SUMMER UNDERGRADUATE RESEARCH POSTER SESSION

ABSTRACT BOOK

Wednesday, August 1, 2018

Interdisciplinary Life Sciences Building Lobby

Morning Session

10:00 AM – 12:00 PM

Afternoon Session

3:00 PM – 5:00 PM

LAUNCH
UNDERGRADUATE RESEARCH
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LAUNCH Undergraduate Research Summer Poster Session

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Interdisciplinary Life Sciences Building Lobby

Morning Session

10:00 AM – 12:00 PM

Featured Summer Programs:

1. *AERO-U REU*
2. *Aggie Research Program*
3. *Astronomical Research and Instrumentation (Physics & Astronomy REU)*
4. *CARTEEH*
5. *Chemistry REU*
6. *DREU*
7. *Cyclotron REU*
8. *Engineering Undergraduate Summer Research Grant (USRG) Program*
9. *TTI Safe-D*

Afternoon Session

3:00 PM – 5:00 PM

Featured Summer Programs:

1. *Aggie Research Program*
2. *Atmospheric Science in the Gulf Coast Region (ATMO REU)*
3. *Biochemistry REU*
4. *Biomechanical Environments Laboratory (BMEL) Undergraduate Research Program*
5. *CyberHealthGIS*
6. *Ecosystem Science and Management (Costa Rica REU)*
7. *EXCITE (Expanding Scientific Investigation Through Entomology) REU*
8. *Hagler-LAUNCH Undergraduate Scholars*
9. *Louis Stokes Alliances for Minority Participation (LSAMP)*
10. *Observing the Ocean REU*
11. *Ocean and Coastal Research Experiences for Undergraduates (OCEANUS) REU*
12. *TAMHSC COM Summer Undergraduate Research Program (TAMHSCCOM)*

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Morning Session

10:00 AM – 12:00 PM

1. Dendritic and Fractal Growth Regimes in Electrodeposition of Mg: Understanding Growth Mechanisms and Implications for Rechargeable Batteries

Antonio Fraticelli (University of Puerto Rico at Cayey)
Chemistry REU
Research Advisor(s): Sarbajit Banerjee

The insufficient energy-density provided by currently available rechargeable lithium-ion batteries is a major impediment to an increased reliance on renewable energies. Improvements in gravimetric and volumetric energy density could be realized through use of metallic anodes. However, lithium is plagued by a high propensity towards dendrite growth causing capacity fading and safety concerns. Magnesium based batteries have been considered as an alternative, given the high natural abundance of magnesium and potential for further improved volumetric energy density provided by the divalent charge of Mg^{2+}. Perhaps the most promising advantage derives from the many reports that claim Mg is impervious to dendrite growth. Through investigations of the electrodeposition of Mg from Grignard reagents in symmetric Mg-Mg cells under galvanostatic conditions monitored through use of videomicroscopy, we have demonstrated distinctive fractal and dendritic growth regimes. To understand the growth mechanisms, the effects of deposition parameters such as current density, concentration, and surface ligands on the growth regime have been explored. The electrodeposited Mg has been characterized by electron microscopy, powder X-ray diffraction, X-ray photoemission spectroscopy, and infrared spectroscopy. The growth regimes correspond to distinctive Damkohler numbers reflecting variations in chemical reactivity (adhesion coefficients and charge transfer) and transport (self-diffusion along different crystallographic directions and across steps/kinks).

2. Designing Green Recyclable Polymeric Solvent Systems

Dylan Gehrke (Texas A&M University)
Chemistry REU
Research Advisor(s): David Bergbreiter

Solvents are a necessary component for almost every reaction. However, most solvents are volatile and not recyclable. In other cases, solvents can be toxic or have low flash points making them flammable hazards. Recently, the Bergbreiter Group described an alternative type of solvent – oligomeric poly(α-olefins) that replace conventional alkane solvent like hexane or heptanes. PAOs are liquids at room temperature, nonvolatile, nontoxic, recyclable, and do not readily ignite. While all these qualities make them much greener solvents than hexane or heptane, they are fundamentally still just alkanes. Since alkanes are very nonpolar solvents and polar solvents are more commonly used, this study has explored the potential of expanding the usability of PAO solvents by changing the polarity of the solvent via addition of polar cosolvents. While the penultimate utility of cosolvents will be seen in reactions, it is more efficient to screen the effects of the polar co-solvents in the PAOs by measuring solvatochromic shifts of a dye. Our study uses the lipophilic dye Nile Red and the changes in its UV/visible and fluorescence spectra to monitor solvent polarity. The observations show that small amounts of polar cosolvent addition lead to a significant shift in the polarity of the PAO solvents are agree with other studies that used a dansyl fluorophore solvatochromatic probe. These results suggest that reactions that require polar solvents can be run in the greener PAO solvent systems with only modest amounts of added polar cosolvent.

3. New Insights on Immobilized Sonogashira Catalyst Systems

Antoine Brouttier [Ecole Nationale Superieure de Chimie de Mulhouse (ENSCMu)]
Chemistry REU
Research Advisor(s): Janet Bluemel

The Sonogashira C-C cross coupling is one of the most important reactions used in industry, e.g. for pharmaceuticals production. One representative application involves the coupling of aryl halides with terminal alkynes.[1] Sonogashira catalysis typically utilizes Pd(0) and a Cu(I) co-catalyst. Previous research has led to several mononuclear immobilized catalysts that have shown impressive activity and recyclability.[1] However, there is still room for significant improvement. Past iterations have shown that the Pd center is migrating from one tethered ligand to another which is the most probable cause for leaching, catalyst deactivation, and diminished recyclability.[1] This led to the notion of a heterobimetallic immobilized system that incorporates both the Pd and Cu centers within the same moiety, in this way mitigating the necessity for the Pd to migrate to find a Cu center and help to improve the rate limiting transmetallation step.[2] Recently, a homogeneous version of the Pd(II)/ Cu(I) catalyst precursor has been synthesized and characterized that has shown very promising catalysis characteristics . Current work focuses on synthesizing an analogous immobilized version and investigating its catalytic activity, recyclability and any potential nanoparticle formation[3] as an additional or parallel source of catalysis.

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3. Guenther, J.; Reibenspies, J.; Blümel, J. *Adv. Synth. Catal.* **2011**, *353*, 443-460.

4. Electronic Property Control in [NiFe] Complexes Related to Hydrogenase Active Sites

Valeria Suarez Vega (Sonoma State University)
Chemistry REU
Research Advisor(s): Marcetta Darensbourg

A top challenge faced by the world is the urgent requirement for a clean, sustainable and inexpensive energy source. The conversion of solar energy into electrical and storage in chemical bonds, such as H_2, is expected to be the optimal solution. The most effective catalyst for the conversion so far is the noble metal platinum.[1] In nature, enzymes called hydrogenases catalyze reversible H_2 production from protons and electrons through active sites which feature abundant metals, such as nickel and iron as the core and in sulfur-rich coordination environments.[2] Specifically, my project focuses on the electronic properties of the bridging thiolates in the [NiFe]-H_2ases. In 2016, the MYD group reported a mechanism for a small molecule model of active site of [NiFe]-H_2ases,[3] in which the partial opening of the bridging thiolate plays a role for proton shuttle.[4] Based on the study, the questions are: a) How can such "hemilability" of the thiolates be controlled? b) What is the effect on H^+ reduction? And, c) will the electron property affect sulfur's function as proton shuttle? Hence, this project developed the synthesis of a series of NiFe heterobimetallic complexes bridged by sulfur with different electron properties. An $[NiN_2S]_2^{2+}$ dimer was used as a synthetic platform for bimetallic NiFe complexes bridged by sulfur(s) to appropriate iron receiver units, specifically $(\eta^5\text{-}C_5R_5)Fe^{II}(CO)$.[4] The electron properties are adjusted by the para-substituent on an arene ring which is connected to sulfur. These new NiN_2S(S-Ar') complexes have been prepared and their crystal structures determined. They form NiFe complexes with the S-Ar' unit as bridge. This work is the synthesis basis for the further study of hemilability and function of thiolate as proton shuttle.

References:

1. Häussinger, P.; Lohmüller, R.; Watson, A. M. In *Ullmann's Encyclopedia of Industrial Chemistry*; Wiley-VCH Verlag GmbH & Co. KGaA: 2000.
2. Vignais, P. M.; Billoud, B. *Chem. Rev.* **2007**, *107*, 4206.
3. Bethel, R. D.; Darensbourg, M. Y., The Bioorganometallic Chemistry of Hydrogenase. In *Bioorganometallic Chemistry: Applications in Drug Discovery Biocatalysis, and Imaging*, Wiley-VCH Verlag GmbH & Co. KGaA, 2014; p 242.
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5. Acid-Doping Study of a Ladder-type Quinoidal Molecule

Christopher Martínez (Univeristy of Puerto Rico at Cayey)
Chemistry REU
Research Advisor(s): Lei Fang, Xiaozhou JiJi

Polyaniline (PANI) is one of the most studied polymers for its broad electronic applications as well as its feasible synthesis and processing, and high environmental stability. Over the past decades, scientists have confirmed that conductive form of PANI is achieved through non-redox acid doping. Among the three PANI analogues of different oxidation states, the fully oxidized pernigraniline base (PB), and its acid-doped salt (PS), are rarely studied. One of the challenges in this research is the easy degradation of PS under ambient conditions. The intrinsic configuration and conformation isomerism complicates the protonation process. As a result, a clear structure-property relationship of PS and its oligomers is still unrevealed. In our design, a ladder-type PB-derived small molecule (Q1) was synthesized with quinoidal structure. Using covalent-bonding, the molecule was fixed in an all-*trans* configuration and coplanar conformation, simplifying the structure study largely. Moreover, the double-strand bond in ladder-structure also enhanced the stability of Q1 after acid doping. In this study, we doped and characterized Q1 to understand its protonation mechanism in solution-state using UV-Vis spectroscopy. We visualized Q1 through different doping levels due to solvent density differences. Some organic solvents interact with Q1 due to their active protons, leading to obvious intermolecular charge transfer, which was studied by absorption and emission spectroscopy. In conclusion, Q1 undergoes protonation process different from its linear analogue as a result of the specific ladder-type structures.

6. Triphenylene Based Carbocations As Catalysts For Oxygen Reduction Reaction

Thanaphon Khrueawatthanawet (Chulalongkorn University)
Chemistry REU
Research Advisor(s): François Gabbaï

In this work we studied the synthesis of three different carbocations including (4-methoxyphenyl) diphenylmethylium (1), bis(4-methoxyphenyl)(phenyl)methylium (2) and tris(4-methoxyphenyl)methylium (3) as catalysts for Oxygen Reduction Reaction (ORR) in organic solvent. Cyclic Voltammograms under an oxygen atmosphere suggested that the ORR took place and cathodic peak current varied linearly with equivalents of trifluoroacetic acid. The kinetics of ORR was studied by UV-Vis spectrophotometry. Results showed that turn over frequencies were found to be 6.16×10^{-3} s^{-1}, 4.82×10^{-3} s^{-1} and 8.92×10^{-3} s^{-1} for (1), (2) and (3) respectively. The results indicated that the best catalyst was (3) and the reaction was first order with respect to each trifluoroacetic acid and concentration of catalyst.

7. Thick-growing, Environmentally Benign Flame Retardant Treatments For Polymers

Etienne Bellevergue (Ecole des Mines d'Alès)
Chemistry REU
Research Advisor(s): Jaime C Grunlan, Simone Lazar

Most flame retardants contain halogens, such as bromine, which have recently been scrutinized for being toxic. For this reason, non-halogenated flame retardant coatings are being developed as environmentally-friendly alternatives. Layer-by-Layer (LbL) assembly, consisting of renewable polymers, is a promising technique to protect polymer substrates from fire. Based on the electrostatic interactions between oppositely charged polyelectrolytes in aqueous solution, engineers are now able to grow flame retardant nanocoatings with multiple bilayers. These nanocoatings need to be as thick as possible, with as few bilayers as possible in order to be a suitable replacement for current flame retardant systems. The goal of this study was to evaluate the tuneable properties (concentration, pH, ionic strength, rinsing, etc.) of LbL, in order to optimize the conditions for a thick-growing, all-polymer flame retardant system consisting of cationic chitosan (CH) and anionic sodium hexametaphosphate (PSP). One approach, involved the incorporation of Trizma Base in the rinsing steps of the LbL process, which lead to thicker film growth when measured using ellipsometry. This thick-growing, renewable flame retardant treatment is a promising environmentally-friendly replacement because of its flame retardant properties and relatively few processing steps.

8. Synthesis of Activity Based Demethylase Probe

Olivia Shade (Seton Hill University)
Chemistry REU
Research Advisor(s): Wenshe Liu

This project explores the stepwise synthesis of a probe to be used for the analysis of histone lysine demethylase (HKDM) activity in cells. Demethylase removes methyl groups from trimethylated histones, ultimately changing the binding affinity and the rate of transcription of the histone. This change in transcription can either activate or repress the gene associated with the histone and impact the expression of the gene. To study the activity of demethylase, the amine, acid, and hydroxyl functional groups of homoserine were first protected using common protecting groups *tert*-butyl carbamate (boc), benzyl ester, and *tert*-butyldimethylsilyl (TBDMS), respectively. Then, chloromethyl chlorosulfonate was used to couple a methyl chloride to a deprotected hydroxyl of the otherwise protected homoserine. The incorporation of an oxygen at the fifth carbon of the lysine analog probe was done to maximize probe stability after recognition by demethylase, ultimately causing the probe to cyclize to produce a five-membered ring and to cleave the fluorescent group from the c-terminus of the probe. Further experiments to replace the chlorine with a trimethylated amine are needed before the protecting groups can be cleaved and the probe can be tested in a biological system.

