders. To fill this need, a low-cost modular payload has been developed to assist with collecting radiation measurements at sites of interest, by integrating multiple currently available technologies, specifically the UltraRadiac™ Plus radiation detector and the Arduino microcontroller platform. The payload has been designed for use by unmanned ground vehicles (UGV), unmanned surface vehicles (USV), and unmanned aerial vehicles (UAV) as well as operators on foot. The payload is able to log data to an on board SD card and transmit data via wireless connection to a control station to be mapped for the operator to plan surveying paths in real time. The payload was tested on a unmanned surface vehicle to measure and map background radiation. The device was found to be capable of recording and relaying the data from the UltaRadiac™ radiation detector to a control station for real-time mapping as intended.

26. Remote Control of Unmanned Vehicles

Vankhanh Dinh (George Mason Universoty)

Program: CSE REU Site: Computing for Disasters

Advisor: Robin Murphy, Computer Science & Engineering

A communication system was implemented for a ground robot and an aerial robot from a web application, allowing a user to remotely drive the robots. As currently done, systems like this are accomplished by a human leading a drone through its tether. The approach taken is such that manual control over the robots is wireless. Remote control over these unmanned vehicles can allow emergency responders to respond to dangerous or inaccessible areas, which allow for a faster and more effective response time as opposed to waiting for direct human response. While we run the risk of hardware and software bugs that might run into the aerial robot into the ground or the ground robot off into destructive territory, the benefits of such a system being made available to emergency responders can greatly increase the number of victims rescued or recovered from disaster zones like Kathmandu during the Nepal earthquakes in April, 2015.

27. Analysis of 3D Surface Reconstruction Algorithms for Digital Archiving

Tobechukwu Ezekwenna (University of Maryland, Baltimore County)

Program: CSE REU Site: Computing for Disasters

Advisor: Robin Murphy, Computer Science & Engineering

This project focused on analyzing the software that creates three-dimensional models from two-dimensional images, for the purposes of digitally archiving artifacts at risk from being destroyed by ISIS or natural causes. This work is important to cultural heritage groups such as UNESCO or Library of Congress, because they currently don't use these types of software for historical preservation. The latest technology in historic preservation is the use of scanners on historical documents and paintings, as well as the use of audio recordings of historical stories, songs, poems, speeches, etc. People also use photogrammetry (the science of

making measurements from photographs) software with 3D printing to create a small scale model of bigger objects, but this causes a loss in scale and size. This research could provide a whole new dimension on how to preserve bigger structures, such as statues and historic cities. This project compared and contrasted different surface reconstruction software on their ease of use and the assumptions that the underlying algorithms make about the image data. The software packages were Photosynth, Agisoft, Pix4D, Poisson Surface Reconstruction, and the Wavelet Surface Reconstruction.

28. An Interface to Automatically Partition Regions for Wide Area Search and Rescue

Quinton Gilliard (Clemson University)

Program: CSE REU Site: Computing for Disasters

Advisor: Robin Murphy, Computer Science & Engineering

Wide Area Search is a web application that can assist search and rescue responders in planning out a wide area search by segmenting an area dynamically based on physical traits of the terrain. Decreased duration of mapping out and segmenting a search area would save valuable time during a disaster response, where time is limited. Responders could use this area segmentation to refer to or edit when mapping out search arrangements. As of now, during a real disaster response this procedure is done manually with little references to aid decision-makers and takes anywhere from 2-6 hours to complete. These wide area searches are not conducted often enough to become intuitive and the information about how to do so could have been covered in classes responders had taken many years before. Therefore, a technological application that can drastically cut the time it takes to coordinate a search effort can work wonders in the field. Currently, the application segments the selected area, but leaves no option for the users to edit the lines and the user interface may be a little complicated to follow. There is also a need to export data as a KML file which would allow the area to be used in other applications, such as Google Maps and Google Earth. The application was tested by responders at the Summer Institute on Texas Floods, where it was given high praise and future feature suggestions.

29. Detecting Debris in UAV Imagery of Disasters

Matthew Hegarty (Texas A&M University)

Program: CSE REU Site: Computing for Disasters

Advisor: Robin Murphy, Computer Science & Engineering

In this poster, I present a method of identifying debris and man-made objects in UAV (Unmanned Aerial Vehicle) imagery that relies both on conventional corner and edge detection techniques, as well as improvements specific to the domain of wilderness search and rescue. This process enables first responders to more quickly sift through the massive amounts of data generated by UAV flights and identify potential locations of interest. Currently, UAV imagery is handled by having several responders view each picture and determine if the image contains features that might represent debris. Humans are not well suited to looking through hundreds or thousands of high resolution images for small features, and quickly become distracted and fatigued. My approach provides a way of reducing the number of images that human responders need to review by filtering out images that are less likely to contain debris, letting responders focus on the more important images. It has been tested on actual disaster images taken at the Wimberley Flood, and feedback from responders and search and rescue professionals has been positive.

30. Expert Damage Photographer App

Emanuel Martinez Vazquez (University Of Puerto Rico Mayagüez Campus)

Program: CSE REU Site: Computing for Disasters

Advisor: Khuong Nguyen, Computer Science & Engineering

After a disaster, structures need to be inspected by a professional engineer, but the imagery will be collected by users who need be instructed how the data should be collected. The goal of this research is to create a simple augmented reality mobile application that provides geographic coordinates, GPS, photos, compass and guides

users in taking useful photos to help in the aftermath disaster recovery process. The user is also provided a series of videos to help achieve their goals and to give an idea of what is an appropriate photo. This a great benefit to responders who are in a potentially dangerous situation because it reduces the time it takes for structural engineer to determine whether a structure poses a threat. All this work was possible through the use of the software development program Xcode. The app will be tested using volunteers who will provide feedback on user experience and any bugs that can be found. In the future, Responder-R will be integrated to the application as well as Google maps, to give a birds eye view when the photo is taken. It is also planned to allow the user decide to take measurements in both metric and customary system.

31. Visualizing Geospatial UAV Data for Search and Rescue Efforts

Abygail McMillan (University of North Georgia)

Program: CSE REU Site: Computing for Disasters

Advisor: Robin Murphy, Computer Science & Engineering

This project addresses one aspect of a need within the field of rescue robotics: data sharing and organization. The program created provides a way to visualize and track field data using GPS coordinates from photographs taken from unmanned aerial vehicles (UAVs). Using this program, responders are able to see where they have already collected data, which will keep them from having to re-tread ground and allows them to more easily pinpoint the exact location of interesting data. They can also quickly and easily view the general area already flown by a UAV, with different ways to customize the experience, such as displaying a polyline instead of markers or choosing to use a time slider to view photographs taken at a specific point in time. Currently, responders must manually sort data, especially if they need to find photographs related to exact times. This opens the door to the potential for error, such as unnecessarily flying the same route multiple times. Field testing with real responders has been carried out, with one set of useable data taken from two UAV flights acquired; the data was entered into the program and displayed correctly. Feedback from responders has been positive, with interest being expressed in seeing further applications of the program.

32. Supporting Image Document Triage And Metadata-Based Recommendations For Disaster Response

Francesca Picarazzi (Texas A&M University-Corpus Christi)

Program: CSE REU Site: Computing for Disasters

Advisor: Robin Murphy, Computer Science & Engineering

When responding to a disaster, sorting through imagery collected by unmanned aerial vehicles (UAVs) is a tedious process that can be made easier and more efficient through use of Information Technology. The goal of this research is to provide a user-friendly and efficient way for people who are responding to a disaster to organize and analyze UAV imagery. To accomplish this, extensions are made to PerCon including support for categorization and automatic generation of related imagery based on image metadata. PerCon, the Personalized and Contextual Data environment, is an analytic workspace designed to enable effective management of large, heterogeneous data sets. PerCon provides a visual workspace in which the user is able to manipulate and form relationships between data objects through spatial organization, data visualizations and annotations. The tools added allow the user to manually classify images using user-defined categories, automatically generate images taken at a similar location to a particular image, and generate a map indicating the location at which a particular image was taken. As this project extends PerCon, responders have access to all of the tools that the analytic workspace PerCon offers along with the categorization and automatic generation of related imagery functions, enhancing the user experience. We tested the PerCon extensions by heuristic evaluation.

33. Spectral Anomaly Detection with Machine Learning for Wide-Area Search and Rescue

Julia Proft (Connecticut College)

Program: CSE REU Site: Computing for Disasters

Advisor: Robin Murphy, Computer Science & Engineering

In wide-area search and rescue missions, unmanned aerial vehicles (UAVs) may be deployed to collect high-resolution imagery which is later reviewed by a responder. The volume of images and the altitude from which they are taken makes manually identifying potential items of interest, like clothing or other man-made material, a difficult task. For this reason, we created a program that automatically detects unusually-colored objects in aerial imagery in order to assist responders in locating signs of missing persons. The program uses the Reed-Xiaoli (RX) spectral anomaly detection algorithm to determine which pixels in an image are anomalous and then generates an "anomaly map" where brighter pixels signify greater abnormality. While the RX algorithm has previously been proposed for search and rescue missions, up until now it has not been evaluated in a high-fidelity setting with real responders and real equipment. We tested the program on 150 aerial images taken over the Blanco River area in Texas after the May 2015 flooding as well as on 100 aerial images from a search and rescue training exercise conducted in July 2015 at the Summer Institute on Flooding. Early feedback from responders suggests that RX spectral anomaly detection is a valuable tool for quickly locating atypically-colored objects in images taken with UAVs for wide-area search and rescue.

34. Connectivity Between Servers: Remote and Local Servers for SkyWriter

Kayla Reid (University of Wyoming)

Program: CSE REU Site: Computing for Disasters

Advisor: Robin Murphy, Computer Science & Engineering

SkyWriter is a multi-platform interface used to enhance the quality of communication for emergency responders during the flight of an unmanned aerial vehicle (UAV). It allows responders connected to a local network to communicate by sketching or highlighting on top of real-time video footage sent from the UAV in flight. This project focuses on enabling SkyWriter to communicate over the Internet in order to allow for an unrestricted amount of distance in between flight team members in the event of a disaster. Internet connectivity for SkyWriter requires a permanent computer on which to run the remote server, and setting the appropriate server permissions and communications settings. A computer has been set up as the remote server, and can run independently of the local server, allowing for training and demonstration of its interface capabilities. This can be done from any computer, tablet, phone, or other web-enabled device on the same network. The next step is to complete the network integration and testing between the remote and local SkyWriter servers, so that responders without access to the local SkyWriter network can use the remote interface with the same real-time data afforded to local responders.

35. Use of Molecular Dynamics to Evaluate Interaction Energy for Improving Prediction of Peptidomimetic Binding to Protein-Protein Interfaces

Muzammil Ali (University of Illinois at Urbana-Champaign)

Program: Undergraduate Summer Research Grant (USRG)

Advisor: Thomas Ioerger, Computer Science & Engineering

Protein-protein interactions (PPIs) play a large role in many biological processes, and are the basis of multiple diseases such as Alzheimer’s disease and cancer. Being able to effectively disrupt key PPIs is central to combatting these diseases. One method by which PPIs can be disrupted is through the use of peptidomimetic scaffolds – small synthesized molecules designed to mimic peptides. An algorithmic method called EKO has been previously developed to find PPIs in the protein database suitable for disruption given a particular scaffold. EKO relies on calculations of root mean square distances between six key atoms of a geometric superposition of the scaffold and protein, which sometimes yields hits that have steric clashes. To identify better hits, a secondary evaluation method was developed based on an analysis of interaction energies between

the scaffold and target protein through GROMACS (a molecular dynamics (MD) modeling package). The new method was two-tiered in its approach. First, GROMACS was used to calculate potential energies of clashes and non-clashes using energy minimization (EM) with the OPLS forcefield. Second, the free energy of binding (ΔGbind) between a scaffold and protein was calculated from a MD simulation using the LIE method. We found that while potential energy analysis was able to detect clashes, they were relaxed during EM. The ΔGbind value was able to asses which scaffold interacted best with the protein. In conclusion, utilizing interaction energies provides an additional criteria by which EKO can sort out the best candidates for disrupting PPIs with peptidomimetic scaffolds.

36. Self-Orthogonal Cyclic Codes Over Finite Chain Rings

Travis LeCompte (Louisiana State Universtiy), **Andrew Nemec** (Texas A&M University)

Program: Undergraduate Summer Research Grant (USRG)

Advisor: Andreas Klappenecker, Computer Science & Engineering

A major difficulty in quantum computation and communication is preventing and correcting error in the quantum bits. The goal of our research is to explore conditions for self-orthogonality of classical cyclic codes over finite chain rings in order to produce quantum stabilizer codes for error correction. In addition we discuss restrictions on a specific family of classical codes known as BCH codes to fit the self-orthogonal criteria.

37. Characterization of Algal, Bacterial, and Fungal Single-Cell Growth in Microdroplets

Jon Luedtke (University of Wisconsin-Madison)

Program: Mechatronics, Robotics, and Automated System Design REU

Advisor: Arum Han, Electrical & Computer Engineering

Early research shows that microalgae have promise to feasibly produce biofuels at a commercial level to reduce the need of fossil fuels and their harmful effects on the environment. In order to reach commercial scale production, every aspect of the production process has to be improved. Droplet microfluidics with its high-throughput, low reagent usage, and tight control of environmental conditions, allows an effective means of mutagenesis screening than conventional bulk methods to find strains of microalgae species that optimize lipid droplet yield. However, there is a lack of research demonstrating how the size of the water-based microdroplet affects the growth and proliferation of microorganisms including algae, bacteria, and fungi. This experiment cultured and encapsulated *C. Reinhardtii*, *E. coli* and *Fusarium* in microdroplets of 75 µm, 100 µm, 150 µm, 200 µm diameter to characterize their respective growth patterns. The experiment found that growth of encapsulated microorganisms depends on the size of its microdroplet.

38. Stimuli-Responsive Colloidal Gel Triggered by Electric Field

Oscar Lopez de Llergo (CANIETI)

Program: CANIETI

Advisor: Xiayun Huang, Chemical Engineering

The principal goal of this research is manipulate the mechanical properties of a colloidal suspension using electric direct current, in order to obtain a gel phase, thus, allow us the characterization of the relationship between the voltage-current applied and the properties of the suspension; this knowledge would be applied for future designs in medical and industrial applications based on this reversible gelation.