9. Population Alternation and Rotational Distribution Following Photodissociation of Ozone in the Hartley Band

Dallas Freitas (University of Hawaii at Hilo)
Chemistry REU
Research Advisor(s): Simon North, Carolyn Gunthardt

Ozone is a triatomic molecule consisting of three oxygen atoms (O_3), occurring most abundantly in the stratosphere, one of the major layers of Earth's atmosphere. Ozone plays a crucial role in the absorption of harmful ultraviolet radiation. Absorption of this ultraviolet radiation causes the O_3 to photodissociate into O_2 and elemental oxygen. Previous studies have indicated a difference in odd and even populations in the rotational distribution of isotopic O_2 molecules, but the exact reason behind this uneven distribution is still yet unknown. Recent results have shown a clear dependence on temperature between these even and odd population alternations. Therefore, to further our understanding of atmospheric modeling, it is essential to decipher the photochemical dynamics of ozone. The Velocity Map Ion Imaging (VELMI) method was utilized in conjunction with state selective Resonance-enhanced multiphoton ionization (REMPI) to study the vector correlations and rotational distributions of ozone photodissociation in the near UV Hartley band of 200-300nm. Experimental REMPI data obtained indicates a larger population of O_2 formed in even rotational states than in odd states. Furthermore, the data obtained indicates little if no correlation between temperature and curve crossing distribution. The exact reason behind this odd distribution is still yet unknown, but further studies could elucidate the mysteries behind the photodissociation of ozone.

10. Investigations into the Solvent-Dependent Nature of Gramicidin Structure Formation Using IM-MS

Jocelyn Ferreira (Texas A&M University)
Chemistry REU
Research Advisor(s): David Russell, Xueyun Zheng

Gramicidin, a natural antibiotic, forms cation-selective transmembrane ion channels. Due to its small size and high availability, gramicidin functions as a model for designing methods to investigate the structure of transmembrane channels. Previous studies have shown three models representing the structure of gramicidin A dimer-forming ion channel: the single stranded head-to-head dimer (SSHH); the anti-parallel double helix (APD); and the parallel double helix (PDH). Here we aim to understand the structure and conformational preferences of different gramicidin peptides using electrospray ionization ion-mobility mass spectrometry (ESI-IM-MS). Gramicidin D, a mixture composed of gramicidin A (80%), B (6%) and C (14%) was studied. The full amino acid sequence for gramicidin is HCO-L-Val-Gly-L-Ala-D-Leu-L-Ala-D-Val-L-Val-D-Val-L-Trp-D-Leu-L-(X)-D-Leu-L-Trp-D-Leu-L-Trp-NHCH2CH2OH, where X is the only difference for each peptide (Trp, Phe and Tyr for gramicidin A, B and C, respectively). It has been previously established that the conformations of gramicidin are solvent dependent. To examine this effect, gramicidin was dissolved in ethanol and isobutanol. Our preliminary ion mobility results showed that both monomers and dimers of gramicidin were observed in the ethanol solution. However, in the be used in further experiments to explore the structure of the gramicidin ion channel within the lipid membrane using the vesicle capture-freeze-drying (VCFD) method.

11. Proteome Screening for L-RNA G-Quadruplex Binding Proteins

Benjamin Chi (Texas A&M University-Kingsville)
Chemistry REU
Research Advisor(s): Jonathan Sczepanski, Charles Deckard

Single stranded oligonucleotides containing at least four consecutive tracts of repetitive Guanines are known to form non-canonical G-quadruplex (G4) structures. These motifs are abundant in the human genome and are believed to serve critical roles in transcriptional regulation. G4 structures are selectively bound by a large number of regulatory proteins, including the histone methyltransferase PRC2. We recently observed that PRC2, a critical epigenetic regulator, was capable of binding RNA G4s completely independent of the stereochemistry of the G4-forming oligonucleotide. Based on these results we hypothesized that other G4-binding proteins could exhibit similar modes of G4-recognition and ultimately be capable of binding G-quadruplexes comprised of L-nucleic acids. In this study, we utilize SILAC (Stable Isotope Labelling with Amino Acids in Cell Culture) and biotinylated G4-probes of either D- or L- RNA to identify various unreported G4-binding proteins as potential therapeutic targets.

12. Gold Deposition on Cesium Lead Mixed-Halide Perovskites (Au-CsPbX3, X = Cl/Br) via Anion-Exchange Reactions

Richard Reyes (Austin College)
Chemistry REU
Research Advisor(s): Matthew Sheldon

All-inorganic cesium lead trihalide perovskite nanocrystals are an active area of research due to their high photoluminescence quantum yields (PLQY), making them candidates for future optoelectronic applications. These perovskites can be modified through ion-exchange reactions, providing the capability to change the composition of these colloidal semiconducting nanocrystals after their initial synthesis. Specifically, a simple anion-exchange reaction has shown fine tunability of the nanocrystal bandgap across the visible spectrum by controlling the ratio of the halides. Currently, gold-semiconductor hybrid nanocrystals are being examined for maintaining their high PLQY, unlike their chalcogenide counterparts. One of the challenges with depositing gold on all-inorganic perovskites is that current methods only work for single halide perovskites. This work explores two methods of anion-exchange reaction to achieve a gold-deposited cesium lead mixed-halide perovskite. One method attempts anion-exchange with pre-deposited Au-$CsPbCl_3$ and Au-$CsPbBr_3$ perovskites. Another method adopts the exchange reaction with gold monohalide salts as the anion source for ion exchange, as well as the gold source for metal deposition. The products of the exchange reaction were studied further to examine the capabilities of these reaction methods. Both methods demonstrate bandgap and single peak photoluminescence shifting from that of the precursor perovskites, indicating successful anion exchange. Additionally, transmission electron microscopy was used to confirm the presence of gold deposition on the perovskite surface.

13. Alignment of Anisotropic CdSe/CdS Nanorods with an Alternative Electric Field

Yann Ibanez [Ecole Nationale Superieure de Chimie de Mulhouse (ENSCMu)]
Chemistry REU
Research Advisor(s): Matthew Sheldon

The current maximum efficiency for a solar panel is 33.7% but it is possible to increase it into 45.1% with the use of the appropriate nanoparticles and setup. In fact, some nanoparticles have excellent optical properties like the Cadmium Selenium and Cadmium Sulfur nanorods (CdSe/CdS). These nanorods (NRs) have anisotropic properties, they can absorb light and re-emit it perpendicularly. The main objective of this project was to create a setup to align these NRs with an alter-native electric field in order to lead the light in the right direction and increase the efficiency of the future solar panel. The alignment is followed by the absorbance study thanks to a setup laser-photoreceiver. In this presentation, I will present the synthesis of the quantum dots (QDs) of CdSe and the formation of the CdS shell as well as the study for the full alignment of the NRs. I will also explain the study of the immobilization of the NRs in a cross-link polymer made of ethylene glycol di-methacrylate (EGDMA) and lauryl methacrylate (LMA) in a 1:10 weight's ratio. It is a photo-polymerization initiated by the phenylbis(2,4,6-trimethylbenzoyl)phosphine oxide (IRGA). At least, the use of the anisotropy study to determinate the degree of alignment the will be presented.

14. Optimization of Nanocomposite VO_2 Thin Films for Thermochromic Applications

Sarah Phillips (Texas A&M University)
Independent Project
Research Advisor(s): Sarbajit Banerjee, Diane Sellers

Vanadium dioxide undergoes a reversible metal-insulator phase transition from the higher temperature, metallic rutile phase to the lower temperature, insulating monoclinic M_1 phase. This transition provides substantial near-infrared optical modulation ideal for use in thermochromic smart windows. Current VO_2-based thermochromic coatings suffer from poor visible transmission as a result of particle size and refractive index-based light scattering in addition to a metal-insulator transition temperature that is too high for terrestrial based-fenestration applications. In this work we aim to mitigate these challenges by 1) using ultrasmall VO_2 particles coated with an antireflective SiO_2 shell to reduce light scattering and 2) doping VO_2 with tungsten to lower the phase transition temperature. We find that the optical performance in the visible region was improved as a function of SiO_2 shell thickness due to optimization of refractive index matching across the VO_2/SiO_2/polymer interface, effectively reducing light scattering. Additionally for tungsten doped-VO_2 we find a delicate balance in post-synthesis annealing treatments, leveraging crystallinity and particle size.

15. Dithiolate-Stabilized Pd(II) Trimetallic Complexes as Precatalysts for C-C Cross Coupling Reactions

Heechang Shin (Texas A&M University)
Independent Project
Research Advisor(s): Marcetta Darensbourg, Holly Gaede

The active site of Acetyl CoA synthase offers a cyc-gly-cys tight binding motif that contains a Ni^{II} center. The *cis*-dithiolates of the NiN_2S_2 metalloligand allows bidentate binding to support a second catalytically active nickel center that allows organometallic like C-C coupling reactions. Recently the MYD group reported NiN_2S_2 stabilized Pd^{II}(diphos) bimetallic complexes as biomimetics of the ACS active site that efficiently allows Suzuki-Miyura C-C cross coupling reactions. Although most previously reported Pd^{II} precatalysts are stabilized by substituted phosphine ligands in their catalytic cycle, it is necessary to pursue an analogy between diphosphine and dithiolate stablilized Pd^{II} units in order to advance the scope for the viability of such heterometallic catalysts. Thus, we report the synthesis and characterization of four $M^{II}N_2S_2{\bullet}Pd^{II}{\bullet}S_2N_2M^{II}$ complexes (where, M = Ni^{II}, $V(O)^{II}$, $Fe(NO)^{II}$, $Co(NO)^{II}$) featuring *bis*-metallo-*cis*-dithiolate bound Pd^{II} in a square-pyramidal stair-step conformation. These trimetallic complexes were tested for Suzuki-Miyura and Sonogashira cross coupling reactions with varied substrate scope; $Ni^{II}N_2S_2{\bullet}Pd^{II}{\bullet}S_2N_2Ni^{II}$ complexes showed best results with 5% catalyst loading at 95 ^{o}C. The $M^{II}N_2S_2{\bullet}Pd^{II}{\bullet}S_2N_2M^{II}$ complexes were characterized by IR, NMR, CV, EPR and X-ray crystallography.

16. Factors Influencing the Properties of Aramid Nanofibers Derived from Various PPTA Parent Materials

Devon Kulhanek (Texas A&M University)
Independent Project
Research Advisor(s): Micah Green

Aramid nanofibers (ANFs) are a novel nanomaterial consisting of bundles of rigid p-phenylene terephthalamide (PPTA) polymer chains. They are derived from the dissociation of macroscale aramid fibers, such as Kevlar. ANFs can be added to composites with nanomaterial or polymer matrices to create composites with enhanced mechanical properties for use in electrodes, battery separators, and other devices. This ongoing study aims to determine how the properties of ANFs are affected by variations in the molecular weight and crystalline structure of their parent material. Samples are prepared by dissociating various grades of Kevlar fibers, provided by Dupont, in anhydrous dimethyl sulfoxide (DMSO) and potassium hydroxide (KOH). Untreated fibers and dissociated samples are then analyzed using AFM, GPC, and XRD to observe differences in ANF dimensions, molecular weight, and crystallinity. The resulting data is expected to show a direct correlation between the size of crystallite domains in parent Kevlar and the size of ANFs. Additionally, this study explores the formation of ANFs from low crystallinity PPTA powder which has not undergone the Kevlar spinning process.

17. Single-Step Esterification of Graphene to Tune Interfacial Energy while Preserving Conductivity

Eliza Price (Texas A&M University)
Independent Project
Research Advisor(s): Micah Green

Graphene is a nanomaterial composed of single or few atomic-layer sheets of carbon atoms in a hexagonal crystalline order. The high electrical and thermal conductivity, specific surface area, and mechanical strength of graphene make this nanomaterial promising for applications in the fields of electronics, energy-storage, medicine, and environmental remediation. For most practical applications, graphene is mixed with other materials, such as polymers. To harness the properties of graphene for these applications, chemical functionalization is often necessary to increase the compatibility of the graphene nanosheets with other materials. In this ongoing study, we demonstrate that graphene derivatives such as graphene oxide and electrochemically exfoliated graphene can be edge-functionalized through an esterification reaction without sacrificing the high electrical conductivity of graphene. Unlike many other functionalization methods, this reaction does not add additional defects to the structure of graphene, so the conductivity of the graphene nanosheets is preserved. A variety of starting alcohol reagents can be used to determine the functional groups added to the graphene and tune its interfacial energy for applications within composite materials. Additionally, the single-step functionalization scheme is facile to carry out, using techniques which could be scaled up to use within industrial applications.