39. Pattern Recognition in Virtual Learning Environments (VLEs) to Strengthen Cognitive Processes in Engineering

Cynthia Soto (Universidad Autonoma de Yucatan)

Program: CANIETI

Advisor: Zenon Medina-Cetina, Civil Engineering

Recent research by the National Academy of Engineering shows a constant and increasing demand of careers in engineering (National Academy of Engineering). However it is also known the existence of a significant gap in the cognitive process of educating engineers. This research introduces an innovative approach to fill in this gap by combining education context and computational support with the aim of optimizing the development of cognitive skills. The objective in order to contribute to fill this gap, is to produce a computer model for create learning scenarios for the career of mechanical engineering. This VLE must meet the needs of the students according to their behavior learning pattern, in order to help them to develop cognitive skills to comprehend engineering concepts. The hypothesis to support this proposal is that with the understanding of learning preferences is possible to develop cognitive skills that help students overcome the barriers of knowledge when they are in self-learning scenarios. This preference can be achieved through the study of the behavior patterns of learning. These patterns could give feedback to students according to the diagnostic evaluation of their interaction with the object of study.

40. Irrigation Runoff Mitigation Cloud Service

Yichao Zhu (Universidad Autonoma de Yucatan)

Program: CANIETI

Advisor: Jorge Alvarado, Engineering Technology & Industrial Distribution

A cloud-based service has been created to support the development of an irrigation runoff mitigation system. The goal of the project is to facilitate information sharing between irrigation runoff sensors and the managers or users in residential or commercial landscapes. Significant water savings can be attained by ensuring adequate flow of information from the sensing points to the user through a well designed irrigation controller. This project also helps integrate the current runoff mitigation system into a scalable cloud environment, where administrators are able to manage thousands of irrigation runoff mitigation system controllers in a single place, anywhere with internet access. This application also automates the current information processing of the data log file generated by the devices.

41. Enhancing the Protein Resistance of Silicone with PEO-Silane Amphiphiles

Mikayla Barry (Texas A&M University)

Program: Independent Research Project

Advisor: Melissa Grunlan, Biomedical Engineering

The safety and effectiveness of blood-contacting medical devices are often compromised due to surface-induced thrombosis. Proteins first adsorb to the surface, and then are joined by bacteria and other cells, leading to increased risk of blockages and infection. To prevent this accumulation, biomaterials must be largely protein resistant. Poly(ethylene oxide) (PEO), a naturally hydrophilic material, is capable of reducing protein adsorption if properly used. When incorporated into materials, this molecule's proper functioning depends on its migration from areas within the material to the water-surface interface. PEO-silane amphiphiles, containing PEO connected by a long, flexible tether to a crosslinker, were synthesized to improve the protein resistance of silicone by facilitating surface restructuring (the migration of the PEO to the surface marked by a substantial increase in hydrophilicity). Uncrosslinked medical grade silicone was modified with amphiphiles of three PEO repeat segment lengths (m = 3, 8, and 16) at varying concentrations (5, 10, 25, 50, and 100 μmol per 1.0 g silicone). Restructuring of the modified silicone was measured by static water contact angle analysis over time. It was found that PEO-segment length played the primary role in determining surface restructuring, with the PEO-segment repeat length m = 8 performing best, while increasing the concentration improved restructuring

to a lesser degree. Adsorption of fibrinogen was also measured and it was observed that only films that restructured extensively were effective in resisting protein adsorption.

42. Optical Properties of Polymer Nanocomposite Enhanced with Conductive Nanoparticle

Matthew Bolen (Texas A&M University), **Yichen Dai** (Texas A&M University)

Program: Independent Research Project

Advisor: Jodie Lutkenhaus, Chemical Engineering

In this study, we examine the optical properties polymer-based composite thin films doped with conductive nanoparticles. Polymer/nanoparticle composite films are assembled using the spray-assisted Layer-by-Layer assembly (LbL) technique. The films were characterized using UV-Vis spectroscopy as well as Optical Microscopy. The aim of this study was to detect and observe any noticeable effects the addition of discreet regions of conductive nanomaterials would have on polymer-based LbL thin films. Growth behavior of the polymer films was analyzed, and a growth profile confirms the linear growth rate of the films. Early results indicate no significant effects on optical properties of the films except observable color change. The absence of a redshift in the absorption spectra of films with dramatically different compositional makeup also indicates no plasmonic interactions among aggregated nanoparticles within the films.

43. Mechanical Properties of a Composite Material Built with 3D Printing

Trace Dressen (Texas A&M University)

Program: Independent Research Project

Advisor: Bruce Tai, Mechanical Engineering

This experiment studies the mechanical behaviors of a new composite material manufactured with 3D printing and polymer impregnation techniques. This composite uses 3D-printed plaster with an open-cellular structure as a frame to encapsulate the silicone resin (PDMS), forming a solid body. Because of the vastly different characteristics of the materials that make it up, the composite could have a wide variety of mechanical behaviors. In this study, design of experiment was performed with four-point bending tests using different composition ratios and sizes of open cells to determine the mechanical properties of the resulting composite. These properties include maximum flexural stress, flexural secant modulus of elasticity, and toughness indices (I5 and I20). The experimental results showed that both the flexural secant modulus of elasticity and the maximum flexural stress were proportional to the plaster content and the unit cell size, while I20 had an opposite trend. The flexural secant modulus of elasticity ranged from 20 to 280 MPa, and the maximum flexural stress ranged from 0.3 to 1.2 MPa for 25%-75% plaster content and 3.25-6.5 mm cell size. Statistical analysis further confirmed the differences between these cases. This experimental study demonstrated the capability of this composite to exhibit different mechanical behaviors for functional applications.

44. Characterization of Cold Plasma Film Deposition in Reaction Chamber

Kendal Ezell (Texas A&M University)

Program: Independent Research Project

Advisor: Duncan Maitland, Biomedical Engineering

Cold plasma treatments are useful for changing the surface chemistry of materials while preserving the bulk chemistry. However, each plasma system has its own characteristic plasma field. Characterizing the plasma field for each system is important for regulating experimental variables and determining bulk treatment consistency as it pertains to high throughput manufacturing. This study focused on mapping the plasma field of an Aurora 0350 Plasma Surface Treatment System and documenting the effects of sample fixturing and bulk treatment shielding. Silicon wafers placed in a 6x6 grid were treated with a low power ethylene/acetylene plasma process in two configurations: directly contacting the shelf, and while elevated 4.5 cm into the plasma field on glass cuvettes. Shielding and bulk treatment viability were analyzed using elevated silicon wafers placed in 4x4 grids on four shelves. All treated samples were analyzed using spectroscopic ellipsometry to

measure film thickness; film thickness was assumed to correlate directly to the reactivity of the plasma field at that location. Sample orientation was shown to have an effect on plasma deposition with raised samples having significantly increased deposition rates. Decreased film deposition was observed on the top and bottom shelves, as well as along the perimeter of the chamber. Plasma deposition rates also increased when moving towards the back of the reaction chamber. These inconsistencies in the plasma field must be carefully considered when bulk treating numerous samples. The characterization of the plasma chamber found in this study can be used for further studies as variable parameters.

45. Optimizing the Encapsulation of Gold Nanoparticles in Calcium Carbonate Microcapsules

Mohammed Haque (Texas A&M University)

Program: Independent Research Project

Advisor: Michael McShane, Biomedical Engineering

Implantable sensors for long-term, minimally-invasive monitoring of tissue biochemistry are of significant interest for the future of personalized healthcare. Raman spectroscopy is an attractive approach to making such measurements and surface enhancement of Raman scattering (SERS) with engineered substrates has enabled amplification to levels sufficient for in vivo analysis. Gold nanoparticles (Au-MBA) capped with the pH-sensitive molecule 4-mercaptobenzoic acid and encapsulated by calcium carbonate microcapsules ($CaCO_3$ MCs) represent one approach to making SERS pH sensors in a format amenable to implantation, but the composite system has not been optimized. Specifically, larger Au-MBA concentrations within the microcapsules increase Raman intensity; however, the effects of Au-MBA loading on the vaterite polymorph formation of $CaCO_3$ MCs are poorly understood. Vaterite is desired for its ideal qualities of high water solubility, high porosity, and fast dissolution. Here, we evaluated the effect of Au-MBA loading in $CaCO_3$ MCs on vaterite formation. We encapsulated systematic concentrations of Au-MBA (2.01, 6.03, 8.04, 12.1, or 15.1 nM) in $CaCO_3$ MCs, and used X-Ray diffraction to measure the relative percent weight of vaterite that was obtained. The optimal loading concentration of Au-MBA was found to be 12.1 nM, which yielded maximum vaterite formation of 91.6%. Further, 15.1 nM Au-MBA could not be properly encapsulated by CaCO3, as evidenced by a relatively low vaterite percentage of 55.5%. These results will inform the design of a protocol that maximizes Raman signal with minimum raw material and maintains reversibility, which may be vital to optimize in vivo use.

46. Validation of CFD Meshing Strategies

Ryan Von Ness (Texas A&M University)

Program: Independent Research Project

Advisor: Debjyoti Banerjee, Mechanical Engineering

The purpose behind this research is to conduct CFD simulations with multiple meshing strategies to see how they will affect the simulations accuracy. This study will give a brief overview of what should be commonly looked for when running a simulation, as well as the approximated time the mesh will take to converge. Three main types of meshes (unstructured, structured, and hybrid) where run for an internal pipe flow using Star-CCM+ software. Features such as cell size, max cell size, min cell size, mesh types, and many others were changed to distinguish there effects on the simulation. Every resulting simulation was then compared to the analytically calculated velocity and thermal profiles for an internal pipe flow. The unstructured mesh proved to be the simplest mesh to implement over a geometry, however it was the least accurate and took a fairly long time to converge. The structured mesh was more difficult to implement however the results were significantly better, despite the drawback of taking the longest time to converge. The hybrid mesh ran the fastest and gave results that were just a little better than the unstructured. After all these trials, the gathered information was then utilized to create a mesh for complex geometries with external flow.

47. Estimating the Non-Homogeneous Elastic Modulus Distribution from Surface Deformations

Miguel Ortiz (Texas A&M University), **Beatriz Carrillo** (Texas A&M University), **Jose Cruz** (Texas A&M University), **Guillermo Duran** (Texas A&M University)

Program: Independent Research Project

Advisor: Sevan Goenezen, Mechanical Engineering

The importance of knowing the material distribution in a solid can be used in many disciplines. The change in material properties found in human or animal tissue could be related to the different tissue types thus helping to classify the tissues in a non-invasive manner. The purpose of this study is to solve the inverse problem in finite elasticity for the non-homogeneous shear modulus distribution only from known surface deformation fields. Hypothetical displacements fields are created, by applying forces on the surface of the model. In order to reconstruct the image, we used the surface displacement fields obtained to test the inverse strategy. We observed that the quality of the shear modulus reconstructions depend on the noise level inherent in measured surface displacement data. The reconstruction quality also depends on the number of surface displacement fields utilized to solve the inverse problem. The displacement fields at the boundaries are highly susceptible to noise which can adversely affect the reconstructions. This issue could be avoided by choosing to ignore displacements at the boundary below a threshold value.

48. Stroke Rehabilitation Using Virtual Enviroments

Cosme Basto (Texas A&M University), **Mark Eckstein** (Texas A&M University), **Junior Garcia** (Texas A&M University), **Manuel Jurado** (Texas A&M University), **Bruno Mendez** (Texas A&M University), **Abril Moreno** (Texas A&M University)

Program: Texas Center for Undergraduate Research in Energy and Propulsion REU

Advisor: Pilwon Hur, Mechanical Engineering

The following research steadies the use of Virtual reality environments for post-stroke arm rehabilitation. The consequences of a stroke can immediately alter the quality of life for the patient involved as well as for close family members. Optimal practice and feedback elements are essential requirements for maximum recovery in patients that have suffered central nervous system lesions. Virtual Reality (VR) provides environments for assessment and training of arm motor deficits using enhanced feedback. Virtual Environment (VE) incorporates practice and feedback elements for maximal motor recovery:

1. Originality and motivation to the task.
2. Varied and challenging practice of high-level motor elements.
3. Optimal, multimodal feedback about movement performance outcome.

49. Effect of Porcine Host Response on Fully Implantable Optical Oxygen Sensors

Justin Clowney (Texas A&M University)

Program: Undergraduate Summer Research Grant (USRG)

Advisor: Michael McShane, Biomedical Engineering

Oxygen is a common metabolic component and many physiologic reactions can be indirectly quantified by its local concentration. Hydrogel-based fully implantable biosensors with incorporated oxygen-sensitive phosphors can enable real-time noninvasive optical measurement of tissue oxygen levels. However, the foreign body response (FBR) in vivo can disrupt oxygen delivery to the sensor, thus reducing longevity, and slowing response time. Here, we assess changes in response of oxygen sensors before and after implantation in a porcine model. Sensors were based on a poly (2-hydroxyethyl methacrylate) (pHEMA) hydrogel matrix functionalized with palladium(II) benzoporphyrin dye. Sensors with a porous inverted colloidal crystal (ICC) structure that promote tissue integration or non-porous “slab” structure (controls) were implanted in a pig for 4 and 6 weeks. Using a custom-built system, lifetime values were measured by exposing the sensors to various

oxygen concentrations (0%, 2%, 5%, 10.45% and 20.9% O_2). We found that the lifetimes for ICC sensors were on average 40 µs higher than those of slabs. To test if this result was due to FBR, the lifetime was measured after storing explants in 6M NaCl for 1, 7, and 14 days to deteriorate tissue. Response range decreased from 220 to 50 µs with increasing salt storage duration, but not for slab sensors. This suggests that the higher degree of tissue integration reduced the oxygen response of the sensor. These results show that FBR causes a significant effect on implant response that will require either calibration correction or mitigation of the FBR to increase sensor longevity.

50. Electrochromism in P3HT-b-PEO/V_2O_5 Hybrid Electrodes

Maria Stracke (Texas A&M University)

Program: Undergraduate Summer Research Grant (USRG)

Advisor: Jodie Lutkenhaus, Chemical Engineering

Vanadium pentoxide (V_2O_5) is a promising cathode due to its high theoretical capacity (294 mAh/g) and cost effectiveness (~$12/kg), but it remains limited by poor lithium-ion diffusion coefficient and electronic conductivity, and severe volumetric changes during cycling. In a previous study, we have successfully demonstrated that the introduction of an electron-and-ion conducting diblock copolymer, poly(3-hexylthiophene)-block-poly(ethyleneoxide) (P3HT-b-PEO), into V_2O_5 electrode improves the electrochemical performance and cyclability. Moreover, V_2O_5 electrodes display a color change at different potentials. The difference in the electrochemical and electrochromic properties of the hybrid electrodes can be explained by understanding the band gap difference. Here, we report electrochemical and energy band gap properties of the hybrid electrodes as a function of composition. Then, a discussion of the dependence between electrochemical performance and energy band gap properties follows. Finally, we demonstrate electrochromism of V_2O_5 based-hybrid electrodes for application.

51. Effects of Temperature and Ionic Strength on the Complexation of PDAC/PSS

Luis Valenzuela (Texas A&M University)

Program: Undergraduate Summer Research Grant (USRG)

Advisor: Jodie Lutkenhaus, Chemical Engineering

Polyelectrolytes (PEs) are polymers that ionize in water to give charged species. Oppositely charged polyelectrolytes can come together in water to form polyelectrolyte complexes (PECs). PECs have a wide range of applications, from industrial to advanced material applications. Many properties of PECs are still not completely understood, such as their stability in different environments and temperatures. This work investigated the effects of mixing ratio, ionic strength, and temperature on the complexation of the strong polyelectrolytes, poly (diallyl dimethyl ammonium chloride) (PDAC) and poly (sodium 4-styrenesulfonate) (PSS). UV-Vis-NIR spectroscopy and visual inspection were performed on the PDAC/PSS complexes, in order to determine the complexes stability and turbidity. Results show that PSS and PDAC in non-stoichiometric ratios and in solutions of low salt concentration were most stable. Furthermore no correlation was found between temperature and turbidity.

52. Analysis of Crashes Involving Emergency Vehicles in Emergency Calls

Garrett Ackner (University of Michigan)

Program: Advancing Transportation Leadership and Safety Center (ATLAS) Summer Internship Program

Advisor: Chiara Silvestri-Dobrovolny, Texas A&M Transportation Institute (TTI)

This study was conducted to measure the effects of crashes involving emergency vehicles in emergency calls. Crashes occurred in the States of Michigan and Texas between 2010 and 2014 were analyzed to investigate data regarding frequency, severity, and location of crashes involving emergency vehicles. Additionally, interviews with emergency vehicle operators were conducted to gain insight on the operating protocols for driving emergency vehicles. The quantitative and qualitative research methods both shared results that

emergency vehicles responding to emergency calls still present high risk of being involved in crashes with civilian vehicles and that further measures need to be taken to possibly prevent and/or reduce the severity of such crash scenarios, which would also improve emergency vehicle responses in emergency calls.

53. Safety Analysis of a Work Zone Queue Warning System

Lolivone De La Rosa León (Polytechnic University of Puerto Rico)

Program: Advancing Transportation Leadership and Safety Center (ATLAS) Summer Internship Program

Advisor: Gerald L. Ullman, Texas A&M Transportation Institute (TTI)

How are severe accidents prevented during freeway construction work zone lane closures? The mission of the Texas A&M Transportation Institute (TTI) is to save lives, time, and resources. Thus, a safety analysis of a work zone queue warning system was performed to assess the benefits of implementing a smart work zone queue warning system and portable rumble strips upstream of freeway work zone lane closures in Texas where traffic queues are expected to form. A large amount of archived travel time data, system implementation data, and roadway crash data was accessed and collated to determine whether these systems were contributing to the reduction of traffic congestion and a safe movement of traffic. An analysis of this data was performed using standard crash analysis techniques to determine the magnitude by which crashes occurring at these freeway work zone lane closures are being reduced by the deployment of the smart work zone systems and rumble strips. The results demonstrate that the intelligent transportation systems (ITS) reduced crashes when a queue was present by 72.7%. Thus, the ITS implementation during freeway work zone lane closure is having positive outcomes.

54. Operational Performance at Two-Way Stop Controlled Intersections

Marci Early (University of Arkansas)

Program: Advancing Transportation Leadership and Safety Center (ATLAS) Summer Internship Program

Advisor: Karen Dixon, Texas A&M Transportation Institute (TTI)

When two cars approach the stop-controlled legs of a two-way stop controlled (TWSC) intersection at the crossing of a major and minor roadway, driver perception regarding which vehicle should be granted right-of-way is often unclear. This confusion can increase if one of the drivers intends to execute a left turn. This research was performed primarily to identify any safety issues with driver perception/understanding in the case of one left-turning vehicle with an opposing right-turning or straight vehicle at the stop-controlled legs of a TWSC intersection. The authors conducted data collection that involved filming and observing vehicle interactions at seven different TWSC intersections within the cities of Bryan and College Station, Texas. The authors specifically evaluated how the left-turning vehicles responded to the TWSC when an opposing vehicle was present. This scenario occurred 113 times for seven intersection locations during a total evaluation period of approximately 25 hours. For these 113 observations, the researchers performed statistical analyses and determined that the minor roadway volume and the first vehicle to approach the intersection significantly influenced driver behavior. The overall study findings confirm the authors' hypothesis that drivers do not fully understand the appropriate (legal) maneuver protocols when stopped at TWSC locations.

55. The Effect of Distractions on a Pedestrian's Waiting Behavior at Traffic Signals: An Observational Study

George Gillette (Texas A&M University)

Program: Advancing Transportation Leadership and Safety Center (ATLAS) Summer Internship Program

Advisor: Kay Fitzpatrick, Texas A&M Transportation Institute (TTI)

Distraction has been a point of interest in transportation research for many years. Recently, this interest has extended from distracted drivers to distracted pedestrians. Past research suggests that distracted pedestrians are less likely to show cautionary crossing habits and tend towards increased crossing times. This study provides

information about the pedestrian waiting to cross, and investigates how distraction and other factors may impact pedestrian start-up time and crossing behaviors. Researchers surreptitiously observed 760 pedestrians at three intersections in College Station, Texas, and coded their characteristics and behavior in real-time. Characteristics recorded were age, gender, distraction, and grouping. Distractions recorded were talking on a phone, texting, listening to music, eating, drinking, smoking, and other. The pedestrian groups were no group (crossed alone), mixed-age group, or peer group. Behaviors recorded were glancing prior to entering the crosswalk, entering the crosswalk early, walking within the crosswalk markings, and hurrying across the crosswalk. Pedestrians who texted and pedestrians who talked on a phone had 21 percent and 31 percent more start-up time respectively. Additionally, pedestrians in mixed-age groups had 14 percent more start-up time. Texting pedestrians were about two times less likely to glance prior to entering the crosswalk compared to undistracted pedestrians. Similarly, a pedestrian engaged in a phone conversation was about five times less likely to glance. These results may provide insight into the ongoing discussion on how to address distracted pedestrians crossing the street.

56. The Perception of Neighborhood Safety: Influential Factors

Marielle Saunders (University of Michigan)

Program: Advancing Transportation Leadership and Safety Center (ATLAS) Summer Internship Program

Advisor: Chanam Lee, Landscape Architecture and Urban Planning

As the U.S. population grows older and more obese, encouraging physical activity among adults over 50 years old becomes ever more important. There are many health benefits associated with physical activity. Walking around one's neighborhood is one of the most common and convenient forms of physical activity. However, among older adults, one factor keeping some from walking is a lack of perceived neighborhood safety, whether crime, traffic, or injury related. This research examines the relationship between these three domains of perceived safety and objective measures of safety such as crash and crime rates, using the survey and GIS data collected from 179 adults over the age of 50 living in College Station and Bryan, TX. Relationships between perceived neighborhood safety and environmental features were also considered. These relationships were examined by using bivariate tests, as well as spatial analysis through ArcGIS. Potentially due to the limited sample size, not all tested variables showed significant associations with safety perceptions. Despite this, both the statistical tests and GIS maps suggest that providing traffic signals, crosswalks, and sidewalks, as well as improving neighborhood maintenance, can lead to better-perceived safety among older adults. Further tests, including multivariate tests, should be performed with larger sample sizes to offer stronger insights.

57. Development of a Smartphone Application to Evaluate Older Drivers

Zachary Snyder (University of Michigan)

Program: Advancing Transportation Leadership and Safety Center (ATLAS) Summer Internship Program

Advisor: Michael Manser, Texas A&M Transportation Institute (TTI)

Older Americans, the fastest growing population group, still rely heavily on personal vehicles for transportation, as driving represents an aspect of freedom and independence that is difficult to replicate. Currently, physicians receive limited information when confronted about an older patient's fitness to operate a vehicle; many physicians perform in-office assessments to observe driving skills, but these tests insufficiently evaluate a patient's driving behaviors. A physician may refer a patient to a certified driving rehabilitation specialist (CDRS), though these appointments are time-consuming, expensive, and availability may be scarce. An effective, accessible, and low-cost alternative for evaluating older driver fitness is needed; the development of a smartphone application for determining older driver fitness has been researched and modeled. An extensive review of literature was performed to research older drivers' health barriers, the nature of behind-the-wheel driving assessments, measurement capabilities of an Android smartphone, and methods used by physicians and driving specialists to define driving fitness. A conceptual model of the system of interaction between physicians and patients was developed, along with models describing functionalities of the smartphone application and results delivery platforms. Integration of a smartphone application to determine older driver fitness would bridge the gap between physicians, rehabilitation specialists, and families. The new system of medical staff interaction would be more objective and more direct when determining fitness to

operate a vehicle, as it would place the driver in a real-world driving environment and specific certain driving behaviors. Full application development is forthcoming, along with full-scale testing and validation.

58. Effects of Randomly Ordered Object Files at Compile Time on ARM Machine Performance

Dario Sanchez (Texas A&M University)

Program: CSE@TAMU REU

Advisor: Daniel Jimenez, Computer Science & Engineering

In this series of tests, our goal was to evaluate the performance variance caused by 1000 random orders of object files. As with much research in Computer Architecture, our goal was to find better orderings of object files which would improve performance on ARM architectures. Unlike work done with X86 architectures, the goal here would not be greater processing power, instead we seek efficiency. Because many of the smartphones and tablets we use today use ARM architectures, the intended gains would come in the form of efficiency leading to prolonged battery life, which has always been a concern with such mobile devices. This work centers on whether or not any random orderings can provide meaningful change in performance, and how to ensure that object files may be ordered in the most optimal way.

Session 2: Physical and Life Sciences
3:00 pm– 5:00 pm

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1. Effects of Environmental pH on *Amycolatopsis mediterranei* NSAR/OSBS Activity

Benjamin Machala (Texas A&M University)

Program: Independent Research Project

Advisor: Margaret Glasner, Biochemistry

Some members of the o-succinylbenzoate synthase (OSBS) enzyme family, part of the functionally diverse enolase superfamily, are capable of performing a promiscuous reaction, the racemization of N-succinyl amino acids (NSAR). Understanding which residues contribute to promiscuity could provide insight into the evolution of new protein functions. The first of these promiscuous enzymes characterized was from *Amycolatopsis sp.* T-1-60, making it the best characterized enzyme of the promiscuous NSAR/OSBS subfamily, and an ideal candidate for further investigation. Nearly all of the members of the OSBS family contain a hydrophobic residue (almost always isoleucine or valine) at the position homologous to residue 261 in the *Amycolatopsis* NSAR/OSBS, extending directly into the active site pocket. Nearly all members of the promiscuous NSAR/OSBS subfamily however, contain an asparagine in the equivalent position, suggesting that this residue may be important for promiscuous activity. Our current hypothesis is that this residue modulates the pKa of a nearby catalytic lysine, allowing it to both remove and replace a proton under physiological pH, a function necessary for racemization activity but not essential for OSBS activity. We are testing this by measuring the pH dependence of NSAR and OSBS activity for both wild-type and N261L mutant Amycolatopsis protein. Here we report the first step in this process, the baseline activity of wild-type protein across the 6-10 pH range.

2. Characterizations of the Effect of Selected Residues on OSBS and NSAR Activity in *Exiguobacterium sp.* AT1b

Shiv Patel (Texas A&M University)

Program: Independent Research Project

Advisor: Margaret Glasner, Biochemistry

Catalytic promiscuity, the ability of an enzyme to catalyze more than one reaction in the same active site, is widely accepted as one of the means by which proteins evolve new biologically relevant functions. Some members of the o-succinylbenzoate synthase (OSBS) family of proteins are also capable of catalyzing a promiscuous N-succinylamino acid racemization (NSAR) reaction. One of these enzymes from *Exiguobacterium sp.* AT1b (ExiOSBS) is capable of catalyzing OSBS reactions at biologically relevant levels (kcat/KM = 2.6×106 M-1s-1, but also weakly catalyzes the NSAR reaction (kcat/KM = 41 M-1s-1), making it an ideal candidate to study catalytic promiscuity as a model for protein evolution. We explored the effect of residues within the enzyme's active site on NSAR and OSBS activity. Upon ligand docking of the N-succinyl-D-phenylglycine substrate in a homology model of ExiOSBS, we noticed that residues I18 and Y284 differ from residues in the NSAR-efficient *Amycolatopsis* NSAR/OSBS. Further analysis of the active site residues showed that residues H22, A23, T132, L137, R290 and A313 were conserved in all other NSAR-efficient enzymes, but differed in ExiOSBS. OSBS assays showed that while mutations at most of these residues altered kcat and KM, their overall catalytic efficiencies for the NSAR and OSBS reactions remained very similar to wild type values.

3. What Is The Role of ATP in Molecular Clock Synchronization?

Joseph Donnelly (Texas A&M University)

Program: Algebraic Methods in Computational Biology REU

Advisor: Anne Shiu, Mathematics

The environment produces repetitive, predictable stimuli. The sun sets routinely each night, and animals adapt automatically by establishing subconscious sleeping patterns. Physiological patterns like this arise from oscillators known as molecular clocks. These biochemical timekeepers are present in nearly all of an organism's cells. Molecular clock synchrony is crucial to prevent weakening of their collective output. Recent investigation of brain cells in mice suggests a synchronizing role of ATP in the mammalian clock. The biochemical mechanism of synchronization via ATP remains unknown. Furthermore, instances in which ATP serves as a signaling molecule are exceedingly rare. The Scheper Model, a system of two delay differential equations, is used to simulate the interaction of ATP with the mammalian clock. I demonstrate theoretical feasibility of the synchronization process, and offer a method of quantifying synchrony between mammalian clocks. Jointly, these techniques yield predictive power and the potential to manipulate molecular clock synchrony at will.

4. Incorporating HDL Interaction into an ODE Model of Atherosclerosis

Diego Lopez (Texas A&M University)

Program: Algebraic Methods in Computational Biology REU

Advisor: Anne Shiu, Mathematics

Atherosclerosis is a cardiovascular disease characterized by the build-up of fatty plaques in the intima of an arterial wall following inflammation of the lining of the artery, which slowly lead to occlusion of the arterial lumen and hardening of the artery walls. One third of Americans over the age of 35 die each year of atherosclerosis of the heart and half of men and women over the age of forty are reported to have some form of this illness. The medical community has long recognized that the concentration profile of low density lipoprotein (LDL) and high density lipoprotein (HDL) in the blood plasma directly correlate to the risk of developing atherosclerosis. In this study, I review the details of the physiology of atherosclerosis, propose a simple ODE model following some reasonable assumptions, and present equilibrium solutions of LDL concentration, HDL concentration, and other important components of the system.