18. Investigating the Solvation Structure of Lanthanide-Water Clusters using Ion Mobility-Mass Spectrometry

Almah Huq (Texas A&M University)
Independent Project
Research Advisor(s): David Russell

The investigation of water clusters using mass spectrometry has yielded results which give insight into the differences in fine and bulk structure of water molecules around a particular solute. Previous research done with lanthanum chloride solutions have shown that large water clusters (n>300 for $[La(H_2O)_n]^{3+}$) surrounding the ion are attainable using Fourier-transform ion cyclotron resonance mass spectrometry (FTICR-MS); however, few results exist using more common MS platforms, and fewer results have used ion mobility-mass spectrometry (IM-MS) to study the solvation structure of lanthanide cations. In IM-MS, ions are separated based on their mobilities through a buffer gas, which is dependent on the ion charge and size or shape, and MS where ions are separated based on their mass and charge. Correlation of mass and mobility trends can provide insights into bulk and fine structure transitions of certain clusters. In this research, aqueous solutions of lanthanum chloride were analyzed using IM-MS. Early observations indicated a smaller series of hydrated $La(OH)_2^+$ and $La(OH)^{2+}$ ions compared to the hydrated lanthanide ions observed in the literature. The observed ion series are also dependent on the electrospray technique, as initial electrospray droplet sizes may affect the size of the hydrated clusters. Specifically, the $[La(OH)_2(H_2O)_n]^+$ series shows/demonstrates a deviation in linearity between drift time and the number of water molecules, n, was identified, possibly due to a transition from fine structure to bulk structure. With further investigation this phenomenon can be further elucidated.

19. Structural Effects of Competing Osmolytes on Melittin Studied via Ion Mobility-Mass Spectrometry

Michael Knowles (Texas A&M University)
Independent Project
Research Advisor(s): David Russell

Osmolytes play an important biological role by affecting protein folding and protein structure stability [in solution, in the body, in the droplet]. Trimethylamine N-oxide (TMAO) an osmolyte found in most animals, especially in deep-sea fishes, has been found to counteract the protein-destabilizing effects of high pressure and maintain cellular stability. TMAO has also been found to counteract the denaturing effect of urea on proteins structure. High concentrations of TMAO have been linked to major adverse cardiovascular events in human; therefore, it is important to understand the chemical effects of these osmolytes on protein structure. Herein, melittin was used as a model protein to examine the specific effects of TMAO and urea by using ion mobility-mass spectrometry (IM-MS). IM-MS separates samples in the gas phase by pushing them through an inert gas via an applied electric field and can be used to calculate collisional cross sections and other structural information. Our preliminary data has demonstrated that TMAO reduces the charge states of melittin in aqueous solution. However, despite conflicting claims by earlier publications, this charge reduction has not been shown to be counteracted at high relative concentrations of urea to TMAO (up to 100:1) at low overall concentrations. Our further investigation will include higher urea concentrations. Proposed mechanisms for the reduction of charge state and conformation size by TMAO include preferential binding of TMAO to the surface of the protein, preferential exclusion of other co-solutes from the protein surface, reduction in hydrophobic interactions, and an increase in charge-charge interactions.

20. Optimization of Arylamine Synthesis via Palladium Mediated Cross-coupling and Oxidase Catalysis in Undergraduate Teaching Laboratories

Victoria Akwaowo (Texas A&M University), Connor Hoffman Texas A&M University)
Independent Project
Research Advisor(s): Connor Hoffman

Arylamines are important nitrogen-containing compounds used in the production of pharmaceuticals, agrochemicals, and natural products. Traditionally, arylamines are synthesized by premanufactured aryl halides catalyzed by a transition metal, most commonly palladium. However, it has been found that a direct C-H to C-N transition can be made with a hypervalent iodine reagent. Hypervalent reagents are useful two-electron oxidants that have recently been synthesized aerobically by utilizing reactive intermediates of aldehyde autoxidation. These aryl iodides serve to mediate aerobic oxidation during oxidase catalysis, which strongly links the oxidation of substrates to the reduction of dioxygen gas. In these experiments, N-methoxy-4-methyl-N-phenylbenzenesulfonamide was synthesized through two different methods: Pd mediated cross coupling and oxidase catalysis via hypervalent iodobenzene. The overarching goal of this project was to optimize the techniques and procedures to be carried out by upper-level undergraduate students in inorganic teaching laboratories.

21. Pavement Perspective on AV Safety through Optimizing Lateral Positioning Pattern

Alejandro Espejo (Texas A&M University)
TTI Safe-D
Research Advisor(s): Fujie Zhou, Laura Higgins

Autonomous Vehicles (AV) offer many advantages such as decreased traffic collisions and increased accessibility. However, one aspect of their deployment that has been overlooked is the effect of their lane-positioning systems on the pavement. AV position themselves within a lane by maintaining a set distance from a reference point. From the perspective of the pavement, this channelized driving will create deeper wheel path ruts which will increase the risk of hydroplaning in wet weather conditions. In my research, I simulate the effect of channelized driving compared to paths with a larger lateral standard deviation within a lane. These simulations suggest that a uniformly distributed lateral positioning algorithm would cause the shallowest rut depth. I also analyze the results of implementing and testing an algorithm which creates a uniformly distributed path for an autonomous vehicle.

22. Exploring Emissions Exposure Variability Due to Traffic Characteristics

Cristhopher Nunez (Texas A&M University)
CARTEEH
Research Advisor(s): Andrew Birt

In the interest of understanding the relationships between the way emissions vary due to controlled traffic characteristics, this paper explores the outcome of micro simulating emissions outputs and dispersion patterns. Exploring these relationships requires a simple representation of real environments through modeling and data analysis. With the help of Simulation Of Urban Mobility (SUMO) software, traffic conditions are generated with pre-determined conditions. Using the MOtor Vehicle Emission Simulator (MOVES) standard of the Environmental Protection Agency (EPA) for converting traffic characteristics to emissions. The traffic conditions are then used to generate real world estimate of emissions of Particulate Matter of 10 micrograms in diameter (PM10). The chain of analysis can be used model NOx, SOx, HC, CO, CO2, O3 and PM2.5 as they are similarly generated with MOVES to analyze the variability in exposure in different time intervals. With this study, we then analyze the variability and significance in the amount of pollutant generated versus the amount of time people are exposed to such pollutant.

23. Developing and Analyzing a Literature Library on Traffic Emissions, Air Pollution, Exposures, and Health

Kristen Sanchez (Texas A&M University)
CARTEEH
Research Advisor(s): Haneen Khreis

This project serves to develop and analyze the Center for Advancing Research in Transportation Emissions, Energy, and Health (CARTEEH) Literature Library. The library aims to provide users with efficient access to a hub of articles related to 'full-chain' elements: traffic, emissions, dispersion/air quality, exposure, and health impacts, in addition to technology. The full-chain is a process connecting events between traffic activity and final health outcomes. The library is open-access and accompanied by an online search tool, both available at: https://www.carteeh.org/carteeh-literature-library/. Development of the library was accomplished through the search for, collection, organization, and analysis of 686 relevant articles. This work provides a higher-level analysis of where the literature is clustered and where it is missing, identifying research and knowledge gaps, and guiding the composition of similar libraries and design of relevant studies in the future. The results highlight a current lack of studies addressing all full-chain elements—only 3.6% of the library. This knowledge gap demonstrates a greater need for researchers to implement full-chain analyses in their studies—especially when aiming to impact policy change for traffic-related air pollution (TRAP). Additional recommendations include analyzing library usage, surveying experts for study collection, creating a more effective method for library feedback, and including more grey literature. Current limitations include a non-systematic literature selection and subjective study categorization. We encourage students, researchers and practitioners interested in the area of transportation and health to utilize this resource. Any questions or suggestions regarding the library may be directed to KS at k-sanchez@tti.tamu.edu.

24. Proving Linkages between Mobility and Public Health: A Conceptual Model

Andrew Glazener (Texas A&M University)
CARTEEH
Research Advisor(s): Tara Ramani, Haneen Khreis

This paper details the relationship between mobility and public health. Mobility (or transportation) is influenced by four factors: transportation mode, emergent and disruptive technology, transportation infrastructure, and the land use and built environment of an area. Each of these determine how we choose to move ourselves and goods, and each of these choices levy a public health implication. A literature review was conducted based off studies and papers identified by faculty supervisors, as well as works found independently, that support the linkages between mobility and certain public health outcomes. Synthesizing the information from these varying sources, this paper summarizes the public health implications of mobility choices. This will serve as a framework for future studies looking to further explore the characteristics of certain mobility-public health pathways.

25. Interaction Templates for Multi-Agent Systems

Tobi Ogunyale
DREU
Research Advisor(s): Nancy Amato

This paper describes a framework for multi-robot motion planning problems that require or utilize interactions between robots. We consider both homogeneous and heterogeneous robot systems that complete a set of motion tasks. Some of these tasks require robots of varying agent types, while others can be performed by a single robot but could be executed more efficiently by a robot team. Plans for these types of problems need to consider interactions between agents on a motion planning level to determine the feasibility and cost of each agent's portion of the task. Modeling these problems with current task and motion planning (TMP) approaches typically requires reasoning about the possible interactions and checking many of the possible robots combinations when searching the task-state graph for a solution. We present a system that instead handles certain types of robot interactions strictly through the motion planning process, thereby moving the handling of interactions from the 'task' layer to the 'motion' layer. This is achieved through Interaction Templates (ITs), which are small roadmaps that encode an interaction between a set of robots. The agents' roadmaps are connected to the corresponding ITs to create a combined roadmap that can be searched for a path which satisfies the motion task. This combined roadmap naturally encodes the interactions between agents and allows them to be considered in a manner similar to individual robot actions. We apply the IT method to various scenarios to demonstrate that the system utilizes interactions whenever necessary or beneficial.

26. Biometric Verification Using Eye Tracking and Sketch Recognition

Hannah Musson (Mills College)
DREU
Research Advisor(s): Tracy Hammond

Due to the composition of the eye muscles, every person's eyes move in unique saccadic patterns as they look between two points. Biometric identification of a subject through saccadic eye movements has been explored in the past, but the results are often inconclusive or impractical because the eye tracker is unreliable or because the processes are too complicated to replicate on a larger scale. By treating the eye movements as a drawing, or a sketch, we are able to analyze the data using sketch recognition (calculating Rubine's features) and machine learning techniques. This process is efficient and effective, and it reduces the frequency of mistakes due to inaccurate eye tracking because it relies on a head mounted virtual reality device that supports eye tracking. If incorporated into other biometric security systems, eye movement verification could increase security strength and reduce the effectiveness of counterfeit attacks.

27. Characterization of Pit and Floc Morphology in Coagulation Processes

Stephanie Brown (College Station High School)
Independent Project
Research Advisor(s): Shankar Chellam

Chemical (CC) and electro-coagulation (EC) are processes pertinent to water treatment, but gaps in the understanding of the parameters that effect each process currently limit their application in some fields. Understanding the corrosion processes occurring on electrodes in EC and the morphology of flocs generated in CC is essential to improving the efficiency of these processes. This project focused on developing measures and methods to quantify and characterize the corrosion of electrodes and the floc structures that develop during EC and CC. For pitting corrosion occurring during EC, two primary measures were developed: the percent of total active electrode area experiencing corrosion, and the depth distribution of various points on the electrode surface (so as to assess the depth of pits formed). For floc morphology resulting from CC, the focus was on measures of fractal dimension.

28. Boundary Flow Control by Discharge Plasma and E/N Reaction Rates by Methane and Ethylene Fuel Injection

Daniel Hartman (Texas A&M University), Mitchell Weaver (Texas A&M University),
David Yorn (Texas A&M University)
AERO-U
Research Advisor(s): Albina Tropina

Scramjet engines are powerful, high speed thrusters whose change in size governs the way pressure is altered throughout the device. The first part of this research explores two methods for the boundary layer control in a supersonic flow, which are based on the dielectric barrier discharge and laser discharge. Corresponding thermal and momentum source terms will be introduced to the Navier-Stokes equations. The MacCormack method for the solution of 2D Navier-Stokes equations for compressible flow is utilized. This involves the application of the finite difference method in each grid cell and its implementation in FORTRAN using OpenMP for parallel programming. On this stage of the research we present verification results for the code based on the comparison of calculations results on different grids and analysis of the plasma source term. The second part of the research centers on the combustion process in a scramjet where the flow remains supersonic throughout the engine, creating a large issue for igniting the air/fuel mixture. Specifically, the research being conducted is finding the formation of combustion precursors as a function of the reduced electric field (E/N ratio). The steps involved include the calculations of the electron impact reaction rates for a methane-air and an ethylene-air fuel mixture with different equivalence ratios using BOLSIG+, which solves the seven variable Boltzmann equation. Using the method determined in part one of the research, we are able to determine how to create the optimal conditions for the combustion in part two.

36. Design and Construction of an Aerosol Sampling System for LIBS-Based Elemental Analysis

Andrew Marsh (Texas A&M University)
Independent Project
Research Advisor(s): Waruna Kulatilaka

The analysis of aerosols using laser-induced breakdown spectroscopy (LIBS) enables real time identification of the elemental composition of the gas and particulate makeup of an aerosol. The purpose of this research is to design and construct a test apparatus for freestream elemental analysis of aerosols using LIBS. Due to the laser being focused to generate the plasma that is analyzed by the spectrometer, the laser-induced damage threshold of the glass composing the test cell had to be determined in order to prevent damage. To determine the damage threshold, the glass was tested using the LIBS apparatus at varying fluences for 10 laser pulses operating at 10-Hz repetition rate. The damage threshold is defined as the laser fluence just prior to the onset of observing silicon emission lines through the LIBS detection system. The damage threshold was determined to be 9.57 J/cm^2, which is in consistent with the value reported in the literature as well as observed physical damage on the surface. The corresponding minimum distance of the test cell window surface is 5.30 cm from the focal point of the laser beam. The flow rate for the system was calculated on the assumption that a slow, laminar flow provides consistent delivery of the aerosol through the sample chamber. A flow rate between 2–10 lpm was selected in order to allow for variations between experiments to determine the optimal flow rate. This test apparatus will be used to analyze metal particles released to air by burning propellant samples.