5. Characterization of MicroRNAs Secreted from *Drosophila* Fat Body and Their Effects on Potential Target Tissues

Jose Duran (Texas A&M University)

Program: CSE REU Site: Computing for Disasters

Advisor: Ginger Carney, Biology

Drosophila fat body (the insect adipose tissue) affects biological processes by influencing immunity, reproduction, behavior and nutrient homeostasis. However, little is known about the types of signaling molecules released by the fat body that are involved in these processes. MicroRNAs (miRNAs), which are 19-23 nucleotide non-coding RNAs that act as translation inhibitors by binding to the 3'UTR regions of target mRNAs, have arisen as key genetic regulators in diverse biological pathways. In mammals there is recent evidence for communication between several tissues by secreted miRNAs. We hypothesized that the insect fat body also secretes miRNAs involved in intercellular communication. Some miRNAs are expressed within the *Drosophila* fat body, but no complete miRNA expression profile exists for the fat body. In this project we will analyze the miRNAs expressed in the fat body and test whether these miRNAs are secreted into the hemolymph for targeting other tissues. Our long-term goal is to examine the expression of miRNAs secreted from fat body into hemolymph under various stress conditions to determine the impact of fat body secreted miRNAs on other tissues. By analyzing these miRNAs we expect to have a better understanding of the genetic communication between the fat body and other organs such as the central nervous system (CNS).

6. Taurine Diminishes Aging-Associated Hyperexcitability of the Mating Circuit in *C. elegans*

Michael Boachie-Mensah (Texas A&M University)

Program: Independent Research Project

Advisor: L. Rene Garcia, Biology

In vertebrates, the organic acid taurine is hypothesized to function as a non-canonical neurotransmitter and as an antioxidant. Here we use *C. elegans* male mating as a model to assess taurine's physiological role. Mating consists of motor sub-behaviors that entail the insertion of a male copulatory organ (the spicule) into the hermaphrodite vulva, leading to sperm transfer. These behavioral sub-routines are regulated by sensory-motor neurons that secrete acetylcholine and induce spicule protraction. However, as males age, the efficiency of these behaviors deteriorates due to hyperexcitability, resulting in decreased mating potency at day 3. Thus, taurine may modulate the circuitry excitability and ultimately improve mating behavior in older males. To address if taurine effects the spicule circuit excitability, we took a pharmacological approach. Bathing males in the acetylcholine-agonist arecoline (ARE) promotes artificial spicule protraction. Therefore, we tested whether combining taurine with ARE alters spicule protraction. We found that taurine does not co-regulate arecoline-induced protraction, but taurine pre-exposure diminishes the percentage of males that protracted their spicules. To test whether taurine decreases the aging-related decline, virgin males were grown in plates containing taurine or water for up to 3 days. These animals were then paired with hermaphrodites and the mating performance quantified. We found that taurine improves mating prowess in aged males. These results suggest that taurine is an important modulator of the effects of aging and represent a novel therapeutic avenue to treat aging-associated diseases.

7. Fruit Flies as a Model for Understanding Animal Metabolism and Energy Usage

Jason Mallett (Texas A&M University)

Program: Independent Research Project

Advisor: Ginger Carney, Biology

Although animal metabolism and energy usage are extensively studied, there are still many aspects of the process that remain a mystery. *Drosophila melanogaster* fruit flies serve as a general model for understanding genetic processes that can affect humans suffering from metabolic disorders. Flies that do not express fit have increased starvation resistance, signifying that fit may play an important role in metabolism. We hypothesized that flies that did not express fit ate more than their wild-type counterparts, providing additional nutrition that allowed them to survive starvation conditions. Our data do not support this hypothesis. Next, we hypothesized that the difference in starvation resistance between the two groups was a result of differences in the way food is metabolized. To test this hypothesis, we analyzed the ability of flies with or without fit to withstand starvation after being raised on diets with increasing protein content. The results showed that flies lacking fit are more susceptible to increasing protein than controls. Our data suggest that fit may interact with TOR signaling, a metabolic pathway conserved between flies and mammals, to regulate protein metabolism in fruit flies.

8. FIT is a Contributing Factor in the Lifespan of *Drosophila melanogaster*

Kassie Ruocco (Texas A&M University)

Program: Independent Research Project

Advisor: Ginger Carney, Biology

Metabolic disorders such as diabetes and obesity have become increasingly prevalent in humans. Regulating metabolism is important for proper functioning of the body because if optimal nutrient intake is not maintained, metabolic disorders can occur. The fruit fly *Drosophila melanogaster* is a good genetic model for studying metabolism because many of its metabolic pathways function similarly to those of other animals. An organism's current metabolic state can affect its ability to respond to stress. One major source of metabolic stress that we study is starvation and how the gene fit affects the fruit fly response. fit is expressed in adipose

tissue. We found that fit deficient flies live longer when starved, which signifies its importance for wild-type starvation. We tested fit deficient flies for changes in lifespan because starvation resistance is often coupled with increased longevity. The results showed that fit mutants live longer than their controls, indicating that fit expression has essential effects on lifespan. We hypothesize that the protein FIT modulates feeding behavior and activity levels via the central nervous system because FIT is secreted from the fat body. In response, there is an increased lifespan of the fit mutants.

9. Studying the Physiological Roles for Regulation of mRNA Stability by A 3'UTR Intron in the mRNA Specifying Eukaryotic Release Factor 1 (eRF1)

Matthew Theodore (Texas A&M University)

Program: Independent Research Project

Advisor: Matthew Sachs, Biology

Gene expression is an essential component to the proper functioning of an organism and many quality control mechanisms exist to maintain fidelity in gene expression. Eukaryotes use nonsense-mediated decay (NMD) as a process to increase fidelity by degrading mRNA arrested by a premature stop codon context which may otherwise result in a nascent polypeptide. mRNAs containing spliced introns in their 3'UTRs can be targets for the NMD pathway because the "normal" termination codon is assessed to be premature because of the downstream spliced 3'UTR intron. This study attempts to resolve the physiological roles for regulation of mRNA stability by a 3'UTR intron in the mRNA specifying eukaryotic release factor 1 (eRF1), which is the factor that physically recognizes stop codons in the ribosomes. Our laboratory previously demonstrated that the erf1 3'UTR with the intron confers NMD regulation to a reporter, while a matched intronless reporter does not. This work was done in the model fungus *Neurospora crassa*. Thus we hypothesize that regulation of erf1 levels by NMD is critical for maintaining proper expression levels of this gene to maintain physiological balance. Here we describe our molecular cloning approach to produce matched intron-containing 3'UTR and intron-lacking 3'UTR versions of erf1 in its endogenous context in the *N. crassa* genome.

10. Probing the Arrangement of TatBC Heterodimers in the TatBC Oligomer, the Signal Peptide Receptor Complex of the Tat Protein Translocation Pathway

Raaghav Bageshwar (College Station High School)

Program: Summer Research Program at Health Science Center

Advisor: Siegfried Musser, Molecular and Cellular Medicine

The Twin Arginine Transport (Tat) pathway transports fully-folded and assembled proteins in bacteria and plants. The minimal Tat components required for translocation in *Escherichia coli* are TatA, TatB and TatC. Tat signal peptides bind to the TatBC receptor complex in a hairpin configuration that reaches partway across the membrane. This binding interaction forms independent of the proton motive force (PMF). In the presence of a PMF, TatA assembles with the TatBC-precursor complex, and together form the conduit necessary for the bound precursor protein to be transported to the periplasm. The oligomerization state of the TatBC complex is not known. Electron microscopy studies have suggested that TatBC forms an octamer with the substrate binding site on the outside of the octamer. In contrast, a face-to-face dimer model was recently suggested in which the signal peptide binding sites face inside the complex. Here, we seek to test these two models by probing the accessibility of cysteine mutants to a membrane-permeable fluorescent dye ATTO-647N-malemide. Eight TatC single cysteine mutants that form a ring around the center of the TatC transmembrane structure were generated. Labeling of the TatC mutants in inverted membrane vesicles will be monitored by the fluorescence emission intensity of bands on SDS-PAGE gels. We expect that lipid-exposed cysteines will be accessible to the dye, and that cysteines within the interior of the TatBC oligomer or at protein-contact interfaces will be inaccessible.

11. Expression of the Transcription Factor Npas4 in the Brain of Adult Rats Based on Sex

Thomas Pelkmann (Texas A&M University)

Program: Summer Research Program at Health Science Center

Advisor: Ursula Winzer-Serhan, Neuroscience and Experimental Therapeutics

Development of proper excitatory/inhibitory balance is crucial for appropriate function of neuronal circuitry. Npas4 is a transcription factor which promotes the formation of inhibitory synapses on excitatory neurons, and fine tunes excitation onto inhibitory neurons. Thus, Npas4 regulates the excitatory and inhibitory balance within the brain. Investigating the basal expression of Npas4 in males and females could lead to greater insight to sex specific differences, which could contribute to the variation between the sexes in certain neurodevelopmental disorders. We hypothesize that Npas4 is differentially expressed in female and male brains, which may contribute to differences in the excitatory/inhibitory balance in male and female brains. In order to test this, four male and four female post-natal day 60 rat brains were processed through in situ hybridization. Radioactive sense and antisense cRNA probes for Npas4 were then synthesized using 35S-UTP with a linearized plasmid containing an Npas4 gene template. The radioactive signal was recorded by placing the slides on Kodak film, analyzed using the computer program MCID Basic, and statistics were determined using Statview. We found there was no difference in the localization of Npas4 expression between males and females. However, there were significant differences in expression intensity of Npas4 in multiple areas, with female brains having significantly less mRNA hybridization signal compared to males. Npas4 could play a role in sex differences in maintaining the excitatory/inhibitory circuitry balance. In particular, Npas4 could have an interesting role in neurological diseases that have different presentation between the sexes.

12. Testing Thermodynamic Compliance of Chemical Reaction Networks in Polynomial Time on Average

Meredeith McCormack-Mager (Texas A&M University), **Carlos Munoz** (Texas A&M University), **Zev Woodstock** (Texas A&M University)

Program: Algebraic Methods in Computational Biology REU

Advisor: Anne Shiu, Mathematics

Violations of the second law of thermodynamics often occur undetected in chemical reaction networks, leading to inaccuracy of the model. Beard et al. have given necessary and sufficient conditions for determining thermodynamic feasibility of flux vectors based on cycles of an oriented matroid derived from a reaction network's stoichiometric matrix. Their theorem implies an algorithm that requires computing all cycles of the oriented matroid, of which we show there are sometimes exponentially many. Such an algorithm would thus run in exponential time. We extend the ideas of Beard et al. to find a polynomial time algorithm for checking thermodynamic feasibility of a reaction network. Rather than relying on cycle computation, our algorithm instead depends on interior point methods for linear programming, which run in polynomial time in the worst case, and at most sub-linear time on average. As linear programming methods continue to improve, so will the efficiency of our algorithm. Of independent interest, we demonstrate several nice theorems for cycle computation.

13. Directed Assembly of Porphyrin Coulomb Islands by Nanografting and Click Chemistry

Erin Avery (SUNY Oneonta)

Program: Chemistry REU

Advisor: James Batteas, Chemistry and Material Science and Engineering

Erin Avery[1,2], Alison Pawlicki[3], Matthew Jurow[4], Charles Drain[4] James Batteas[2,3]
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Integrating electroactive molecules like porphyrins into existing CMOS technologies provides a means of using the definable electronic states of molecules to influence device functionality. Porphyrins are a good candidate for this because they are synthetically tailorable, aromatic, robust, and exhibit reversible oxidation/reduction states. Examples include field effect gating in semiconducting nanowires for chemical sensing and charge trapping for memory cells. Previously we demonstrated that while single molecules of porphyrins attached to Au surfaces by alkanethiol tethers show tunneling behavior, ensembles can form pi-stacked islands, that undergo a change in charge transport mechanism to charge hopping, whereby the island size and its associated charging energy influences the transport mechanism. Controlling island size may afford exquisite control over the transport behavior. Islands of random dimension can be formed using self-assembly approaches, but to test this hypothesis in detail, a two-step process has been developed to form porphyrin islands of controlled size for modulation of electronic properties by molecular assembly. First, Atomic Force Microscopy (AFM) was used to nanograft pentanedithiol islands (5x5 nm to 600x600 nm in dimension) into a background of dodecanethiol on Au(111) films. The nanografted pentanedithiol templates were immersed in 1 mM solutions of 5,10,15-(tripyridyl)-20-(pentafluorophenyl)porphyrin (TPPF5), where the pendant fluorphenyl ring of the porphyrin could selectively react with the exposed thiol on the grafted island via a click reaction. Details of patterning, assembly process, and structures formed using this approach will be described. Future work will include a systematic study of the effect of island size on the electronic properties.

14. Designing Polymer Supports to Minimize Leaching of Phase Separable Catalysts

Taylor Banks (Washington University in St. Louis)

Program: Chemistry REU

Advisor: David Bergbreiter, Chemistry

The recovery and reuse of catalysts is an objective of green chemistry that can be achieved using liquid/liquid biphasic thermomorphic systems and phase selective polymer-bound catalysts. In these thermomorphic systems, two immiscible liquids are heated until they become a single phase. Then a soluble polymer-bound catalyst effects a reaction. After cooling, the solvents become immiscible again. With an appropriate polymer, the catalyst and products will be in separate phases. However, some leaching due to inefficient separation of the catalyst from the product phase can occur, leading to unsustainable losses of catalyst. This presentation describes how polymer-bound dyes can be used as inexpensive surrogates of catalysts to study this leaching. Previously, our group investigated leaching of nonpolar phase selective polyisobutylene-bound dyes into the polar phase of these thermomorphic systems showing that this leaching can be lowered by altering the structure of the dye, the molecular weight of the polymer support, and the solvent choice. My studies expanded on this theme, using polyethylene glycol (PEG)-bound dyes. I showed that leaching extent of polar PEG-bound dyes varies with the structure of the dye, the size of the polymer support and with the nature of the two solvents. Using PEG 2000-bound dyes in mixtures of DMF, MeOH, 90%EtOH or acetonitrile with heptane, the leaching is below 0.15%. Future experiments will be carried out on dyes on other sizes of PEG. During this work, a new method of removal of excess phenol in Williamson ether syntheses was also developed.