37. Bioreactor Design for Study of Shear and Strain on Endothelial Cells

Halit Erdemir (Texas A&M University)
Independent Project
Research Advisor(s): Caleb Davis Moreno

Inadequacy of lymphatic transport can lead to Lymphedema, a buildup of fluid in the tissues, a condition affecting millions in the developing and developed world. Current treatments do not permanently reverse these symptoms, largely because the mechanisms leading to this disease are not well understood. Previous research indicates that lymphatic endothelial cells are sensitive to stress and strain, producing biochemical signals which may affect lymphatic pumping. To identify potential mechanisms, we will study the effects of shear stress and strain on lymphatic endothelial cells in vitro. Our specific approach is to create a bioreactor with the ability of emulating the internal mechanical environment of the lymphatic vessels. The bioreactor consists of a parallel plate system that simulates fluid shear stresses through flow applied by a LabVIEW-controlled pump. Strain on the cell-seeded membrane is applied by the upward and downward motions of a linear actuator connected to a stepper motor. In preliminary experiments, the bioreactor produced shear stresses of up to 15 dynes/cm^2, and a stretch of the membrane of 15-20%. Its polycarbonate construction makes it resistant to autoclaving/disinfecting and makes it biocompatible with organic cells. It is sealed effectively through the use of silicone gaskets integrated between the two parallel plates. With the design and implementation of this bioreactor, the endothelial cell cultures able to be subjected to a customizable and independent amount of stress and strain. This provides for the ability to research critical complications present within the lymphatic system.

38. Refraction Index Calculations in Non-Equilibrium Air at Hypersonic Flight Conditions

Cody Shelton (Texas A&M University)
Independent Project
Research Advisor(s): Albina Tropina

For hypersonic flight, in order to allow proper function of on-board optical instrumentation and to communicate with ground control, knowledge of optical effects accompanying flight conditions needs to be understood. Around the aircraft, flows behind shocks and in boundary layers are in non-equilibrium and therefore, the thermal-optical effects have to be known. In order to do this, air composition must be analyzed at higher temperatures so that major species can be identified. From this, an analysis of the effects of internal excitation and air composition on the molecular polarizability and refractive index can be performed. For this work, the effects were computationally studied for atomic nitrogen and nitric oxide. The laser frequency and temperature dependent polarizability and refractive index were determined using semi-classical quantum mechanics approach. The laser creates a transition dipole moment, causing electric fields to bend as the wave travels through the medium. Analysis of the refraction index change with temperature was performed for a laser wavelength of 532 nm. Results include the polarizability of atomic nitrogen with a changing induced frequency and early results for the polarizability calculations of air at different temperature.

39. UAV Water Monitoring

Preston Bracamontez (Texas A&M University), Cody Chalmers (Texas A&M University),
Neil Doran (Texas A&M University), Jason Haripin (Texas A&M University),
Johnna Knight (Texas A&M University), Eric Peraza (Texas A&M University)
Independent Project
Research Advisor(s): Dale Cope, Zong Liu

As livestock and agriculture operations increase in scope, it puts a great strain on freshwater resources across the state of Texas. To conserve natural resources and reduce operational costs, livestock and agriculture producers look to recycle water from on-site wastewater lagoons as a means of irrigation for their operations. To recycle this wastewater, water samples must pass quarterly water quality inspections to ensure the safe concentration of harmful contaminants such as Phosphorus, Nitrogen and Pathogens. Current methods involve collecting water samples using small boats or walking along the shore and taking samples within a few feet of dry land. These methods are hazardous as individuals collecting samples run the risk of drowning and exposure to harmful by-products such as Hydrogen Sulfide. An unmet need exists to develop a system to collect wastewater samples in a faster, safer, and more cost-effective manner. We have developed a UAV based water monitoring platform that allows for water samples to be collected in a faster, safer, and more cost-effective manner. Using electric motors, microcontrollers and 3D printed parts, this product can attach to a multitude of commercial UAV's and work in conjunction with their normal flight operations. The user can either (1) automatically control the collection with an Arduino microcontroller via the press of a button or (2) manually control the collection module using a handheld radio control (RC) remote. This collection module allows agriculture and livestock producers to collect water samples for testing in a safer, faster and more cost effective manner.

40. Mothers' Experiences with Interpersonal Violence as Risk to Antenatal Care: A Latent Class Analysis of the Tanzania Demographic and Health Survey

Eric Smith (Texas A&M University)
Aggie Research Program
Research Advisor(s): Francisco Ishino

Background/Significance: Children under five living with HIV is a prevalent health burden in Tanzania. Major public health efforts have been successful in decreasing the once prominent disease. However, to fully achieve the overall Healthy People 2020 goals, novel environmental risk factors must be identified. The focus of this research was on critical environmental determinants from interpersonal violence (IPV) on HIV testing during antenatal care (ANC) visits. *Methods:* MPlus 8 was used for latent class analysis (LCA) on the Tanzania Demographic and Health Survey 2010. LCA refers to a technique to identify unobservable – or latent – subgroups within a population. LCA provides an ability to understand the impact of multiple risk exposures to identify intervenable factors. The use of LCA allows for the creation of tailored interventions for the most at-risk subgroup within a population. *Results:* LCA indicated three classes: mothers with no experience of IPV (56%); mothers with moderate levels of IPV (29%); and mothers with high levels of IPV (15%). Mothers with no experience of IPV were the most likely to use ANC (77%). Multinomial logistic regression comparing mothers with no experience of IPV to those having moderate and high levels of IPV revealed that type of residence (rural versus urban), ANC visit with HIV-PMTC talk, and mother's formal education did not have a significant role. *Conclusions:* IPV experiences were the most significant and determining factor of ANC HIV testing. Interventions focusing on empowerment of women could possibly improve HIV testing during ANC visits.

41. Strain Measurements From Both Sides of Rat Skin

Gerardo Castañeda (Texas A&M University)
Biomechanical Environments Laboratory (BMEL) Undergraduate Research Program
Research Advisor(s): Michael Moreno, Mingliang Jiang

Obtaining mechanical properties of tissues is useful because they can help tissue engineers create regenerative medicine. Biological tissues are complicated to examine because they are multilayered, inhomogeneous, and anisotropic. The results on the top layer could be different from the bottom layer. For this reason, it is imperative that we conduct mechanical tests with the same conditions on both sides of the sample. In this experiment, a biaxial system was used to perform uniaxial tensile tests on rat skin tissues to determine whether both sides of the tissues exhibit the same deformation or not. The tissues were marked with four black beads on each side. One camera was mounted on each side to capture the motions of the beads. A custom written program is used to track the beads and calculating deformation.

51. Benchmarking Machine Learning Methods for Predicting the Pathogenicity of Missense Mutations

Oluwaseyi Moronfoye (Texas A&M University)
USRG
Research Advisor(s): Yang Shen

Missense mutations are genetic mutations in which a change in nucleotides (the basic structural units that form DNA and RNA) results in a change in gene products and the workhorse molecules of life – proteins. Some of these mutations can be highly pathogenic, increasing the chances of various kinds of cancer, whereas some can be relatively benign. For more insights into how to classify the pathogenicity of missense mutations and how to unravel the underlying mechanisms, I have employed different machine learning models and assessed their ability to accurately classify hundreds of BRCA1 and BRCA2 genetic mutations into two broad classes – likely non-pathogenic and likely pathogenic (increasing the risk of breast cancer). To that end, I have applied machine learning models including support vector machine, random forest, and regularized logistic regression. And I have used both linear and nonlinear kernels to improve separability, cross-validation to determine the optimal hyperparameters, and various methods to address challenges from the imbalanced dataset. I have also used principal component analysis to visualize the data and understand the model performances, which has led me to propose future improvements for model accuracy such as including more examples and both structural and functional mutation features.

52. Older Populations and TNC Utilization

Eric Wheeler (Texas A&M University)
TTI Safe-D
Research Advisor(s): Melissa Tooley, Laura Higgins

Transportation Networking Companies (TNCs) have been on the rise in the last decade for various individuals. A TNC is an opportunity that allows a passenger to arrange a ride through a digital network where the driver is compensated for this service that is more than the driver's costs of providing the ride. TNCs operate from a digital network, which could be introduced through smart-phone application or by a simple phone call in some scenarios, but none-the-less this kind of access plays as a huge influence in the audience groups that widely utilize these services. The reason being, it is quite noticeable that the upcoming/younger generations know about and are a whole lot more comfortable with TNCs compared to older communities. A big portion of most TNC use is through technological advancement making this statistic considerably understandable, introducing the initial barrier, exposing older communities that can't necessarily be on roadways as they use to, the aids and assets that TNCs provide. Overcoming this barrier is going to be one of the most important tasks I face this summer by producing and developing outreach materials to inform and educate older populations about using TNCs. Beneficial outreach could consist of a guidebook with specific details including how to use a smartphone and smartphone applications as well as educational/technical articles to mitigate additional perceived barriers with an overall purpose of providing insight within the transportation industry on how to maintain mobility and increase safety for older populations who face limitations.

53. Modelling Autonomous Vehicle Car Following

Christopher Nelson (Texas A&M University)
TTI Safe-D
Research Advisor(s): Alireza Talebpour

This research paper examines how human drivers behave while following CACC autonomous vehicles. This paper includes a literature review of CACC adapted vehicles, car following behavior, and ACC adapted vehicles. In past research, many researchers have noted that human drivers are frequently involved in rear-end collisions with autonomous vehicles. Many researchers have suggested that by altering the braking behavior of autonomous vehicles, these collisions could potentially be avoided. In this research paper, autonomous vehicles were modelled with a wide variety of car following scenarios. In each of these scenarios, the autonomous vehicle was being followed by a human driver. In the first model, pedestrians crossed in front of the autonomous vehicle, resulting in a necessary stop. The behavior of the human drivers following the vehicle was noted. In another model, the autonomous vehicle arrived at a stop at a red light at an intersection. The behavior of the human drivers behind the vehicle was again noted. And in another model, the vehicles were engaged in free flow traffic, typical of a standard highway, and the car following behavior of the human drivers was noted. Following the completion of these models, Dr. Alireza Talebpour and I tested the models using an autonomous vehicle on a closed course. Following the testing of the autonomous vehicle, the results were recorded and conclusions were drawn on the effectiveness of the model in potentially reducing rear-end collisions with autonomous vehicles.

54. Vision Based Detection of Emergency Vehicles

Katherine Garcia (Texas A&M University)
TTI Safe-D
Research Advisor(s): Sivakumar Rathinam

The future of vehicle autonomy depends on its ability to operate safely. This includes the potentially life saving requirement of yielding to emergency vehicles. For this project, the object detection algorithm was trained to detect police emergency vehicles in real time. In order to train the algorithm to accurately distinguish police vehicles from other means of transportation, the model was supplied with a database of vehicle images. The image frames were taken from videos of emergency vehicles on the road and were annotated to form the database used to train the algorithm. Annotating the data consisted of using software to indicate the location of police vehicles, as well as non-emergency vehicles. Once the algorithm was trained, it was then tested on a new set of traffic videos to confirm it could distinguish police vehicles from non-emergency vehicles. The accuracy of the system was measured by recording the police vehicle identification results of each frame. The trained object detection algorithm demonstrated an accuracy of 83% and a precision of 95%. Images of other emergency vehicles like firetrucks and ambulances will be added to train the algorithm to recognize all types of emergency vehicles. This method of visual emergency vehicle detection proved to be effective, and could be paired with siren audio detection to form an integrated approach for autonomous vehicles to comply with traffic laws and operate safely.

55. Safe-D: Countermeasures to Detect and Combat Inattention while Driving Partially Automated Systems

Andres Crucetta Nieto (Texas A&M University)
TTI Safe-D
Research Advisor(s): Thomas Ferris

Nearly 1.3 million people die in road crashes each year, on average 3,287 deaths a day. While most of these accidents could be prevented with the rise of self-driving vehicles, humans will still need to be aware of the vehicle and its environment. To fully take advantage of the self-driving revolution we need to set in place the right alert systems within each vehicle to let the human take-over in yet undiscovered areas. This project will investigate and develop countermeasures for problems that can arise when human drivers are required to recognize an automation failure, and assume manual control of a partially automated vehicle. This study incorporates a driving simulator, and three sets of displays: auditory, visual and tactile. The displays will prompt the driver to take over in those key scenarios in which the driver's self-driving system will disable itself upon different road conditions. After conducting this study, the researchers hope to integrate the best-performing displays into an automated vehicle and evaluate the performance of the system under realistic conditions.

56. Countermeasures to Detect and Combat Inattention while Driving Partially Automated Systems

Lea Huntington (Texas A&M University)
TTI Safe-D
Research Advisor(s): Thomas Ferris

This project will investigate and construct countermeasures for situations when humans driving assume control of partially automated vehicles and have to recognize a fault in the system. This project is a combined effort of researchers at Texas A&M, Texas Transportation Institute (TTI), and Virginia Tech Transportation Institute (VTTI). TAMU team is responsible for the literature review, developing scenarios that test driver inattention combined with automation faults that could endanger drivers, and determining the best cue system to guide eyes for the transition manual driving. The scenarios are formed using STISIM drive, a driving simulator and will be used to conduct a human subject study that will use 3 different multisensory cues (visual, auditory, tactile) to guide attention back to the controls. There are three scenarios that each participant will complete. The first one is to teach the user how to use the simulator, the second is a baseline for driving ability, and the third is to test the different displays with different events. The third scenario is used to test situational awareness and attention.