15. Thermochemical Analysis of Intermolecular Vs. Intramolecular Reactions in Iridium Complexes

Alyssa Bienvenu (University of Louisiana at Lafayette)

Program: Chemistry REU

Advisor: Michael Hall, Chemistry

Photochemical activation of $Cp^*PPh_3IrH_2$ produces the Cp^*IrPPh_3 complex (1), which was studied for its ability to activate C-H bonds under mild conditions because such activation would open routes to important products directly from alkanes. As observed in experimental work, complex 1 in benzene undergoes both intermolecular and intramolecular C-H activation to produce products in a nearly 1:1 ratio. Literature suggests that the intramolecular reaction should be favored due to the high local concentration of the aromatic C-H bonds of complex 1. Density functional theory, including BP86, BP86GD3, and TPSSh functionals, was used to investigate the details of the intermolecular and intramolecular reaction mechanisms. The preliminary results on this reaction mechanism from a simplified model complex, $CpIrPH_2Ph$ (2), indicate that the 1:1 ratio is a kinetic effect as the final products are too stable to be in thermal equilibrium. The calculated activation energies, both electronic energy and Gibbs' free energy, for the C-H transition states favor the intramolecular mechanism over the intermolecular mechanism. Although all the transition states have not been determined for the experimental reactant 1, the increased steric requirements for this larger complex suggest that the two key activation energies would be even closer.

16. Towards Phase Transfer Activation of Fluorous Nickel(II) Polyethylene Catalyst

Stephen Bierschenk (Texas A&M University)

Program: Chemistry REU

Advisor: John Gladysz, Chemistry

Polyethylene constitutes 38% of the 190 million metric tons of plastics that are produced annually worldwide.[1] Meeting this huge demand for polyethylene requires consumption of valuable energy resources and provides an opportunity to propose new, more environmentally friendly methods. This project aims to make ethylene polymerization a more efficient process by increasing the activity of a known family of nickel(II) catalysts via fluorous phase transfer activation. This process involves the phase transfer of a highly fluorinated triphenyl phosphine to a perfluorinated phase, preventing it from competing with ethylene for the active site of the catalyst.[2] To meet the goals of this project, the imine ligand [[(2,4,6-(3,5-$(CF_3)2C_6H_3$)3-C_6H_2)-N=C(H)-(3-(9-anthryl)-2-O-C_6H_3) was synthesized in 16% yield by a multistep process which included a Grignard reaction, a Suzuki coupling and Schiff base reaction. The purity and structure of the ligand was confirmed using 13C{1H} and 1H NMR. Additionally, the Ni(II) source, $TMEDANi(Me)_2$, has been synthesized in 41% yield. From these two compounds, the nickel precatalyst will be synthesized and polymerization rate tests will be run. If successful, this strategy will reduce the amount of energy required to polymerize ethylene by increasing the catalytic rate of a family of nickel catalysts.

[1]Rappaport, H. Ethylene and Polyethylene Global Overview, Proceedings from the 2011 World Petrochemical Conference, Houston, Texas, May, 2011.
[2]Corrêa da Costa, R.; Gladysz, J. A. Adv. Synth. Catal. 2007, 349, 243-254.

17. Isotope Effects, Dynamic Matching, and Solvent Dynamics in a Wittig Reaction

Christoph Braccher (Texas A&M University)

Program: Chemistry REU

Advisor: Daniel Singleton, Chemistry

The mechanism of the Wittig reaction of anisaldehyde and a stabilized ylide was investigated by a combination of experiments and theoretical calculations. 13C kinetic isotope effects in acetonitrile were experimentally determined as 1.033 by NMR analysis at natural abundance, whereas theoretical calculations yield an isotope effect of 1.049 for the first transition state and 1.015 for the second. The calculation suggest predominant rate

control by the second step, whereas the experimental data show a significant degree of competition between rate limiting steps, indicating that the the transition state paradigm does not provide a good description of the Wittig mechanism. A correct mechanism must account for the observed presence of dynamic effects.

18. Synthesis of Imidazole-based Metal-Organic Frameworks for the Purpose of Carbon Capture

Mario Cosio (Texas A&M University)

Program: Chemistry REU

Advisor: Hong-Cai Zhou, Chemistry

Four imidazole-based metal-organic frameworks (MOFs) were synthesized from copper (II) nitrate salt via solvothermal methods. These MOFs demonstrated great stability in amine solutions of diisopropylamine, diethylamine, and triethylamine based on powder X-ray diffraction results. This stability afforded the opportunity to test whether these MOFs can be post-synthetically modified with alkyl amines to improve the carbon capture ability of the framework. Baseline measurements of the unmodified frameworks show BET surfaces areas from 108.7930 m^2/g (PCN-352) up to 2961.7273 m^2/g (PCN-353). CO_2 uptake measurements of the unmodified framework demonstrate a max uptake of 39.1667 cm^3/g and 17.1387 cm^3/g (PCN-354) at 273K and 295K respectively. Focus has now shifted to post-synthetic modification of the PCN-35x MOFs to increase amine functionality inside the pores of the MOFs.

19. Mononuclear First-Row Transition Metal Complexes with Potential Single-Molecule Magnetic Behavior: Testing Theory

Connor Daly (Shippensburg University of Pennsylvania)

Program: Chemistry REU

Advisor: Kim Dunbar, Chemistry

Single-molecule magnets (SMMs) possess many attributes of potential use for computer memory applications as well as computing functions. These memory applications are the result of the bistability of the molecule's spin states. The molecule must circumvent a thermal energy barrier in order to reverse its spin state, and this barrier is proportional to the total spin ground state and the magnetic anisotropy of the material. The magnetic anisotropy is known to provide a significant contribution to the height of this barrier. One recent theoretical model predicts that high-spin mononuclear SMMs with specific geometries and certain valence electron counts may exhibit large anisotropy effects that would increase the height of the barrier. In my REU project, the model has been tested by synthesizing Fe(II), Co(II), and Ni(II) trigonal bipyramidal first-row transition metal complexes with a tris-(4-phenyl-3-aza-3-butenyl)amine (trenbn) chelating ligand. The model predicts that the Fe(II) and Ni(II) complexes will have a large negative anisotropy value and that the Co(II) complex will exhibit a large positive anisotropy value. Initial magnetic studies performed on the Fe(II) and Co(II) suggest that the molecules show the beginnings of signals indicative of SMM behavior at very low temperatures.

20. Tetraphosphine Linkers with Tetrakis(biphenyl)silane Cores for Immobilizing Catalysts on SiO_2

Kevin Dong (Texas A&M University)

Program: Chemistry REU

Advisor: Janet Bluemel, Chemistry

The research performed during this REU program was focused on immobilized catalysts. For example, Wilkinson's catalyst was coordinated to a rigid tetrahedral scaffold linker incorporating biphenyl spacers and immobilized on SiO_2. The immobilization facilitates the separation and recyclability of the catalyst. It can also prevent common catalyst deactivation pathways seen in homogeneous systems such as catalyst dimerization. This has been proven by the previous success of the rigid scaffolds with tetraphenyl element cores by the

Bluemel group. The new biphenyl scaffolds are highly advantageous for the lifetime of the catalyst, because of features like increased distance from the metal to the reactive silica surface. First we synthesized and characterized multiple tetraphosphine scaffolds (R = Cy, Ph, iPr, tBu) with biphenyl moieties. Measurements with solid-state NMR helped determine that the scaffolds are immobilized with three phosphines bound to the surface with one remaining for coordination of a metal complex. After addition and ligand exchange with Wilkinson's catalyst, hydrogenation experiments were performed. 1-Dodecene was hydrogenated to dodecane in toluene. The catalyst begins initially as an orange solid. After it is placed under a H_2 atmosphere, it quickly becomes yellow, but is not active until formation of nanoparticles.

21. Possibility of Generating Hydrated Electrons from Doped Quantum Dots

Jeron Estwick (Southern Adventist University)

Program: Chemistry REU

Advisor: Dong Son, Chemistry

Quantum dot's optical properties make them a prime interest in photo catalysis. Mn doped quantum dots have a relatively long excited state compared other quantum dots that can produce high energy electrons, called hot electrons. The goal of this research is to test if Mn doped CdS/Zn Core/Shell quantum dots can generate hydrated electrons from a continuous wave laser as opposed to a pulsed laser. A hydrated electron is generated when a hot electron absorbs more energy which allows it to separate completely from the quantum dot into the surrounding water. This electron is then free to react with other species in solution. Hydrated electrons have a distinctive absorption spectrum but are short lived and generate a weak signal. A lock in amplifier is being used to measure the absorbance of an aqueous quantum dot solution under various excitation conditions.

22. Effect of CyaY on Iron Sulfur Cluster Assembly

Steven Havens (Texas A&M University)

Program: Chemistry REU

Advisor: David Barondeau, Chemistry

Iron sulfur clusters (Fe-S) are utilized by most living organisms in such critical processes as electron transfer, radical generation, sulfur donation, and regulation of enzyme activity. The human protein frataxin (FXN), the loss of which has been shown to lead to the neurodegenerative disease Friedreich's ataxia, activates the human Fe-S cluster biosynthesis. However, the bacterial homologue of FXN, CyaY, has been shown to inhibit the bacterial Fe-S cluster biosynthesis. However, CyaY had previously been shown to not affect the cysteine desulfurase activity of the bacterial cysteine desulfurase IscS, which actually provides sulfur for the cluster biosynthesis. Therefore we think CyaY must slow down the sulfur transfer step from IscS to scaffold protein IscU. Here we are testing our hypothesis by measuring the rate of formation of IscS and IscU persulfide in presence and absence of CyaY using a novel method involving [35S]-cysteine to detect persulfide and HPLC under acidic conditions to separate IscS and IscU persulfide. Our result clearly indicates that CyaY actually does inhibit the sulfur transfer step with a hint that it might also slow down cysteine desulfurase activity, which the traditional assay failed to demonstrate.

23. Doping Complex Oxides: Consequences for Electronic Structure

Joshua Jude (Texas A&M University)

Program: Chemistry REU

Advisor: Sarbajit Banerjee, Chemistry

Significant progress has been achieved in controlling the size, morphology, and crystal structure of metal oxide nanocrystals, but insight into modulation of electronic structure through dopant incorporation remains underexplored. Here, we examine the significance of anionic and cationic doping of complex metal oxides with reference to specific functional applications in energy conservation. The first thrust considers the anion doping of vanadium(IV) dioxide with sulfur in order to decrease the transition temperature for the structural

phase transition between the monoclinic (infrared transparent) and tetragonal (infrared reflective) phases for use in stimuli-responsive coatings. It is shown that sulfur doping is a very successful method for modifying the concurrent electronic and structural transition in this material, although further fine-tuning is needed to optimize the transition temperature for "smart window" applications. The second research thrust entails doping of lanthanum oxychloride (LaOCl) with luminescent Ln^{3+} ions in order to create photoluminescent nanomaterials for deployment within phosphors. It is shown that doping Tb^{3+} and Eu^{3+} ions into LaOCl yields nanocrystals that luminesce in the green and red regions, respectively, of the electromagnetic spectrum upon ultraviolet excitation. Such luminescent nanoparticles are vital for the construction of phosphors required for solid-state lighting applications. The ability to modify electronic structure in addition to size and morphology using dopants allows for unprecedented opportunities for tuning phase stabilities and thus functional properties of complex oxides and oxyhalides.

24. Design and Synthesis of High Crystalline Amine-functionalized Covalent-Organic Frameworks for Carbon Capture

Steven Klawinsky (Texas A&M University)

Program: Chemistry REU

Advisor: Lanfang Zou, Chemistry

Atmospheric carbon dioxide levels are rising and not only are they a major environmental concern, but the current way of removing them through using amines is expensive and becoming less practical in application. Herein we present a strategy to synthesize three amine-functionalized covalent organic frameworks, a-COF-1, a-COF-2, and a-COF-3. They were analyzed through gas uptake measurements of N_2 and CO_2. a-COF-1 and a-COF-3 were reduced with $NaBH_4$ to increase their ability to capture carbon dioxide. Given the results presented and their properties, these new materials show great potential for practical CO_2 capture.

25. Unraveling the Origin of Enantioselectivity in SPINOL-Phosphoric Acid Catalyzed Syntheses of 2,3-Dihydroquinazolinones

Croix Laconsay (Marist College)

Program: Chemistry REU

Advisor: Steven Wheeler, Chemistry

Chiral phosphoric acids have received a lot of recent attention due to their excellent performance in asymmetric catalysis. Here, the origin of enantioselectivity in a catalytic asymmetric synthesis of 2,3-dihydroquinazolinones by Huang and co-workers is explored (ACS Catal. 2013, 3, 2244). In their study, 2,3-dihydroquinazolinones (DHQZ's) were synthesized with high enantioselectivity using SPINOL-derived chiral phosphoric acid catalysts. The wide use of DHQZs in pharmacological activities make them a highly sought after synthetic target. However, preventing racemization of DHQZ's has remained an ongoing challenge. Using density functional theory calculations, we show that the enantioselectivity of this reaction is determined during the rate-limiting transition state of the cascade sequence involving stereoselective intramolecular amine addition which affords the final cyclic product. Aspects of stereoselectivity involving non-covalent interactions of particular substituent configurations are explored. The high enantioselectivity of aryl R-groups and ortho substituents on the R-groups is caused by the presence of strong non-covalent interactions between the catalyst and the substrate.

26. Towards Quinacridone-Stimuli-Responsive Polymer Gels

Kathleen Larson (University of California, Merced)

Program: Chemistry REU

Advisor: Yen-Hao Lin, Chemistry

Central to this research project is the ability to highly tailor stimuli-responsive polymers. These polymers have numerous applications in the biomedical field[1], as viscosity modifiers[2], and in the field of engineering[3]. Using quinacridone and (poly)ethylene glycol as the base for polymer synthesis allows for the production of alternating “hard-soft” polymer chains. The mobility of PEG and the complimentary hydrogen bond donor-accept pair of quinacridone make for the ideal polymer synthesis. Modifying the molecular weight of PEG modifies the dynamic response. This project covers significant progress made towards the development of stimuli-responsive polymers.

27. Mesostructured Surfaces for Water/Oil Separation

Sean Martens (SUNY Geneseo)

Program: Chemistry REU

Advisor: Sarbajit Banerjee, Chemistry

We have developed an inorganic membrane for oil/water separation derived from a ZnO coating on stainless steel meshes. The morphology of the zinc oxide tetrapod nanostructures display orthogonal wettability based on interfacial energies and mesoscale surface topology. The ZnO tetrapods possess a high surface area and promote interfacial interactions in the Cassie-Baxter regime for water. Conversely, long chain alkanes (oils) flash spread on the mesh and permeate through, resulting in separation. The surface energy was tuned with a fluorinated self-assembling monolayer (SAM) to create a second higher surface energy material that is oleophobic, and shows promising coating applications for oil tanks and pipelines.

28. Characterization of a High Speed Gas Flow Using NO_2 Fluorescence in the VENOM Technique

Madison McLivoy (Texas A&M University)

Program: Chemistry REU

Advisor: Simon North, Chemistry

The measurement of stereoscopic velocimetry simultaneously with two dimensional temperature measurements is valuable for characterizing flows pertinent to combustion and hypersonics. We present an extension of the previously demonstrated VENOM (Vibrationally Excited Nitric Oxide Monitoring) technique by expanding our ability to characterize a high speed gas flow field by extending the velocity determination to the out-of-plane component. Previous reports have demonstrated VENOM as a viable technique to simultaneously characterize two dimensional velocity and temperature. Here we present three dimensional velocimetry and two dimensional temperature using 2.5% NO_2 in Nitrogen in a Mach 6.2 flow nozzle in an isentropic flow. This was accomplished using two additional angled ICCD cameras to capture the time-delayed images com-pared to the original VENOM technique. A well calibrated out-of-plane flow was generated using a small aluminum wedge in a uniform high speed flow.

29. Synthesis of Metal Heterostructure Nanocrystals

Jennifer Miller (Youngstown State University)

Program: Chemistry REU

Advisor: Matthew Sheldon, Chemistry

Metal semiconductor heterostructure nanocrystals exhibit unique optical properties that make them desirable in applications ranging from photovoltaic cells to molecular imaging studies. This study explores the growth of gold on cadmium sulfide (CdS) and cadmium selenide (CdSe) nanorods, as well as the synthesis of cesium lead bromide perovskite nanocrystals. Gold deposition was successfully achieved on both CdS and CdSe nanorods. Furthermore, the amount and position of gold deposited on the CdS nanorods were tuned by varying reaction time and precursor concentration. Future work will focus on optimizing gold deposition parameters on both CdS and CdSe nanorods, and designing a synthetic procedure for gold deposition on cesium lead halide perovskite nanocrystals.

30. Tagging Alcohols on to Polycarbonates Derived From Carbon Dioxide and 3,4-epoxy-tert-butyl-3-butenoate

David Rosenbaum (Texas A&M University)

Program: Chemistry REU

Advisor: Donald Darensbourg, Chemistry

With carbon dioxide emissions on the rise it is imperative that there be developments to reduce the accumulation of this greenhouse gas in the atmosphere. Currently CO_2 has been proven to be a renewable C1 feedstock in the production of polycarbonates by its catalytic coupling with epoxides. While some CO_2-based polycarbonates have been commercially available, their hydrophobicity has limited their applications, especially in biomedical areas. There is thus an active interest in expanding the utilization by increasing their hydrophilicity. A strategy to address this would be to carryout post-polymerization functionalization to introduce hydrophilic groups. Herein, we present our work involving the use of 3,4-epoxy-tert-butyl-3-butenoate in the CO_2/epoxide coupling reaction. The resulting copolymer can be modified to bear ester groups via deprotection of the butenoate followed by esterification with desired alcohols. These polycarbonates have been successfully characterized by NMR spectroscopy, gel permeation chromatography and differential scanning calorimetry. Further transformation to result in a hydrophilic polymer will be discussed.

31. Kinetic Isotope Effects and Dynamics for Friedel-Crafts Acylation

Ashley Sanchez-Santiago (University of Puerto Rico at Humacao)

Program: Chemistry REU

Advisor: Yexenia Nieves, Chemistry

Ashley A. Sanchez-Santiago[a,*], Yexenia E. Nieves-Quinones[b] and Daniel A. Singleton[b]
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Electrophilic aromatic substitution reactions of veratrole were studied by a combination of experimental kinetic isotope effects (KIEs), standard theoretical calculations, and dynamic trajectory calculations. The acylation of veratrole using aluminum chloride exhibits an inverse intramolecular $^{12}C/^{13}C$ kinetic isotope effect of 0.990-0.991 and an intermolecular isotope effect of unity. However, the acylation of veratrole using silver perchlorate, showed an intramolecular $^{12}C/^{13}C$ kinetic isotope effect of unity. This difference in the KIE indicates that the nature of the active electrophile has changed with the differing catalysts. In addition, various product ratios were measured for the acylation of butyl phenyl ether, in order to see if a change in the catalyst will affect the product distribution. Results showed that, in fact, the product ratios depend on the catalyst employed. All these results are inconsistent with the conventional mechanism, and they implicate dynamic control of the regioselectivity subsequent to the rate-limiting step.

32. Hydroxyl Radical Footprinting of the Human Fe-S Cluster Assembly Complex

Katherine Senn (University of Wisconsin Oshkosh)

Program: Chemistry REU

Advisor: David Barondeau, Chemistry

Iron-sulfur (Fe-S) clusters are protein cofactors that are found in all living organisms and have a variety of functions including electron transfer, substrate activation, and regulation of gene expression. In humans, the synthesis of Fe-S clusters primarily occurs in the mitochondria and requires an assembly complex composed of NFS1, ISD11, ISCU2 and FXN subunits. NFS1 and ISD11 function as a cysteine desulfurase to deliver sulfur to ISCU2 where iron and electrons (from ferredoxin) are used to build a cluster. This process appears to be regulated by FXN. Importantly, mutations in any of these genes are related to human disease. Currently, limited information is available about the assembly complex; therefore, to determine structural information about the assembly of the complex, we implemented a method to investigate protein-protein interactions using hydroxyl radical labeling of solvent-exposed amino acid residues. We designed a flow cell and optimized the conditions for amino acid oxidation by hydroxyl radicals, which originate from the splitting of hydrogen peroxide by a 248 nm KrF laser. The proteolytic fragmentation of the Fe-S assembly proteins was optimized to maximize the amino acid coverage observed by mass spectrometry. MALDI and LC-ESI mass spectrometry methods were explored to determine the ideal way to detect oxidation of the proteins. Alternate methods to explore structure and function were also employed, and included mutagenesis, activity assays and spectroscopic methods. Together, these results contribute to our understanding of the eukaryotic Fe-S assembly complex with potential implications in human disease.

33. Quantifying the Strengths of Dual Hydrogen Bonding Organocatalysts

Jacqueline Shea (Texas A&M University)

Program: Chemistry REU

Advisor: Steven Wheeler, Chemistry

Despite the importance of dual-hydrogen-bonding organocatalysis, the optimal hydrogen-bond donors for various common functional groups remain unknown. Additionally, the relationship between the ability of a given organocatalyst to form strong hydrogen bonds with the substrate and the resulting catalytic activity is unclear. These relationships can be studied by using modern tools of computational quantum chemistry to quantify the effects of dual-hydrogen-bonding organocatalysts in model reactions. Complexes of 25 dual-hydrogen-bonding organocatalysts with methyl vinyl ketone (MVK) and nitroethylene (NE) were studied, along with the corresponding organocatalyzed Diels-Alder cycloaddition of MVK with cyclopentadiene and the Friedel-Crafts alkylation of NE with indole. Overall, the results reveal key relationships between catalyst binding energy and catalytic efficacy, while also providing quantitative information about the hydrogen bond strengths and transition state lowering ability of a wide range of model catalysts for these two reactions.

34. Synthesis of Indolocarbazole Based Small Molecule: Towards Donor-Acceptor Type Ladder Polymers

Julia Taylor (Texas A&M University)

Program: Chemistry REU

Advisor: Lei Fang, Chemistry

The use of Donor-Acceptor type ladder polymers as semiconducting materials in optoelectric devices has been widely explored by many to increase the efficiency of these devices and also to decrease the cost required for manufacturing. As such, the construction of indolocarbazole with benzothiodiazole units is reported as a A-D-A type small molecule, which has many ideal qualities needed for use in organic photovoltaic devices. The synthesis reported is a facile, and versatile method utilizing Suzuki coupling reactions and ring closing metathesis to construct defect-free small molecules, and in the future, ladder polymers.

35. Evaluation of AziA3-ΔKR in Azinomycin Biosynthesis

Matthew Terra (The University of Texas at Tyler)

Program: Chemistry REU

Advisor: Dr. Coran M. H. Watanabe, Chemistry

Azinomycin B which is produced by Streptomyces sahachiroi has shown to possess potent anti-tumor activity. This occurs when this secondary metabolite forms interstrand crosslinking within the grooves of DNA. Azinomycin is of great interest due to this ability however the complete biosynthesis of this natural product is not known. This experiment hopes to help shed light on how the disruption of the ketoreductase (KR) domain affects the timing of the biosynthesis of the epoxide moiety in azinomycin B. Here we report the construction of the disruption plasmid pKC 1139-AziA3KR for the disruption of the KR domain.

36. Tunable Platforms for Charge Transfer: Integrating CdS Quantum Dots with Ternary Vanadium Oxides

Kelly Nieto (Texas A&M University)

Program: Chemistry REU

Advisor: Kate Pelcher, Chemistry

Photoelectrochemical cells (PECs), which harness sunlight to produce O_2 and H_2 from water, have emerged as one of the most promising methods of utilizing solar energy. Integrating nanocrystalline materials as tunable platforms in PECs allows for control of the energetic offsets of the platform and facilitates modulation of the thermodynamics and kinetics of directional charge transfer. β-Pb$_x$V$_2$O$_5$ nanowires are a prime candidate for charge transfer due to the presence of a midgap state situated between the conduction and valence bands that is minimally positive to the water reduction potential, potentially allowing for hole transfer. Once these nanowires are interfaced with various II-VI quantum dots, the QD/β-Pb$_x$V$_2$O$_5$ heterostructures can then potentially be used in PECs. CdS/β-Pb$_x$V$_2$O$_5$ heterostructures were synthe-sized using successive ionic layer adsorption and reaction (SILAR), a chemical bath deposition method that can be cycled numerous times to control quantum dot growth. V_2O_5 nanowires are used as the control in this process because the un-doped nanowires do not possess a midgap state, and thus serve as an appropriate control. Scanning electron microscopy, transmission electron microscopy, Raman spectroscopy, and energy dispersive x-ray spectroscopy were used to character-ize the prepared heterostructures. CdS/ β-Pb$_x$V$_2$O$_5$ heterostructures were successfully synthesized, indicating that SILAR is an effective mean of controlling the deposition and composition of the quantum dot over layer.

37. Kinetics of Absorption and Desorption of Phenanthrene

Marilyn Wisler (Texas A&M University)

Program: SEAWATER Summer Research Program

Advisor: Tony Knap, Oceanography

In this experiment, the absorption and desorption rates of phenanthrene on silicone substrates will be determined in seawater. Phenanthrene is an example of a three-ringed polycyclic aromatic hydrocarbon (PAH) that is somewhat soluble in seawater. PAH are created from incomplete combustion. When disasters such as oil spills occur, PAH found in crude oil bring a hazardous threat to nature. PAH research can provide insight into the impacts of harmful contaminants in the environment. Knowledge of their absorption and desorption rates on silicone substrates can help scientists estimate the effects these contaminants can have on living things such as corals and oysters when used in dosing experiments, and also for use as passive samplers, as silicone and corals and oysters behave similarly with PAH exposure. Specific to this experiment, if an oil spill were to occur scientists can gain knowledge of the number of organisms that could perish and/or know the maximum time they have to stop a spill from spreading so that organisms do not perish.

38. Range Expansions of an Invasive Vine, Japanese Honeysuckle (*Lonicera japonica*), in Eastern Texas Forestlands From 2006 to 2011

Erin McGrew (Texas A&M University), **Sara Stephens** (Texas A&M University)

Program: Independent Research Project

Advisor: Hsiao-Hsuan Wang, Wildlife and Fisheries Sciences

Biotic invasion has become a critical issue in most ecosystems word-wide. In the twentieth century, the U.S. alone has experienced a huge economic loss due to the presence of non-native species. Many studies have shown that eastern Texas forestlands is the area of primary concern with regards to the invasive plant species. Japanese honeysuckle (*Lonicera japonica*) was the most aggressive invasive vines in eastern Texas forestlands in 2006 and can have negative effects on the native vegetation of the communities in which it is prevalent. Hence, the objective of this study is to quantify the range expansion of Japanese honeysuckle in eastern Texas forestlands. Our method is to analyze an extensive data set (Southern Nonnative Invasive Plant data Extraction Tool) collected as part of the Forest Inventory and Analysis Program of the U.S. Forest Service from 2006 to 2011. Our results indicated the presence of Japanese honeysuckle on sampled plots almost double during this period (from 352 plots to 615 plots) and about 46% of original invaded plots (162 plots) increase the Japanese honeysuckle coverages. Japanese honeysuckle spread extensively toward north. Our quantification of the recent trends in range expansions suggests that Japanese honeysuckle will continue to threaten eastern Texas forestlands.

39. Post-wildfire Comparison of the Herpetofauna in Burned and Unburned Areas Near Bastrop, Texas

Aminta Arevilca (Texas A&M University), **Kaitlyn Forks** (Texas A&M University), **Erin McGrew** (Texas A&M University), **Thanchira Suriyamongkol** (Texas A&M University)

Program: Independent Research Project

Advisor: Hsiao-Hsuan Wang, Wildlife and Fisheries Sciences

Large wildfires, such as the one that occurred in 2011 near Bastrop, Texas, are natural phenomena that can impact native fauna by altering their habitats. The objective of this study is to compare the number and relative abundance of amphibian and reptile species in areas burned in 2011 with those in unburned areas near Bastrop. We sampled weekly over the two-month period from June to July using PVC pipes and cover-boards placed around each of four ponds. Species trapped were *Hyla cinerea*, *Hyla versicolor*, *Acris crepitans*, *Rana sphenocephala*, *Scincella lateralis*, *Incillius nebulifer*, and *Cnemidophorus sexlineatus*, including a total of 73 amphibians and 2 reptiles. Approximately 61% of the individuals were trapped in the burned areas. Based on the preliminary results, our study suggested that individuals of several species may be using the PVC pipes and cover-boards as alternative habitats in burned areas.

40. The Journey of a Thousand Milestones Begins with One Step: Evidence-based Strategies for Sustaining Diversity in Academic Careers in the STEM Fields

Lori Schuetze (Texas A&M University)

Program: Independent Research Project

Advisor: Adrienne Carter-Sowell, Psychology

Leveraging diversity is one of our nation's most pressing economic imperatives for the Science, Technology, Engineering, and Math (STEM) fields. To achieve this goal, we must increase the number of underrepresented racial and ethnic minority (URM) graduate students in STEM doctoral degree programs. A broad spectrum of research has been devoted to tracking the flow of recruitment and retention of underrepresented students into academic careers. A pilot study was conducted as part of a five-campus, Texas A&M University System (TAMUS) social science studies research program under the National Science Foundation's Award No. HRD - 1308144, 1308163, 1308149, 1308080, 1308200. The objective of this research plan is to foster an improved

climate for diversity and interdisciplinary scholarship on the Texas A&M University campuses. In the initial study, we administered a questionnaire to TAMUS STEM field graduate students (n = 44). The self-reported data was calculated to provide aggregated ratings of graduate students' 1) sense of community at the department level, 2) social belonging at the lab level, and 3) leadership from the primary faculty advisor. The results indicated that students across the five campuses reported a relatively positive attitude in relation to social belonging at the lab level and leadership from their primary faculty advisors. In contrast, across campuses, students' sense of community at the department level varied from 'somewhat satisfied' to 'somewhat dissatisfied.' The work from this pilot study is being used to develop the longitudinal, mixed methods research design and data collection scheduled for the 2015-2016 academic year.