57. Local Volume Database

John Maner (Texas A&M University), Liam Plybon (Texas A&M University)
Astronomical Research and Instrumentation REU
Research Advisor(s): Andrew Pace, Jennifer Marshall

The Local Volume Database (LVDB) is an SQL database of measurements of hundreds of galaxies and globular clusters taken from over 250 publications. The LVDB allows users to access a current snapshot of the structural, dynamical, and chemical properties of Local Group satellites through user created SQL queries, Python, or precompiled .FITS tables.

58. Recyclable Polymeric Solvent Systems for Sequestration of Trace Polar Organics from Water

Mona Fattahi (Texas A&M University)
Independent Project
Research Advisor(s): David Bergbreiter

Water purification is of increasing importance not only because of the general need for clean fresh water but also because water is often contaminated with trace organics produced as by-products of modern industry. Typical trace organics include nonpolar species like benzene or halogenated alkanes – chemicals with known hazards. However, other impurities with polar groups are also problems. In this work, we have developed fully recyclable hydrocarbon solvent systems using mixtures of an oligomeric hydrocarbon and polymeric cosolvents – solvent systems that are nontoxic, nonvolatile, and inexpensive. In our preliminary work, we have carried out NMR spectroscopy studies using internal and external standards to show that these systems remove a number of polar organic compounds from water including water miscible neutral ethers, substituted polar arenes, and even perfluorinated trace organic compounds.

59. Laser-Based Fabrication of Bio-Inspired Surface Textures to Control Tribological Performance

Natalie Kane (Northeastern University)
Metrology and Non-Destructive Inspection REU
Research Advisor(s): Mathew Kuttolamadom

Drawing biomimetic inspiration from the superior tribological properties of snake scales, this project investigates micro texturing metal surfaces using an additive manufacturing machine, and the tribological performance associated with those textures. In order to maximize or minimize its friction at different points of travel, a snake possesses multiple types of scales with varying surface geometries, and motion capabilities. Applying this concept to a synthetic material, the surface of a metal part can be similarly textured in order to maximize or minimize its coefficient of friction. For this, a laser within an additive manufacturing machine (selective laser melting) was used to engrave patterns onto a sample. After creating a sample containing 22 sections of varying surface geometries, each section was characterized in order to ascertain the accuracy of the intended patterns at micro scales using a high resolution Alicona surface profiler. Next, an inclined plane sliding test was performed to find their coefficient of friction. The tribological properties were further measured using tribometric tests. Based on these results, additional textures were created that included gradient patterns, as well as bio-inspired variations to control friction/wear.

60. The Supermassive Black Hole Hunt: Examining the Kinematics of Galaxy NGC 1270

Satya Butler (Bowdoin College)
Astronomical Research and Instrumentation REU
Research Advisor(s): Jonelle Walsh

We examined the galaxy NGC 1270 using spectra obtained from the 10m Keck I telescope in Hawaii assisted by adaptive optics (AO) with the near-infrared, integral field unit (IFU) OSIRIS.We processed the raw frames using the OSIRIS data reduction pipeline to produce calibrated spectra at hundreds of different points within the galaxy. Then, using a Python routine that we wrote, a Penalized Pixel-Fitting (pPXF) method was applied to the spectra to determine the line-of-sight velocity distribution of the stars, characterized by the velocity, velocity dispersion, and higher-order moments that measure the distribution's deviation from a Gaussian shape. Analyzing this kinematic information will allow us to constrain the mass of the supermassive black hole at the center of NGC 1270.

61. Selection of Milky Way Analogs using the Dark Energy Survey

Silvana Delgado Andrade (University of Massachusetts Amherst)
Astronomical Research and Instrumentation REU
Research Advisor(s): Louis Strigari, Jennifer Marshall

The study of satellite galaxies around Milky Way (MW) analogs is crucial for understanding the structure of galaxies and their dark matter halos. We present the methods used to select a sample of MW analogs using Dark Energy Survey's year-three release, investigating MW analog galaxies in this footprint for the first time. We compare our results to a study done with the Sloan Digital Sky Survey on the abundance of satellite galaxies around MW-like galaxies. We identify candidates as nearby galaxies ($z < 0.055$) with color $g - r > 0$ and an absolute magnitude within +/- 0.25 of the MW. Additionally, we develop a method to remove candidates that have objects brighter than the MW and lie within a chosen angular distance of the candidate galaxy. As a result, we identified 3017 analogs, in comparison to the 8388 analogs from the SDSS study. This will be used to statistically identify the number of satellites around MW-like hosts, an important measurement for classifying dwarf spheroidal galaxies and dark matter subhalos.

62. Modeling ^{8}B Solar Neutrino Detection in CEvNS

Nikko Cleri (University of Connecticut)
Astronomical Research and Instrumentation REU
Research Advisor(s): Louis Strigari

In the continued search for dark matter and information about the energy density of the universe, it is becoming increasingly evident that many answers may come from the study of neutrinos. This presentation discusses methods used to create models for the observation of coherent neutrino-nucleus scattering (CEvNS) events in neutrino observatories. For this project, we focus on the ^{8}B produced solar neutrinos, which are the biggest background in dark matter searches. We also address the potential limitations of modern detectors by modeling the expected events detected above a minimum threshold recoil kinetic energy. For the most massive nuclear targets, xenon detectors, we expect a flux of $\sim 10^{3}$ events per ton per year over all threshold recoil energies.

63. Measuring Proper Motions of Fornax and its 5 Globular Cluster Using Gaia Data Release 2

Kelsey Glazer (Towson University)
Astronomical Research and Instrumentation REU
Research Advisor(s): Jennifer Marshall

Fornax is one of the most massive dwarf spheroidal satellite galaxies of the Milky Way and is unusual for it contains 5 globular clusters (GCs). Based on the standard distribution of dark matter in galaxies, the Fornax GCs are predicted to spiraled into the center of Fornax by now. Their long-term survival has implications for the nature and distribution of dark matter in galaxies, which makes measuring their proper motions (PMs) even more crucial. Due to the far distance of Fornax and its GCs, measurements of their PMs are difficult to obtain. However, with the release of Gaia Data Release 2 (Gaia DR2), we are given the largest and most precise measurements of an all sky survey to date. From Gaia DR2, we examined Fornax and its 5 GCs in PM space. We conclude with a PM measurement of Fornax and the first ever PM measurement of GC2. An overcrowding issue prevented the PM measurements of the 4 other GCs. Although the current precision of Gaia is not high enough to improve our understanding of the dark matter halo, future Gaia releases will be able to.

64. Analysis of RR Lyrae Stars in Milky Way Stellar Streams

Jessica Myron (Texas A&M University)
Astronomical Research and Instrumentation REU
Research Advisor(s): Jennifer Marshall

RR Lyrae stars are old, metal poor pulsating variable stars typically found in discrete stellar populations such as galaxies, globular clusters, and their disrupted remains called stellar streams. Because of their well-calibrated period-luminosity relationship, RR Lyrae are excellent distance indicators; and can be used to determine the distance to the stellar populations where they are formed. We searched through RR Lyrae discovered by the Dark Energy Survey to potentially find if these stars are associated with various known galaxies and stellar streams. One such stream we evaluated was Indus, and we determined the membership of nearby RR Lyrae by analyzing their proper motions from the Gaia space satellite. Further analyzing Indus and other stellar streams will increase our knowledge of dark matter distributions in the stellar halo, improve our distance estimates in the local universe, and shed light on the formation of our own Milky Way galaxy.

65. Software Development for Tcal: A Mobile Spectrophotometric Calibration Instrument

Sarah Hughes (Royal Holloway)
Astronomical Research and Instrumentation REU
Research Advisor(s): Jennifer Marshall, Peter Ferguson

TCal is a mobile spectrophotometric calibration unit that will be used to characterise imaging systems at observatories around the world. We developed software in LabVIEW to automate our scans to measure transmission as a function of wavelength and place all calibrated systems on a common photometric baseline. Our calibration system uses a ~1 nm wide tunable source to measure the instrumental response function of the telescope optics and detector from 300 nm up to 1100 nm. The system consists of a monochromator-based tunable light source that illuminates a flat field screen. This screen is monitored by calibrated photodiodes allowing us to measure the telescope throughput as a function of wavelength. This system will be taken to various 1-8m telescopes that expect to devote time to wide field/synoptic survey follow-up.

66. Photometric Analysis of SN 2018bgz

Sebastian Gonzalez (University of Pennsylvania)
Astronomical Research and Instrumentation REU
Research Advisor(s): Kevin Krisciunas

Over the past few decades, Type Ia Supernovae (SN Ia) have proven to be very useful tools in Extragalactic Astronomy and Cosmology due to the fact that they behave as "Standardizable Candles," objects that adhere to observable relations that allow for methods to calculate their intrinsic brightness. With the knowledge of a Supernova's (SN's) intrinsic brightness, a great deal of further information can be inferred through photometric analysis. Here, we present an illustrative example of how that analysis can be done and what can be learned from it. Specifically, we present the result of our photometry of images taken over the course of about 3 weeks with CCD detectors on the 1-m Swope telescope at the Las Campanas Observatory and various other nodes of the Las Cumbres Observatory Global Telescope of SN 2018bgz, a SN Ia located in the outskirts of UGC 9544. The most notable results from our photometric analysis include an inferred distance to the SN of $d = 142.4 \pm 5.4$ Mpc which corresponds to a redshift of $z = 0.034$, a Burns stretch-BV value of $s_{BV} = 1.089$, and a Hubble constant of $H_0 = 71.4 \pm 3.4$ km s^{-1} Mpc^{-1}. Evidently, our analysis indicates that SN 2018bgz is close to a normally declining SN Ia, a conclusion that is made more sound by the fact that our value for the Hubble constant is consistent with other more robust measurements.

67. Development of pETSI: prototype Exoplanet Transmission Spectroscopy Imager

Taylor Plattner (The University of Kansas)
Astronomical Research and Instrumentation REU
Research Advisor(s): Darren DePoy, Luke Schmidt

The goal of this project was to build a device, called pETSI, which is specifically designed to identify and directly measure atmospheres around a large number of exoplanets orbiting bright stars. Light from the telescope will enter pETSI and be collimated by a 200 mm camera lens. The collimated beam will pass through a prism, which provides a precise amount of dispersion (high enough to separate the resulting multi-band images). After dispersion, the light passes through a multi-band filter and the filter will transmit a large number of well-defined bands onto a spot on a detector. From the resulting spectra, we will be able to observe hundreds of transits and use the presence of known atmospheric features to signify the presence of an exoplanet atmosphere. In future work, pETSI will be used for a campaign to observe hundreds of TESS-identified targets using relatively small telescopes (1-2m-class), with the goal of determining which targets are most valuable for follow-up by larger and more precious resources such as the James Webb Space Telescope (JWST) and large ground-based facilities.

68. IIb or Not IIb: The Photometry of Type IIb Supernovae

Katya Leidig (Boston University)
Astronomical Research and Instrumentation REU
Research Advisor(s): Peter Brown

Type IIb supernovae (SN IIb) are a type of core-collapse supernova, meaning they result from the explosion of massive stars, and are characterized by their spectra, which evolve from being dominated by Balmer hydrogen lines to helium lines. This unique spectral evolution is thought to be due to partial stripping of a hydrogen rich envelope from the event's progenitor. With the rapid increase of supernova detections by large telescopes in the past decade, more multi-wavelength photometric data is available than ever before, including data from the Swift Ultra Violet Optical Telescope (UVOT) in six ultraviolet and optical filters. Here we have compared and analyzed the photometric light curves of four type IIb supernovae, focusing on the UV and visible bands. This analysis will be able to aid astronomers in predicting the detectability of supernovae at large distances where the UV bands are redshifted to optical wavelengths, as well in the classification of type IIb supernovae.

69. Dynamical Fragment Formation In CoMD Simulations

Bryan Harvey (Moravian College)
Cyclotron REU
Research Advisor(s): Sherry Yennello

Previous measurements have been made showing a relationship between fragment alignment and composition in heavy ion collisions. It is proposed that as the post-collision excited dinuclear projectile-like-fragment (PLF*) rotates for some time until it dynamically splits into two fragments at which point neutron-proton equilibration and rotation would simultaneously cease. This mechanism should imply a relationship between these fragments' alignment, composition, and post-collision contact time. In order to understand these relationships, Constrained Molecular Dynamics (CoMD) simulations were run using a Zn-70+Zn-70 collision at 35 MeV/nucleon. We focus on events where the light fragment has a charge of Z=4; a geometric filter of $4.5° < \theta < 27°$ is applied. Visualization techniques were developed for event-by-event detailed analysis to better understand the mechanisms predicted in the model. As expected, correlations between contact time, fragment alignment, and composition were observed.

70. TDHF Calculation of 238U+232Th at 7.5 MeV/nucleon

Ian Jeanis (Texas A&M University)
Cyclotron REU
Research Advisor(s): Sherry Yennello

For the past three decades, multinucleon transfer reactions has been studied as a alternate form of producing more neutron rich super heavy elements. Multinucleon transfer in heavy ion collisions was investigated using Time Dependent Hartree Fock (TDHF) formalism. TDHF is used to evaluate 238U+232Th collision at Elab = 7.5 MeV/nucleon to determine potential outgoing fragments. The reaction was explored with prolate deformed nuclei parallel (aligned) and perpendicular (anti- aligned) to the beam. Information regarding angle, mass and charge, contact time were obtained from the exit channel. The 238U+232Th reactions displayed greater mass exchange when the reactants displayed aligned and anti-aligned configurations.

71. Sensitivity of Electric Dipole Polarizablity to Bulk Nuclear Properties

Ethan Hunt (Seattle Universtiy)
Cyclotron REU
Research Advisor(s): Shalom Shlomo

Electric dipole polarizability, α_D, has been considered in the literature to be sensitive to the neutron skin Δr_{np} and density dependence of the symmetry energy $J(\rho)$. We carry out a detailed investigation of the sensitivity of α_D to $J(\rho)$ and its derivatives evaluated at the saturation density ρ_0, neutron skin thickness, and other bulk nuclear matter (NM) properties. We use the Hartree-Fock based Random phase approximation to calculate α_D from the strength function for the isovector giant dipole resonance for ^{40,48}Ca, ^{68}Ni, ^{90}Zr,^{120}Sn, ^{208}Pb and compare with experimental data. We also determine the Pearson linear correlation coefficients between α_D and NM properties. Our calculations were carried out using 33 Skyrme type interactions with wide ranges of values for NM properties. We determine approximate bounds on the values for certain NM properties.

72. Desktop Cement 3-D Printer

Miguel Cervantes (Texas A&M University), Miguel Esparza (Texas A&M University),
Derek Li (Texas A&M University), Aaron Sanderson (Texas A&M University)
Aggie Research Program
Research Advisor(s): Zhijian Pei

The construction sector is an $8.5 trillion global industry. It accounts for 6% to 10% of the workforce in industrialized countries. It is also a major contributor to the U.S. economy. In 2016, it accounted for 4.3% of the national employment. However, the industry faces certain challenges. As per the International Labor Organization (ILO), 25% to 40% of work-related deaths in industrialized countries occur at construction sites. Furthermore, productivity in the industry continues to remain a challenge. The emergence of additive manufacturing (AM) processes capable of printing large-scale structures could help address these challenges. The objective of this research project is to construct a desktop scale extrusion-based cement 3D printer. The design process involves modifying a desktop 3D printer that uses the fused filament fabrication (FFF) AM process. The modifications involve major hardware and software changes. These changes include adding material delivery system for the cement mixture, incorporating structural support for the system components, and appropriate modifications to the printer's firmware to facilitate material extrusion. Knowledge gathered in this research project would be vital to understanding the relationship between process parameters, material properties and part quality. This printer will be used as a proof-of-concept for developing a larger-scale printer capable of extruding human-scale structures. Large-scale implementation of AM processes in civil infrastructure construction would facilitate improved safety and productivity in the global construction industry.

73. Preliminary Construction of Directional Fast Neutron Detector

Tyler Milkeris-Zellar (University of West Florida)
Cyclotron REU
Research Advisor(s): Grigory Rogachev

Developing a fast neutron detector with directional capabilities has useful advantages above current techniques. Directionality has the advantage of allowing the distinction of a weak neutron source from ambient neutron background. The viability of three potential photomultiplier devices: a SensL silicon photomultiplier (SiPM), a Hamamatsu SiPM and a Hamamatsu photomultiplier tube (PMT) was tested and prompted the energy calibration of the leading Hamamatsu PMT. By utilizing the charge over amplitude pulse shape discrimination (PSD) method, the standard figure of merit formula was used to quantify the neutron and gamma discrimination for each of the photomultiplier devices. For the photomultiplier with the best figure of merit, energy calibrations were done using the time of flight between a signal produced by fission fragments and neutrons resulting from the spontaneous fission of Cf-252 detected in a para-terphenyl scintillator. This work identified the optimal photomultiplier to be the Hamamatsu PMT and a successful energy calibration of this PMT was performed. This work has provided advancements that are essential in the eventual development of a directional fast neutron detector prototype.

74. Using Machine Learning to Improve Discrimination between Gamma and Neutron Events in P-Terphenyl and 6Li Glass Detectors

Sophia Andaloro (University of Dallas)
Cyclotron REU
Research Advisor(s): Grigory Rogachev

Developing reliable neutron-gamma pulse shape discrimination methods for scintillator detectors is important for fundamental science and modern applications. Traditional pulse shape discrimination approaches become inadequate for low energy particles. We developed and optimized machine learning methods in order to overcome these energy limitations and improve neutron-gamma separation. We sought to classify these particles using an artificial neural network (ANN) and visualize neutron-gamma separation through dimensionality reduction techniques. In order to create training and testing data sets, p-terphenyl crystal and ^{6}Li glass detectors were used to detect isolated gammas from fast neutrons (p-terphenyl) and thermal neutrons (^{6}Li glass). This data was then used to optimize the ANN which consisted of a non-sequential model using binary classification. Dimensionality reduction techniques were used to separate neutrons and gammas for visualization purposes. We discuss the accuracy of the ANN in separating neutrons and gammas over the incident energy spectrum and present dimensionality reduction methods which yielded distinct separation between gammas and neutrons.

75. Coherent Dielectron Pair Production in High Energy Indium Collisions

John Thomas (Texas A&M University)
Cyclotron REU
Research Advisor(s): Ralf Rapp

An excess of dielectron pairs has been measured in high-energy heavy-ion collisions at low transverse momentum. These dielectrons cannot be explained with modern models of the thermal radiation from Quark-Gluon Plasma and hadronic matter. This excess is a strong indication of virtual photon interactions prior to the collision. Current models of virtual photon interactions deviate from experimental data at lower dielectron masses. To investigate the discrepancy, we will present new calculations describing the production of coherent dielectrons from virtual photon interactions in peripheral Indium-Indium collisions at SPS energies (17.3 GeV per nucleon). These calculations will explore, in this reaction, the excess of dielectrons in the lower mass region.

76. Mass Measurements Using TAMUTRAP and Upgrades to its Control System

Cristhian Gonzalez Ortiz (Universidad de los Andes)
Cyclotron REU
Research Advisor(s): Dan Melconian

The TAMUTRAP facility, located in the Cyclotron Institute at Texas A&M University, is based on a novel, large-diameter cylindrical Penning trap where radioactive ions are confined. The main objective of this experiment is to test the Standard Model by making precise measurements of the ß-v angular correlation parameter on several isospin T=2 super-allowed proton emitters (e.g. ^{32}Ar). In order to efficiently load the ions into the Penning trap, a radio frequency quadrupole (RFQ) gas cooler and buncher is used. The following work focuses on the calibration process used in order to remotely control the pressure of the gas cooling system and several high voltage power supplies used throughout the beamline. Several LabVIEW VI's were designed for this purpose. Additionally, the mass of ^{23}Na was measured relative to ^{39}K to demonstrate the mass-measurement capabilities of TAMUTRAP. The measured mass of ^{23}Na was 22.9897738(22) u, which agrees with the literature value within a precision of $1.9*10^{-7}$.

77. Mass Measurements of ^{23}Na and Beamline Upgrades for TAMUTRAP Facility

Guadalupe Duran (Brandeis University)
Cyclotron REU
Research Advisor(s): Dan Melconian

The Texas A&M University Penning Trap (TAMUTRAP) facility was designed to test the Standard Model by studying the β^{+}-ν_e angular correlation parameter of superallowed β-delayed proton decays. Currently, the trap is being commissioned by utilizing stable isotopes to perform precision mass measurements. Using the prototype Penning trap, we performed mass measurements of ^{23}Na by analyzing the time-of-flight and resonance frequency of the ions. We found the mass of ^{23}Na to be 22.9897659(18)u which agrees with the literature value within a precision of $1.5x10^{-7}$. After performing these measurements, we implemented several upgrades to the hardware of the facility. This included the cleaning, assembling, and installation of a spherical deflector and beam steerer. Additionally, an attempt to realign Section I of the TAMUTRAP beamline was made using an optical transit technique to prepare the Penning trap to receive radioactive beam from the K150 cyclotron. We found that to be fully aligned with the K150, we need to shift section II of the beamline as well, which will be done in the early Fall. Finally, the new, full-sized Penning trap was cleaned, assembled and preliminary tests were conducted to prepare for its installation.

78. Using PIXE and PIGE for Elemental Composition Analysis

Elysia Salas (Texas A&M University)
Cyclotron REU
Research Advisor(s): Alis Manso, Sherry Yennello

PIXE (particle induced x-ray emission) and PIGE (particle induced gamma-ray emission) are complementary ion beam analysis (IBA) techniques used to study elemental composition both quantitatively and qualitatively. PIXE uses alpha emission or a proton beam to induce atomic transitions from higher to lower energy levels as appropriated by the Bohr model. PIGE utilizes an ion beam to cause a nuclear reaction by overcoming the Coulomb repulsion of a nucleus, interacts with nuclear particles and yields gamma-rays. A CdTe (x-ray and -ray) and Si-PIN (x-ray) detector were used to detect energy emissions of four samples in air and vacuum using a 9.5 mCi Am-241 alpha source. The detectors were calibrated by using 1µCi of Ba-133, Co-57, and Am-241. An $E^{1/2}_{x\text{-}ray}$ versus Z curve was established to approximate Z values of unknown energy peaks in samples for the CdTe detector by analyzing ^{29}Cu, ^{73}Ta, ^{50}Sn,^{35}Br, 1µCi Co-57 and 1µCi Ba-133. Based on the limit of detection, the samples were analyzed for: the presence of Fe/Ni in a sample, the success in eradicating Al from a “raw” versus “treated” sample and the identification of O in a carbonized sample. The Al counts in the “treated” sample were below the limit of detection and were interpreted as a success. In the sample associated with the detection of Fe/Ni, sufficient Ni was detected but Fe was not. In the case of oxygen, the attributed energies of O could not be distinguished from electronic noise experienced by the detectors.

79. Bayesian Modelling of the PSR J0737-3039A Moment of Inertia

Robert Stahulak (University of Utah)
Cyclotron REU
Research Advisor(s): Jeremy Holt, Yeunhwan Lim

Neutron star observations have the potential to strongly constrain models of the nuclear equation of state. In the near future, precise measurements will be made of the moment of inertia for several known neutron stars. The purpose of this work is to make predictions to further constrain the parameters of the dense matter equation of state using these measurements. To this end, we will calculate neutron star moments of inertia for a wide class of equations of state already constrained by microscopic many-body theory and empirical data. The neutron star moment of inertia will be derived from numerical solutions of the Tolman-Oppenheimer-Volkov (TOV) equations assuming a symmetric fluid body with corrections for general relativity using a slow-motion approximation. Comparisons were made with a prior determination of the mass of the binary pulsar PSR J0737-3039A.

80. Precise Measurement of Transition in ^{103}Rh from ^{103}Ru decay to Test the Internal Conversion Theory

Xavier James (University of Wisconsin-La Crosse)
Cyclotron REU
Research Advisor(s): John Hardy

This project is an extension of a series of precision measurements of internal conversion coefficients (ICC) to the 39.8-keV, E3 transition in ^{103}Rh. Our goal is to distinguish the two versions of the internal conversion theory, one which ignores the atomic vacancy left behind from the emitted electron and another that takes the vacancy into account. A RuCu sample was activated with thermal neutrons at the Texas A&M TRIGA reactor. Spectra were recorded with an HPGe detector was calibrated to a precise efficiency of about ± 0.15% relative uncertainty. In the acquired spectra, the impurities of the ^{103}Ru source were properly analyzed and amended based on the energy and areas of the γ -ray peaks using MAESTRO-32, a multichannel analyzer software program, and the Evaluated Nuclear Structure Data File (ENSDF) database. The more precise gf3 γ-ray analysis software further used to get the precise peak areas of the intense transitions of ^{103}Rh to get the clean areas of the 20.6-keV Rh K x-rays and the 39.8-keV γ -ray used to extract the experimental value of the. In comparison to the theoretical calculations, our preliminary result, although not in agreement with both theoretical calculations, is much closer to the hole “frozen orbital” limit but in clear disagreement with the “no hole” limit in accordance with the previous results. More experiments are required to further improve upon the internal conversion theory with taking into account the vacancy left by the atomic electron.

81. Precise Measurement of 39.8 E3 Transition into ^{103}Rh from ^{103}Ru decay to Improve the Internal Conversion Theory

Xavier James (University of Wisconsin-La Crosse)
Cyclotron REU
Research Advisor(s): John Hardy

This project is an extension of a series of precision measurements of internal conversion coefficients (ICC) to the 39.8-keV, E3 transition in 103Rh. Our goal is to distinguish the two versions of the internal conversion theory in which one ignores the atomic vacancy left behind from the emitted electron and another that takes the vacancy into account. The first sample of Ruthenium Oxide analyzed previously was contaminated with 153Gd that affected the 39.8-keV region, reason in which we activated a second 1.1 mg/cm2 of natural Ru on a Cu backing to determine a more accurate ICC. A RuCu sample was activated with thermal neutrons at the Texas A&M TRIGA reactors. Spectra were recorded for seventy-four days with an HPGe detector that has been calibrated to a precise efficiency of about ± 0.15% relative precision for a large range of energies. In the acquired spectra, the impurities of the 103Ru source were properly analyzed and amended based on the energy and areas of the γ -ray peaks using MAESTRO-32, a multichannel analyzer software program, and the Evaluated Nuclear Structure Data File (ENSDF) database. The more precise gf3 γ-ray analysis software further used to get the precise peak areas of the intense transitions of 103Rh to get the clean areas of the 20.6-keV Rh K x-rays and the 39.8-keV γ -ray used to extract the experimental value of the α. Our preliminary result is in better agreement with the theoretical calculations including the atomic vacancy; this is consistent with our previous measurements, indicating that the atomic vacancy must be taken into account.