41. IRE1α Signaling Cascades in Macrophage Cells Control the Intracellular Lifestyle of *Brucella*

Olga Belyanina (University of Pennsylvania)

Program: Independent Research Project

Advisor: Paul deFigueiredo, Microbial Pathogenesis and Immunology

Brucella is a zoonotic bacterial pathogen that causes brucellosis, a disease of global consequence that induces acute and chronic symptoms in humans and animals. The pathogen can infect a wide variety of mammalian cell types. However, macrophage cells constitute a particularly important replicative niche. Here, we demonstrate that the activities of proteins in a host signal transduction cascade that includes IRE1α are critical for controlling the intracellular replication and subcellular trafficking of the pathogen in macrophage cells. In previous work, bone marrow derived macrophages from IRE1α-/- animals, or murine embryonic fibroblasts (MEFs) deficient in the IRE1α pathway proteins BAK/BAX or JNK1, displayed reduced intracellular replication and extrusion from host cells. I have extended these studies to show that the pathogen displays aberrant intracellular trafficking in IRE1α-/- BMDMs or BAK/BAX-/- or JNK1-/- MEFs, thereby implicating IRE1α in controlling this process. Taken together, the data indicate that IRE1α signaling cascades in macrophage cells control the intracellular lifestyle of *B. melitensis*. Because the examined molecules constitute targets for pharmacological development, this work also opens upon new therapeutic options for addressing brucella infection.

42. Development of the Focal Plane Detection System for the Future Gas-Filled Separator at the Cyclotron Institute

Erin Bertelsen (Dickinson State University)

Program: Cyclotron Institute REU

Advisor: Cody Folden, Cyclotron Institute

A focal plane detection system is being developed for use with the gas-filled separator previously known as SASSYER (Small Angle Separator System at Yale for Evaporation Residues) that will be installed at the Cyclotron Institute at Texas A&M University. This system will be used to study heavy ($Z \geq 90$) elements and features two 60x40 strip double-sided silicon detectors (DSSDs) and accompanying multiplexing read-out electronics. The DSSDs cover an area of 120 mm x40 mm and are read-out by fourteen 16-channel multiplexers (Mesytec MUX-16) that perform the function of a preamplifier, shaper, and leading-edge discriminator in one unit. The multiplexers are controlled by four "MUX drivers," each of which serves as a signal bus for multiple MUX-16 boards. The system allows a single 16-channel ADC to read the combined 200 strips of both DSSDs. A four peak source composed of Gd-148, Pu-239, Am-241, and Cm-244 was used to characterize the performance of the system, with a preliminary energy resolution of ~60 keV measured for the Am-241 alphas. This contribution will discuss the work performed in assembly of the test setup, optimization and performance check of the multiplexers, and the preliminary energy and position data collected with the α-source.

43. Simulation Study of Background Particles in the Muon Telescope Detector at the STAR Experiment at RHIC

Matthew Breen (Texas A&M University)

Program: Cyclotron Institute REU

Advisor: Saskia Mioduszewski, Physics & Astronomy and Cyclotron Institute

The newly constructed Muon Telescope Detector (MTD) at STAR studies the fundamental properties of the Quark Gluon Plasma (QGP) through the detection of muons, which have (relative to electrons) reduced Bremsstrahlung radiation, allowing for more precise measurements. It is important to examine the response of the MTD to background particles. The response is studied with simulated Ω and Φ particles, decaying into pions, kaons and protons (our background particles). These particles are embedded into real events (14.5 GeV Au+Au collision data), and then the tracks and MTD hits of the charged-particle decay products are simulated/reconstructed. The simulated particles have known kinematics and particle identifications, enabling targeted analysis of the MTD response to specified particles. The particles are subjected to the same analysis cuts applied to the muons to study their survival probability and the sensitivity of the MTD to the background particles. The distributions of the coordinates of the tracks projected to the MTD relative to reconstructed MTD hits are also analyzed and compared to actual data.

44. Electromagnetic Field Generation Using a Multiphase Transport Model in Heavy-Ion Collisions

Tianen Chen (Carleton College)

Program: Cyclotron Institute REU

Advisor: Che-Ming Ko, Cyclotron Institute

We computed the electromagnetic fields generated in heavy-ion collisions by using a Multi-Phase Transport Model (AMPT) simulation. For our simulation, we examined Au-Au collisions at various energies from 15 GeV to 200 GeV. We compare results to the electromagnetic field characteristics generated from the Heavy Ion Jet Interaction Generator (HIJING) model. In particular, we studied how variations on time, impact parameter, and the Quark-Gluon Plasma (QGP) can affect the evolution of the electromagnetic fields. Additionally, we found the distributions of the electromagnetic fields for different events produced by the AMPT model. In a previous study done by Deng et al., the interactions between the electromagnetic field and the QGP were not included. Currently, the magnitude of the conductivity of the QGP is debated. However, if the conductivity is significantly large, the QGP will be greatly influenced by the electromagnetic field and in turn, the QGP will contribute to the original electromagnetic field. Our results indicate a general correlation between AMPT and HIJING results.

45. Momentum Spectra of Bottomonium in the Heavy-Ion Collisions

Jordan Fox (Seattle University)

Program: Cyclotron Institute REU

Advisor: Ralf Rapp, Cyclotron Institute

Shortly after the Big Bang, the early universe consisted of a dense nuclear medium that took a short time to expand and form hadrons from quarks and gluons; this medium is called the quark-gluon plasma (QGP). It is believed that a QGP can be created in ultra-relativistic heavy ion collisions (URHICs), and that heavy quarks created early in the collision act as a probe of the QGP. We investigate models of producing bottomonium states in ultra-relativistic heavy ion collisions (URHICs) at RHIC and LHC energies in order to describe the regeneration of bottomonia from the QGP as it depends on transverse momentum. To simulate the evolution of the bottomonium abundance in URHICs, we rely on the results of a kinetic rate equation approach, which describes the number of bottomonia as it approaches equilibrium. We first implement a blastwave model to estimate the transverse momentum spectra of locally thermalized Upsilon meson 1S and 2S states, boosted by a flow field. However, since the Upsilon 2S is not fully thermalized in the QGP, we employ a quark

coalescence model in the calculation of its in-medium distribution. Finally, the total nuclear modification factor is calculated accounting for the interplay of suppression and regeneration mechanisms of bottomonia in heavy ion collisions as compared to proton-proton collisions at ATLAS.

46. A PYTHIA Simulation Study of Direct-Photon- and Pi0-Triggered Hadron Correlations in p+p Collisions at a Center of Mass Energy of 200 GeV in Comparison to STAR Data

Christopher Marble (Tarleton State University)

Program: Cyclotron Institute REU

Advisor: Saskia Mioduszewski, Physics & Astronomy

Heavy-ion collisions at the Relativistic Heavy Ion Collider (RHIC) have provided evidence for the existence of a new hot and dense state of matter called the Quark-Gluon Plasma (QGP). Proton-proton (p+p) collisions provide a baseline measurement in order to understand the properties of the QGP in heavy-ion collisions. Comparisons of jet yields in Au+Au collisions to those in p+p collisions are done to determine the attenuation of hard-scattered partons in the QGP. In this study, p+p collisions are simulated at a center of mass energy of 200 GeV using the PYTHIA 8.185 event generator. Jets are studied via two-particle azimuthal correlations, with the recoil jet analyzed via charged-hadron yields on the away-side (Δphi~Pi) of a Pi0 or a direct-photon trigger. The away-side charged-hadron per-trigger yields at mid-rapidity (|eta| < 1), for transverse momenta (pT assoc. > 1.2 GeV/c), are obtained for Pi0 and direct-photon triggers for |eta| <1 and pT Trigger > 8 GeV/c. The fraction of transverse momentum carried by triggered Pi0 from its hard-scattered ancestors is studied to understand the energy imbalance between the triggered Pi0 and the outgoing parton in p+p collisions. PYTHIA simulation results of the away-side charged-hadron yields, for Pi0 and direct-photon triggers, are in reasonable agreement with the data collected in p+p collisions at the STAR experiment.

47. Precise Measurement for the 109.3-keV M4 transition in 125m-Te: Extended Test of Internal Conversion Theory

Kenneth Ofodile (Texas A&M University)

Program: Cyclotron Institute REU

Advisor: John Hardy, Cyclotron Institute

We have extended our series of precision measurements of internal conversion coefficients (ICC) to the 109.3-keV, M4 transition in 125mTe. The goal of these measurements is to test the Dirac-Fock theoretical ICC calculations, particularly concerning the role played by the atomic vacancy, or hole, caused by the conversion process itself: Must it be explicitly included in the calculations, or can it be ignored as has often been done in the past? A sample of 99.9%-enriched 124mTe was prepared by our electro-depositing a layer of 1 μm tellurium oxide, 17 mm in diameter on a 10-μm thick pure aluminum backing and then activating the sample by thermal neutrons at the Texas A&M TRIGA reactor. Decay spectra were subsequently recorded for three weeks with our well-calibrated (±0.15% relative precision) HPGe detector. The ratio of K x-rays to 109.3-keV gamma rays was used to extract the K-shell ICC αK. Special care was taken to identify all contaminant activities and account in detail for any affecting the energy regions of interest. After correcting for impurities, the difference in attenuation and the Voigt shape of the K x-ray peaks, we determined αK(109.3)=185(7). While not in definitive disagreement with the calculations in which the K-shell atomic vacancy is ignored, αK(no hole)=179, our result is much closer to the calculated result when the vacancy is included, αK(hole)=186. This is consistent with previous results in our measurement series. We are currently striving to reduce the experimental uncertainty further.

48. Hard and Thermal Photon Absorption in a Quark-Gluon Plasma

Eric Palmerduca (Colgate University)

Program: Cyclotron Institute REU

Advisor: Rainer Fries, Cyclotron Institute

The direct photon spectrum in nuclear collisions is of interest as it holds information such as the temperature of the quark-gluon plasma (QGP) and of the hot hadron gas (HG) created. Re-interactions between emitted photons and the medium are often omitted in calculations due to the assumption that these photons' mean free path is significantly longer than the spatial dimensions of the fireball. This study tests the validity of this assumption by modeling hard and thermal photon reabsorption in a rapidly expanding and cooling fireball. Thermal photon production rates, calculated using complete leading order perturbative quantum chromodynamics (pQCD) for QGP and state-of-the-art rates for HG, are used to compute absorption rates of hard and thermal photons. The hot fireball of QGP and HG is simulated by ideal hydrodynamics. The spectrum and elliptic flow of these photons are calculated and compared both to p-p collisions and to data from ultrarelativistic heavy-ion collisions (URHIC) at the Relativistic Heavy Ion Collider (RHIC) and the Large Hadron Collider (LHC).

49. A Study of the Contribution from Non-Perturbative Effects to Di-jet Yields at Forward Rapidity

Anna Poulsen (University of Dallas)

Program: Cyclotron Institute REU

Advisor: Carl Gagliardi, Physics & Astronomy

It is well known that the spin of the proton is equal to ħ/2, but the internal structure of the proton and the spin contributions made by its parton constituents, especially gluons, remains enigmatic. By studying asymmetric pairs of jets produced in polarized proton-proton collisions produced at forward rapidity, more information about the spin contribution of the gluon can be attained. Next to leading order perturbative quantum chromodynamics calculations indicate that measurements of a pair of jets at forward rapidity with transverse momenta (pT) of 5 and 8 GeV/c can provide valuable additional information regarding the polarization of the gluons. However, these calculations do not include background contributions from initial-state radiation, underlying events, and beam remnants that can create additional particles, which appear in a detector as jets. In this study, PYTHIA simulations were used to analyze jets of stable final-state hadrons. A simple procedure is found to reject the background contributions. Most of the di-jets that remain can be matched to initial hard scattered partons with momentum fractions x2 of the order 10-3, and x1 of 0.4 or greater. These kinematics indicate that the remaining jet pairs will provide relevant information about the gluon's contribution to the proton spin. The information provided by this simulation will help prepare the way for future experiments at RHIC that will provide us with a better understanding of the proton's structure at the partonic level.

50. The Tin-132 Giant Dipole Resonance as a Constraint on Nuclear Matter Properties

Brandon Roach (University of Notre Dame)

Program: Cyclotron Institute REU

Advisor: Shalom Shlomo, Cyclotron Institute

Nuclear giant resonances provide a sensitive method for constraining the properties of nuclear matter (NM) - many of which have large uncertainties - and thereby improve the nuclear energy-density functional. In this work, self-consistent Hartree-Fock random-phase approximation (HF-RPA) theory was employed to calculate the strength function and energy of the isovector giant dipole resonance (IVGDR) in the doubly-magic tin-132 nucleus. Several (17) commonly-used Skyrme-type interactions were employed. The correlations between the IVGDR centroid energy and each nuclear matter property were explored, as were correlations between the nuclear matter properties and the tin-132 neutron skin thickness. Experimental data for the IVGDR centroid energy was used to constrain the symmetry energy density J and its first and second derivatives L and Ksym,

respectively, of NM. Further investigation, particularly of nuclides far from stability, will be needed to extend the nuclear energy-density functional to the extremes of density and neutron abundance found in neutron stars and astrophysical nucleosynthesis environments.

51. Distribution of Ions in Laser-Driven Fusion Reactions

MacKenzie Warrens (University of Dallas)

Program: Cyclotron Institute REU

Advisor: Aldo Bonasera, Physics & Astronomy and Cyclotron Institute

Experiments of laser-driven fusion reactions are important for many aspects, such as measuring the cross section of plasma. In the experiments at University of Texas the Texas Petawatt Laser irradiates deuterium clusters of various sizes suspended in 3He gas absorb laser's energy. The clusters undergo a Coulomb explosion, forming a hot plasma which initiates the reactions. This analysis studies two possible fusions: D(d, 3He)n and 3He(d,p)4He. Signals are recorded using a Faraday cup detector, then transformed and analyzed in energy space. In this work we investigate if the log-normal distribution is an appropriate description of the energy distribution of the ions. If the log-normal distribution is a good fit, the energy distribution can be thought of as chaotic enough to appear thermalized. The chaos may be due to many-body interactions over long distances, as well as the different charges and masses of the particles involved. Using the well known S-factor for the two reactions and the fits, the number of fusions is calculated and compared with experimental data.

52. Electrical Properties of Various Gas Mixtures for Active Target Detector Application

Daniel Yates (Pacific University)

Program: Cyclotron Institute REU

Advisor: Grigory Rogachev, Physics & Astronomy

Experiments with rare isotope beams (RIBs) open new opportunities to study properties of exotic nuclei and measure reaction cross sections relevant for nuclear astrophysics with radioactive ions. However, RIBs typically have intensities many orders of magnitude lower than conventional stable beams; this requires the development of new, more efficient detectors such as the Texas Active Target (TexAT) detector currently being developed at the Cyclotron Institute. With this detector, the target gas is also used as the active medium for tracking and energy loss measurements of charged recoils. Various gas mixtures will be used under different conditions and it is important that drift velocity and gas gain are well established. This study uses a time projection chamber with an applied electric field to measure drift velocity and electron gains of four gases to be used as targets in TexAT. The experimental values are then compared to simulation. Drift velocities of electrons were measured as a function of the electric field for each gas and pressure and then were compared to simulated values obtained from CERN's Garfield++ simulation package. The simulated and experimental drift velocities matched with root-mean-square deviations typically less than 10% for each pressure. These results provide important accuracy verification of the simulation programs and determine systematic uncertainties in track reconstructions with TexAT which rely on these simulations.

53. pAggieSpec: A Low-Resolution, Commercial Lens, Opictal Spectrograph

James Beck (Texas A&M University), **Timothy Costa** (University of Massachusetts at Amherst), **Gabriel Fuentes** (University of Florida), **Shae Hart** (Carnegie Mellon University)

Program: Astronomical Research and Instrumentation REU

Advisor: Darren DePoy, Physics & Astronomy

This summer, we were tasked with the design, construction, and testing of a low-resolution, optical spectrograph. The preliminary Aggie Spectrograph (pAggieSpec), is a low-cost instrument that uses off-the-shelf Nikon™ lenses, a mercury calibration lamp, and two CCD cameras. pAggieSpec will allow institutions

to provide quality instruments inexpensively. We found that pAggieSpec provides reliable spectra within the 4000-6000 Å range. Further testing needs to be done to extend the coverage over the full visible spectral range (4000-7000 Å).

54. A Search for Astrophysical Transients with a Small Aperture Telescope

Tarini Konchady (Johns Hopkins University)

Program: Astronomical Research and Instrumentation REU

Advisor: Lucas Macri, Physics & Astronomy

AggieCam is a wide-field, small aperture instrument that was used to survey young (<50 Myr), nearby (<150 pc) stellar associations for transiting exoplanets and eclipsing binaries. The data analysis is based on a difference-imaging pipeline in an attempt to increase eclipse detection capabilities. Difference imaging matches the image quality between two images of the same star field and subtracts them, leaving only the change in flux due to bona fide astrophysical events in the output image. This reduction method is highly sensitive to the detection of other astronomical events which were not part of the telescope's main science goal (i.e. stellar flares, asteroids or supernovae). These events, called transients, appear as correlated residuals on the differenced frames and can be easily detected against the background. An analysis of >200 hours of AggieCam data across all fields found 49 possible transients and 8 possible Near Earth Objects (NEOs). A preliminary reduction of follow-up observations from McDonald Observatory is also included.

55. Measuring the Stellar Kinematics of the Compact Galaxy NGC1270

Raina Musso (Southwestern University)

Program: Astronomical Research and Instrumentation REU

Advisor: Jonelle Walsh, Physics & Astronomy

NGC 1270 is a nearby elliptical galaxy that is compact with a large stellar velocity dispersion. We observed NGC1270 in the near-infrared with the 10 meter Keck I telescope using the integral field unit OSIRIS with adaptive optics. This project focused on measuring the stellar kinematics as a function of spatial location within the galaxy. The galaxy is rapidly rotating with velocities of ±260 km/s. We find that the galaxy has high stellar velocity dispersions ranging from 300 km/s about an arcsecond away from the nucleus to values of 480 km/s at the center. Given the peaked velocity dispersion profile, this galaxy may host a very large supermassive black hole. Future work will include using these stellar kinematics to dynamically measure the mass of the black hole.

56. A New Method to Select Lyman Alpha Emitters at Redshift ~ 7

Shaquann Seadrow (Hampden-Sydney College)

Program: Astronomical Research and Instrumentation REU

Advisor: Casey Papovich, Physics & Astronomy

The Lyman-alpha emission line is the most natural transition produced by ionized neutral Hydrogen. It is practical for tracing ionizing radiation produced by intense star formation in young galaxies. Previous surveys find that the galactic Lyman-alpha emission collectively decreases in strength with increasing redshift (earlier ages of the Universe). This has significant implications at z~7, which is when Lyman-alpha is expected to be emitted as a result of the re-ionization of the Universe. In this study, we develop a method to select galaxies in the CANDELS fields that have strong Lyman-alpha emission by taking advantage of existing broadband Hubble and Spitzer photometry. By modeling the spectral energy distributions (SED) from objects with robust photometric redshifts, we determine the best-fit SED that is blind to the data around the Lyman-alpha line, thus allowing us to use the rest of the SED to make an upper-limit prediction of the Lyman-alpha. We find that Lyman alpha emission is more likely to be present in UV luminous galaxies. These Lyman-alpha emitting candidates will be pursued in an upcoming HST grism survey by P.I. Casey Papovich.

57. Processing Images from the Hubble Space Telescope and McDonald Observatory

Irene Vargas-Salazar (Louisiana State University)

Program: Astronomical Research and Instrumentation REU

Advisor: Kim-Vy Tran, Physics & Astronomy

We measure the brightness and colors of distant galaxies with imaging taken by the Hubble Space Telescope (HST). In order to use this data for analysis, the raw imaging data are corrected for cosmic ray contamination, astrometrically aligned, and combined in the three different filters that we use. With images in these filters, we generate Red-Green-Blue (RGB) color images and measure and catalog the fluxes for thousands of objects which can be used for more data analysis. Our method can be generalized to imaging from any telescope. To demonstrate, we also reduced imaging and produced a colored image of the Omega Nebula of Sagittarius in the Milky Way that was taken with the McDonald 0.8m telescope.

58. Searching for Gamma ray Emission from Rocky Bodies Around Nearby Stars

Darren Woodson (Kansas Wesleyan University)

Program: Astronomical Research and Instrumentation REU

Advisor: Louis Strigari, Physics & Astronomy

Using the Fermi Large Area Telescope (LAT) we report on the utilization of the LAT to find evidence of particle cascades produced by cosmic ray interactions with surfaces of rocky bodies around nearby stars. In order to test the capabilities of Fermi as a tool to detect these bodies we pointed at α Lyr looking for signs of γ rays emitting off any asteroid-like bodies associated with the debris disk. Using an energy range of 100 MeV to 100 GeV the closest source to α Lyr's coordinates, we found, is not associated with the star. Since no source was seen at these coordinates we concluded that the signal proposed to be there by these particle cascades is too faint to be detected by Fermi

59. Characterization of OSBS/NSAR Enzymes from *Amycolatopsis sp.* T-1-60 and *Lysinibacillus varians*

Asma Aziz (University of Houston – Downtown)

Program: Independent Research Project

Advisor: Margaret Glasner, Biochemistry

Promiscuous enzymes that can catalyze different reactions in same active site can evolve to provide new enzyme functions. The promiscuity model of protein evolution suggests that an enzyme can have a side reaction other than its native reaction. If a promiscuous side reaction is beneficial, it can evolve to become a new biological function. To study this process we have focused on the o-succinylbenzoate synthase (OSBS) family of enzymes, part of enolase superfamily. Many proteins in the OSBS/NSAR subfamily catalyze both OSBS activity and *N*-succinylamino acid racemization in the same active site. Our goal is to compare OSBS/NSAR activity with different enzymes, and use site-directed mutagenesis to study specific residues in a single protein. We performed site-directed mutagenesis on the 50s loop of *Amycolatopsis sp.* T-1-60, one of two flexible loops near the active site and compared the OSBS/NSAR activity with the wildtype. M50A and Y55A mutations were chosen because these two positions are in contact with the substrate in the active site. Our results show that the OSBS activity of Y55A mutant lowered by 8 fold compared to wildtype, but the NSAR activity was only lowered by 1 fold. For the M50A mutant both OSBS and NSAR activity was lowered by 3 fold as compared to wildtype. We also characterized a new protein from *Lysinibacillus varians* and discovered that it has both OSBS and NSAR activities. Based on genome context similar to the previously characterized *Geobacillus kautophilus* OSBS/NSAR this protein is likely bifunctional, where both activities are physiologically important.

60. Data Mining in EcoliWiki to Investigate Gene Expression in *E. coli*

Walter Lenoir (University of Texas at Austin)

Program: Biochemistry REU

Advisor: Jim Hu, Biochemistry and Biophysics

Cells adapt their gene expression levels when faced with differing physiological conditions. Quantitative methods to measure expression have been developed over the years in order to evaluate the molecular biological response to these conditions; complete sequences allow us to assess expression of all the genes in the genome instead of looking at them one at a time. Compiling cellular expression studies into a public resource will allow for individuals to have unique interpretation and comparison. EcoliWiki is a tool that gathers research done on *E. coli* K-12 and related strains of *E. coli*, including gene expression levels. Using EcoliWiki, data from two published studies were mined and compared. One study, from Link et al, used quantitative protein sequencing of proteins separated on 2-D gel methods to calculate specific gene expression levels. The other study, from Li et al. is based on inferring protein levels from synthesis rates measured by ribosome profiling. Our results show that the smaller dataset from the Link study is not well correlated with the Li dataset and while it is biased toward abundant proteins, it is not complete. The ribosome profiling method used in the Li dataset provides a much more complete view of the *E. coli* proteome. Additional data mining of the Li dataset revealed interesting expression trends in the different growth media.

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Featured Programs

Advancing Transportation Leadership and Safety Center (ATLAS) Summer Internship Program

ATLAS Center accepts students from the University of Michigan, Texas A&M, Polytechnic University of Puerto Rico, and University of Arkansas for a 10-week summer intern program. The internship includes active involvement on safety-related research projects with a mentor at the Texas A&M Transportation Institute.

Algebraic Methods in Computational Biology REU

Hosted by the Department of Mathematics, students in this program investigate mathematical models from three areas of mathematical biology: biochemical reaction networks, immunology, and neuroscience. The emphasis will be on systems amenable to analysis by algebraic and combinatorial methods.

Astronomical Research and Instrumentation REU

Hosted by the Department of Physics & Astronomy and the Mitchell Institute for Fundamental Physics and Astronomy students in this program conduct astronomical research with Texas A&M faculty and research staff. Possible fields of study in astronomical research include supernova, cosmology, the high-redshift Universe, Dark Energy, the cosmic distance scale, the Milky Way galaxy, and extrasolar planets.

Biochemistry REU

Hosted by the Department of Biochemistry and Biophysics, students in this program work under the direction of a Biochemistry and Biophysics faculty member to research topics including: structural biology, molecular genetics, genomics, enzymology and biophysics.

CANIETI

The English Language Institute (ELI) supports Texas A&M University's Engineering International Programs office in hosting graduate degree seeking students sponsored by a Mexican initiative called CANIETI (Cámara Nacional de la Industria Electrónica de Telecomunicaciones y Tecnologías de la Información). CANIETI is a pilot partnership to prepare Mexican students to apply to graduate school in the United States, potentially to Texas A&M. CANIETI, the Mexican National Chamber of Electronics and Telecommunication Information Technology, is the entity representing the electronic, telecommunications, and information technology sectors by promoting students' development in a global environment. By sponsoring students who will bring their global experience back to Mexico, CANIETI hopes to increase the competitive development of the national industry with legal sense and social responsibility.

Chemistry REU

The program, funded by the National Science Foundation, focuses on interdisciplinary projects in biological, green, and materials chemistry. In our program, students become full members of a research group, carrying out fundamental research on topics that span the chemical sciences.

CSE@TAMU REU, CSE REU Site: Computing for Disasters and DREU

Students are offered a specific project based on their interests and course work. They work with responders at Disaster City, learn about human-centered design in computing, and work with their faculty and graduate mentors on individual research projects.

Cyclotron Institute REU

The Texas A&M Cyclotron Institute, with support from the National Science Foundation, serves as a Research Experiences for Undergraduates site during the summer of each year. This REU site focuses on research in nuclear and

particle science. Students will have the opportunity to work closely with internationally renowned scientists at a major university-based nuclear facility.

Mechatronics, Robotics, and Automated System Design REU

Hosted by the Engineering Technology & Industrial Distribution, this National Science Foundation (NSF) Research Experiences for Undergraduates (REU) program provides opportunities for undergraduate students to learn about mechatronics, robotics, and automated system design. Program objectives are to help participants to understand the research process, to acquire laboratory skills, and to be well-positioned for graduate school and career success.

Research Experiences for Undergraduates (REU)

The National Science Foundation (NSF) funds a large number of research opportunities for undergraduate students through its REU Sites program. An REU Site consists of a group undergraduates who work in the research programs of the host institution.

SEAWATER Summer Research Program

The SEAWATER undergraduate research program will focus on "Observing the Ocean: hypoxia, harmful algae, oil spills and ocean acidification." Students will be introduced to research using data from ocean observatories and time series. Students will work in laboratories and on seagoing projects, with faculty and staff in Oceanography and at the Geochemical and Environmental Research Group (GERG).

Summer Research Program at Health Science Center

The purpose of the Summer Undergraduate Research Program is to give undergraduate students who have an interest in pursuing a future career in biomedical research the chance to work in academic laboratory and perform a research project during the summer. The College of Medicine Summer Research Programs also offer medical students the opportunity to work with a faculty mentor on research projects in basic or clinical disciplines.

Texas Center for Undergraduate Research in Energy and Propulsion REU

The Department of Mechanical Engineering hosts Texas Center for Undergraduate Research in Energy Propulsion Research Experiences for Undergraduates (REU) program. Students work alongside professors and graduate students conducting research on a broad range of topics related to energy and combustion science.

Undergraduate Summer Research Grant (USRG)

The purpose of the USRG program is to involve outstanding students who have completed their sophomore year and are interested in learning about undergraduate research and graduate school. Participants will make contributions to ongoing faculty research and, more importantly, gain an appreciation for and an interest in research.

The Undergraduate Research Poster Session is hosted by Honors and Undergraduate Research every summer to support the students and faculty involved in undergraduate research programs here at Texas A&M University. As a recognized "high impact practice," undergraduate research experiences increase undergraduate student learning and success, not only while students are at Texas A&M, but long after graduation.

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