82. Designing Dichroic Filters for Use in a Microwave Camera to Study Electron Cyclotron Resonance Ion Sources

Sarah Peery (Willamette University)
Cyclotron REU
Research Advisor(s): Carl Gagliardi

The Electron Cyclotron Resonance (ECR) ion sources in use at Texas A&M University are well understood in their function, but better diagnostics are needed to study the details of ECR plasma dynamics. Currently, a microwave camera sensitive in the 15-85 GHz range is being designed to image the Electron Cyclotron Emission (ECE) from the plasma. The camera will include a set of dichroic filters to prepare the signal for reception by the antenna array and superheterodyne receiver electronics. The dichroic filters will be made up of arrays of aperture antennas and designed to electronically switch between passbands with 10 Ghz bandwidth. This work explored potential designs and optimized various array geometries via MEEP, an electromagnetic simulation software that uses the finite-difference time-domain (FDTD) method, and a hill climbing algorithm.

83. Extraction of Indium into Hydrophobic Amine-Based Mixtures from Dilute Hydrochloric Acid Medium

Joseph Edgecomb (Saint Martin's University)
Cyclotron REU
Research Advisor(s): Mike Youngs, Folden lll, Evegeny Tereshatov

A method for the extraction of Indium into hydrophobic Eutectic Solvents (ESs) from dilute Hydrochloric Acid is reported in this work. ESs are mixtures of at least 2 compounds in which the melting point of that mixture is lower than those of the individual components. Combinations of 3 amine-containing compounds, Lidocaine, Grape Smell (Methyl Anthralate) and Proton Sponge (1,8-Bis(dimethylamino)naphthalene) as well as DL-menthol and Ibuprofen, were used to prepare hydrophobic binary (2 compounds) and ternary (3 compounds) systems. The compositions of these mixtures corresponding to the lowest melting or glass transition temperature are used for liquid liquid extraction. The transfer of Indium from the aqueous phase to the organic phase was measured based in the ratio of activity of the tracer isotope In-111 between the two phases after separation. The mechanism of extraction of Indium into the organic phase is also reported in this work.

84. Study of 22Ne(6Li,t)25Mg Three Particle Transfer Reaction Using TIARA and MDM Spectrometer

Esha Rao (Rutgers University)
Cyclotron REU
Research Advisor(s): Greg Christian, Shuya Ota

The (^{6}Li,*t*) transfer reaction serves as a powerful tool to study ^{3}He clustering states. Furthermore, for N=Z target nuclei (^{6}Li,*t*) and (^{6}Li, ^{3}He) are expected to populate mirror states in the resulting recoil nuclei, due to the strong ^{3}He + ^{3}H clustering property of ^{6}Li. There is also potential to study nuclear structures by three particle transfer, e.g., using a radioactive ion beam, which can be a useful method for nuclear astrophysics. The ^{22}Ne(^{6}Li,*t*)^{25}Mg experiment was performed in inverse kinematics using a 7*A* MeV ^{22}Ne beam and ^{6}LiF target at the Texas A&M University Cyclotron Institute. To better understand (^{6}Li,*t*) three particle transfer reaction, measurements of ^{25}Mg, *t*, and gamma-rays were made in coincidence using a magnetic spectrometer, Si, and Ge detectors. By doing this, the populated states of ^{25}Mg were clearly identified thus enabling an understanding of the reaction selectivity. The angular differential cross sections were then measured to extract the spectroscopic factors. The results of this ^{22}Ne(^{6}Li,*t*)^{25}Mg analysis were compared with data from other reaction methods and theoretical calculations to improve the knowledge about the ^{22}Ne(^{6}Li,*t*)^{25}Mg reaction.

85. Finite Element Simulations: Preprocessing and Postprocessing

Bridget Le (Texas A&M University), Markus Mowatt-Larssen (Texas A&M University),
Luis Rodriguez (Texas A&M University)
Aggie Research Program
Research Advisor(s): Jean-Louis Briaud

The Architecture, Engineering, and Construction (AEC) Industry has a problem. As a new world with complex challenges prevails, simple means adopted to carry out engineering tasks no longer suffice. Exhaustion of existing resources, coupled with an exponentially increasing demand for infrastructure, call for drastic changes in mindset and processes. One way to optimize the use of resources is to promote the use of Finite Element (FE) modeling, especially considering the complexity of engineering projects. If adequately used, numerical simulations would produce optimum designs, which lead to optimal use of resources. Our multidisciplinary team took the initiative to learn modeling using a general-purpose FE program, LS-DYNA, and effectively and efficiently process the resulting data using MATLAB. The goal of this endeavor is to produce a set of documents that aid students, researchers, and practicing engineers in their modeling journey, and in making best use of the data produced. Flow charts are provided to highlight important steps, and successful and failed trials are documented for a more comprehensive learning experience.

86. Development of a Standardized Protocol for Point-of-Care Sleep Apnea

Vivek Tangudu (Texas A&M University)
Independent Project
Research Advisor(s): Satish Bukkapatnam

Studies show that 75% to 80% of patients with Obstructive Sleep Apnea (OSA) remain undiagnosed. Polysomnography (PSG) and Home Sleep Testing (HST), the current diagnostic options, come with the demerits of high rental cost and lack of resources to name a few. As a result, untreated OSA annually adds approximately $3.4 billion to health care costs in the United States. The development of an accurate, affordable, and convenient diagnostic device is necessary to improve worldwide accessibility to the assessment for OSA, and The Practice Parameters of the American Academy of Sleep Medicine (AASM) has presented recommendations for the manner in which to diagnose patients. Several clinics have implemented portable devices following such standards and proven to display a high degree of accuracy. However, a standard has not been established to maintain a consistent experimental protocol and equal validation in the quality of all devices. In an effort to improve the homogeneity of these validation studies, a set of standards have been proposed for implementation. A review of all validation methods such as actigraphy, portable monitoring(PM), and portable PSG bring to light the main points of consistencies and inconsistencies necessary for continued research. After considerable analysis of the experimental setup and methods performed for device validation, the proposed guidelines are classified in a manner of key features that should be included.

87. Language Mini-Nets: Deep Learning on Small Datasets for Automatic Language Identification

Kexin Feng (Texas A&M University)
Independent Project
Research Advisor(s): Theodora Chaspari

This study seeks to develop, demonstrate and validate a robust automatic language identification system for low-resource languages with origins in the African continent. Identification of low-resource data is a traditionally difficult machine learning problem because the sparsity of available resources prevents classifiers from being adequately trained. An effective way to address the inevitable data sparsity in certain applications, such as in low-resource language identification, is transfer learning, which uses the knowledge learned from tasks with large labeled data in settings of limited data. Motivated by the fact that various languages share common phonetic and phonotactic characteristics, the proposed system learns knowledge from rich resources European languages and transfer the knowledge to low resources African languages. The input of the system includes spectrogram patches of speech signals. A convolutional neural network will then be used to analyze this input to complete language identification task. The system is trained on the source data of European languages, while transfer learning is performed by fine-tuning the last layers of the network based on the African language data. The data used in this study come from the publicly available Lwazi corpus, which contains 11 African languages (South English, Afrikaans, isiXhosa, isiNdebele, Sesotho, Sepedi, isiZulu, Siswati, Setswana, Tshivenda, Xitsonga) at the length of 1-3 sec, and the repository VoxForge repository, from which 7 European languages at a 4-6 sec segment length are included (English, German, French, Spanish, Russian, Italian, Spanish).

88. Multi-Objective Stochastic Supply Chain Optimization

Srikari Ayyagari (Texas A&M University), Kevin Nguyen (Texas A&M University),
Branden Salinas (Texas A&M University), Ian Smith (Texas A&M University)
Aggie Research Program
Research Advisor(s): Lewis Ntaimo

The large number of interactions present in supply chains renders their synthesis and optimal design challenging. This is further complicated by the existence of several sources of variability such as uncertainty in feedstock quality, uncertainty in the prices of intermediate products, and uncertainty in consumer demand. Given these uncertainties, the simulation and optimization models used for supply chain modelling become non-deterministic and the decisions of optimally allocating resources, maximizing network flows, and minimizing inventory levels require the use of sophisticated mathematical models to maximize profit while minimizing the value at risk. This project proposes to develop a two-stage stochastic optimization model with continuous recourse to assist in the planning and scheduling of production and storage. Key components of the project include: demand and price forecasting, model formulation based on integer programming, extension of the model to multi-objective optimization, solution algorithm development, model implementation, and assessment of results.

Afternoon Session

3:00 PM – 5:00 PM

1. Global Warming and Internal Variability in Pacific Sea Surface Temperatures

Max Trostel (Carleton College)
Atmospheric Science in the Gulf Coast Region (ATMO REU)
Research Advisor(s): Yangyang Xu

We investigate a recent innovation in the approach to the old problem of separating externally forced climate change from internal climate variability. This method, called Low Frequency Component Analysis (LFCA), builds on more traditional methods in studying climate variability, Empirical Orthogonal Functions (EOF) analysis and Linear Discriminate Analysis (LDA), by distinguishing modes of variability according to timescale. We apply LFCA to Pacific sea surface temperatures from both historical data and the ensemble output from the Canadian Earth System Model dataset. This method produces a greater separation of different modes of external and internal variability than other methods.

2. Choice of Rain Gauge Networks and its Impact on Hurricane Harvey Rainfall Measurements

Alex Smith (Central Michigan University)
Atmospheric Science in the Gulf Coast Region (ATMO REU)
Research Advisor(s): John Nielsen-Gammon

For extreme rain events such as Hurricane Harvey, conclusions on storm-total rainfall accumulations are sensitive to the availability and quality of rain gauge measurements. This project assesses how the choices of rain gauge networks used for examining storm-total precipitation effects analyses of Hurricane Harvey. There are 8 different gauge networks available in Southeast Texas and Southwest Louisiana used in this study, with varying spatial density, perceived quality, and geographic coverage. After quality control of the observations to eliminate spurious observations, comparisons of gauge data to the radar-based National Weather Service (NWS) Quantitative Precipitation Estimator (QPE) 4-km product conclude that as the total rain accumulation increases, gauge accumulation increases from the radar estimate. Bias sources in radar-based QPEs are numerous and well-documented and biases in gauges are typically amplified during extreme rainfall events. To reduce biases in the radar-based QPEs, an algorithm corrects for radar beam blockages, noise suppression, and range effects. With accurate radar-based QPEs, we can determine if spatially correlated rain collection errors exist within the networks. When the errors are identified, bias corrections can correct radar estimated rainfall data and provide more accurate storm totals. Upon completion, our methodology can be applied to future work to improve radar estimated hourly and daily rainfall rates and accumulation, which can increase the accuracy of determining where flooding may occur.

3. Using Sferics Detection To Investigate on Storm Development and Lightning Safety

Mariama Feaster (Jackson State University)
Atmospheric Science in the Gulf Coast Region (ATMO REU)
Research Advisor(s): Timothy Logan

Using sferics detection, lightning data are collected every five minutes during an impromptu severe storm research field campaign during late May/early June of 2018. The 28 May 2018 case was specifically chosen because of the large amount of observed lightning activity prior to the storm being tornado-warned. The data retrieved from two types of sferics detectors (160 and 500 km detection range) illustrate how the storm evolved while within range of the detectors. In addition, the short range detector data illustrate the evolution of the distance of lightning strikes to determine when it is safe for outdoor activities during an approaching thunderstorm.

4. Re-creation of the Edmund Fitzgerald

Jasmine Derry (Texas A&M University), Lauren Hammond (Texas A&M University),
Marisa Harris (Texas A&M University), Yuan-Chi Lee (Texas A&M University),
Kiara Stewart (Texas A&M University)
Hagler-LAUNCH Undergraduate Scholars
Research Advisor(s): Jerry Tessendorf

The re-creation of the Edmund Fitzgerald is a creative work which seeks to utilize Gilligan, a new software capable of creating scientifically useful virtual environments. Using this software, we are able to chronicle the final voyage of the Edmund Fitzgerald which began on November 9, 1975, in Superior, Wisconsin. By examining reports such as the "National Transportation Safety Board Marine Accident Report for the Edmund Fitzgerald" and the "Reexamination of the 9-10 November 1975 'Edmund Fitzgerald' Storm Using Today's Technology", we have assembled environmental conditions such as wind speed, wave height, and ship location. These conditions, when input into Gilligan, drive an accurate recreation of the stormy circumstances surrounding the last 30 hours of the ship and its 29 crew members, and do so more efficiently than a special effects team could by hand. By showing that the final voyage of the Edmund Fitzgerald can be digitally recreated with historical accuracy, this research highlights the importance of our environmental scene simulator in producing highly realistic imagery. In future applications, Gilligan has the potential not only to further our understanding of historic ocean environments, but also to simulate various ocean conditions and visualize their effects on a ship's structure.

5. Sources of Variability in the Timing of the Rainy Season over Monsoonal Regions

James Goodnight (North Carolina State University)
Atmospheric Science in the Gulf Coast Region (ATMO REU)
Research Advisor(s): Rodrigo Bombardi

Monsoonal regions across the world are similar in that they exhibit well-defined wet and dry seasons. The interannual variability of the timing of the rainy season over monsoonal regions is dependent on the interactions between the seasonal variation of insolation, the three-dimensional atmospheric flow, and ocean-land atmospheric fluxes. However, it is possible that a significant portion of the variance of the timing of the rainy season can be explained by global patterns such as the El Nino Southern Oscillation (ENSO) or by simple metrics of atmospheric instability. Therefore, we investigate the relationship between ENSO and the rainy season using lagged correlations between the Niño 3.4 Index and global onset and end date anomalies. We found that ENSO is positively correlated with onset dates while negatively correlated with end dates in the western Pacific, implying an El Nino (La Nina) pattern is associated with shorter (longer) rainy seasons in southeast Asia and northern Australia. We also investigated local thermodynamic conditions associated with the variability of the Indian and North American monsoons. We found that early onset years exhibited locally high moisture content and low temperatures near the surface in the two weeks before and after the onset of the rainy season. We also observed higher sub-cloud moist static energy anomalies in early onset years compared to that of late onset years in both the North American and Indian monsoonal regions, implying atmospheric stability plays an important role in governing the timing of the rainy season.

6. Distribution and Characteristics of Deep Convective Clouds using CloudSat and CALIPSO

Samantha Nebylitsa (Stony Brook University)
Atmospheric Science in the Gulf Coast Region (ATMO REU)
Research Advisor(s): Anita Rapp

Due to their impacts on shortwave and longwave radiation, deep convective clouds play an important role in cloud feedbacks as temperature changes. However, the mechanisms that regulate deep convective cloud cover as environment changes remain uncertain, with hypotheses primarily related to changes in the relative distribution of clear and cloudy areas through either changes in the properties of deep convective anvils or aggregation of convection. This project focuses on using CloudSat and CALIPSO satellite observations to determine how the frequency distribution and characteristics(size, thickness distribution, mean top height) of deep convective clouds changes with dynamic and thermodynamic environmental parameters (SST, water vapor, vertical velocity). Deep convective clouds are identified using contiguous cloudy areas with top heights over 9km and at least one pixel in the cloud with a thickness greater than 7km. Preliminary results show that for increasing SST and water vapor content, the frequency distribution shifts towards deeper clouds with greater spatial extent. These larger clouds have a smaller fraction of precipitating area and more frequency occurrence of cloud thickness <1km, indicating a larger amount of thin anvil.

7. Development of a New Instrument to Measure Freezing Temperatures of Ice Nucleating Particles

Catherine Ott (Texas A&M University)
Atmospheric Science in the Gulf Coast Region (ATMO REU)
Research Advisor(s): Sarah Brooks

In order to study cloud ice nucleation in a laboratory setting, we developed an instrument that will collect 24 droplet freezing temperatures of a single sample. This instrument is small and easily portable giving it the name Biological Ice Nucleation on the GO (BINGO). BINGO will be placed in a NESLAB Ultra Low Temperature Circulating Bath along with a 24 tray plate containing the samples to calculate the freezing temperatures of ice nucleating particles. Construction of the instrument has been completed but calibration against known freezing temperatures is still needed before data analysis can be conducted.

8. A Climatological Analysis of the Variance of the Ellrod Turbulence Index based on Seasonality, the Diurnal Cycle, and the North Atlantic Oscillation

Greg Sova (The University of Louisiana at Monroe)
Atmospheric Science in the Gulf Coast Region (ATMO REU)
Research Advisor(s): Ramalingam Saravanan

Clear Air Turbulence (CAT) can pose a major threat to the aviation industry in a number of ways. Severe turbulence can cause injury to passengers and crew, as well as potentially causing damage to the aircraft. The other major varieties of aviation turbulence (Convectively Induced Turbulence and Mountain-Wave Turbulence) have visual and instrumental clues for pilots to avoid, thus making CAT particularly challenging for the aviation industry. Scientists at forecasting centers around the world forecast for CAT because of this, and they still use the Turbulence Index 1 (TI1) developed by Ellrod and Knapp in 1992. This index is calculated by combining the stretching and shearing deformations of the wind field and finding the product of the combined deformations and vertical wind shear. Using the NCEP/NCAR Reanalysis 1 data, a 10-year climatology (1990-1999) is built of the TI1. Then, data is analyzed by 3-month averages to find seasonal maxima. The winter hemisphere was found to be more turbulent than the summer hemisphere. Since data was available at a resolution of 4 times daily, the diurnal cycle was analyzed, though the magnitude of the change was small over the course of a day. Finally, the North Atlantic Oscillation (NAO) Index was taken into consideration. While the effect is smaller than the seasonal variance, it is greater in magnitude than the diurnal cycle. The positive phase of the NAO exhibits more turbulent conditions over Europe and north Africa, while the negative phase is more turbulent over Canada and southern Alaska.

9. Variations in Pacific Tropical Cyclone Sizes and Precipitation in a GCM

Brandon Cohen (University of Louisiana at Monroe)
Atmospheric Science in the Gulf Coast Region (ATMO REU)
Research Advisor(s): Robert Korty

Observations have shown that tropical cyclone (TC) size varies across the North Pacific, with larger and more variable sizes common in the western part of the basin. These size variations are correlated with relative sea surface temperatures (RSST), with the largest storms found where RSST is highest. This project examines TC sizes and their associated precipitation within a global climate model that covers a 25-year period from 1980 to 2005. A filter was applied to the output of a vortex tracking algorithm to isolate the storms that occurred in the North Pacific Ocean during the months of May to November each year. A climatology was created of both sea surface temperature and RSST, to compare how the mean size of 5 $m \cdot s^{-1}$ azimuthal wind speed (r5) varies with respect to variables such as RSST and maximum intensity. We find that storm size varies from west to east in the model as it does in nature, though its relationship with RSST is only qualitatively similar. Storms in the western North Pacific are larger and more variable, but there is less variability in the sizes of the initial vortices. We also find that storms increase in size with latitude within the tropics. An average of the maximum precipitation rate for the duration of each storm is also examined to determine any relationship with environmental variables.

10. A Comparison of Tornadic and False Alarm Convective Cells in the Outer Rainbands of Hurricane Harvey

Rebekah Cheatham (University of South Alabama)
Atmospheric Science in the Gulf Coast Region (ATMO REU)
Research Advisor(s): Christopher Nowotarski

Tropical cyclones routinely impact the United States, often posing numerous threats to society. Hurricane Harvey is infamously known for the catastrophic flooding it caused in southeastern Texas. Aside from the flooding, however, land-falling tropical cyclones such as Harvey are often capable of producing tornadoes. Forecasting and communicating the dangers of tornadoes to the public is often a difficult task for forecasters, given the multiple, often more pressing, hazards associated with landfalling tropical cyclones. Harvey was particularly challenging in this respect, as 89% of tornado warnings issued by the Houston-Galveston National Weather Service Office (HGX) were false alarms, and several tornadoes that did occur within the HGX County Warning Area (CWA) were unwarned. This preliminary study examines 40 convective cells in the outer rain-bands of Hurricane Harvey in the HGX CWA – 20 false alarm storms and 20 tornadic storms – by comparing their near-storm environments. Relevant thermodynamic and kinematic parameters including Convective Available Potential Energy (CAPE), Storm Relative Helicity (SRH), and other widely used tornadic forecast parameters are compared, with the expectation that tornadic storms will have environments more favorable for tornadoes than false alarms. Case studies are also included to demonstrate the environments and radar presentation of examples of false alarm cells and tornadic cells that confirm the hypothesis and examples that do not.

11. Ice Nucleation Measurements and Parameterizations

Kristen Tucker (University of Wyoming)
Atmospheric Science in the Gulf Coast Region (ATMO REU)
Research Advisor(s): Sarah Brooks

The parameterizations used in climate models to predict concentrations of ice nucleating particles available in the atmosphere to initiate the freezing of ice crystals in clouds need to be further tested for their accuracy in relation to observed concentrations. Current models do not accurately represent the variety of sources and characteristics of aerosols that act as ice nucleating particles, therefor the abundance of clouds composed of ice in climate models may also be inaccurate. Mathematical parameterizations of clouds and their influence on the climate is essential to continue to improve models. Through comparison of ice nucleating particles observed concentration and predicted concentration, a better understanding of the accuracy of parameterizations can be obtained. Observed concentrations are obtained through sampling of the sea surface microlayer that contains primary organic matter that acts as marine aerosols, which may act as effective ice nucleating particles and contribute to the abundance of ice clouds over the ocean. An increased abundance of these clouds has the potential to cool the planet because of an ice crystal's ability to scatter incoming solar radiation before it reaches Earth's surface. A better understanding and representation of atmospheric and oceanic relationships in climate models will improve predictions about the future climate.

12. Aqueous Secondary Organic Aerosol Formation from Acetylene Oxidation in Simulated Clouds

Kristen Axon (Valparaiso University in Valparaiso)
Atmospheric Science in the Gulf Coast Region (ATMO REU)
Research Advisor(s): Don Collins

The atmosphere contains a variety of types of aerosols that collectively impact the climate, earth's radiation budget, and human health. Secondary organic aerosols make up a significant portion of this burden but are not well understood. Formation of secondary organic aerosols (SOA) begins with the direct emission of precursor gases from both natural and anthropogenic sources. Once in the atmosphere, photolysis and oxidation processes convert volatile organic species into products that form new particles or add to existing ones. This has been understood to occur efficiently in the gas phase, but recent studies have also found that SOA forms through aqueous phase reactions. The use of the Multiphase Aging and Production of Particles (MAPP) chamber focuses on the realistic formation of clouds to study the production of aqueous secondary organic aerosols (aqSOA). Acetylene is injected into the chamber and oxidized by hydroxyl radicals to create glyoxal, which readily partitions from the gas to aqueous phase because of its high Henry's Law constant. This study quantified the formation of secondary organic aerosols within cloud droplets that form after the gas phase oxidation of acetylene.

13. Equity of Bike Network Distribution in Several American Cities

Rachel Pierstorff (University of Denver)
Cyber Health GIS
Research Advisor(s): Daniel Goldberg, Tracy Hammond

Although cycling infrastructure is critical in increasing urban bike trips, the equitable distribution of bike networks is inconsistently evaluated and planned for. In order to fully utilize the bike as a healthy, energy-efficient, and cost-effective mode of transportation, it is essential to ensure that bike networks equitably serve all sectors of urban populations. In the absence of such analysis, the construction of valuable bike infrastructure may continue to perpetuate cycles of transportation disadvantage. By measuring the spatial equity of several urban bike networks through GIS and interviewing transportation planners, we demonstrate that equity can play a role in planning, though many other critical factors exist. The analysis revealed varying relationships between cities' urban transport planning and the relative equity of their bike networks, across major cities like Chicago, Minneapolis, and San Francisco, and college towns like Boulder, College Station, and Madison.

14. Floodplain Accuracy Impacts on Dialysis Centers following Hurricane Harvey

Rebecca Kaiser (University of Dayton)
Cyber Health GIS
Research Advisor(s): Daniel Goldberg, Jennifer Horney

According to the National Institute of Diabetes and Digestive and Kidney Diseases, over 661,000 Americans have kidney failure; over 70 percent of those patients are on dialysis to maintain kidney function. Dialysis care requires clean water, access to specialized equipment, and electricity, all of which can be compromised during a natural disaster. As global temperatures increase, the frequency of natural disasters attributed to severe weather increases as well. Flood insurance requirements and evacuation orders are determined using 100 year floodplain map. Having accurate and up to date maps can help prevent kidney failure disasters that were seen in natural disasters such as Hurricanes Katrina, Gustav, and Ike. We investigated the accuracy of floodplains versus the accuracy of inundation maps in Harris County following the flooding caused by Hurricane Harvey in August 2017. A spatial analysis was conducted using 100 and 500 year floodplains of Harris County compared to maps of inundation during Hurricane Harvey and reporting from facilities. Collection of individual facilities' reports was done with phone calls to the facilities.

15. A Longitudinal Assessment of Associations between Medicaid Expansion and Infant and Maternal Mortality

Alexandra Wiggins (University of Dayton)
Cyber Health GIS
Research Advisor(s): Daniel Goldberg, Tracy Hammond

In the United States, 6.1 infants per 1,000 live births die while 26.4 women per 100,000 live births die due to complications associated with childbirth. As part of the Patient Protection and Affordable Care Act, which was enacted in 2010, 25 states chose to expand Medicaid to provide coverage to low-income adults. Research has assessed associations between Medicaid expansion and health insurance coverage, access to care, utilization of care, affordability, and health outcomes. We investigated correlations between the expansion of Medicaid and changes in infant and maternal mortality rates between 2010 and 2016. Annual state-level infant and maternal mortality data from the Centers for Disease Control and Prevention were assessed longitudinally for correlation with state-level Medicaid expansion. whether the state did or did not expand Medicaid. Correlations were adjusted for gender, race, average income, unemployment, infant population and maternal population. The goal of this analysis is to define the effects of Medicaid expansion on maternal and infant mortality rates to inform future Medicaid policy.

16. An Analysis of Heat Indices Used for Quantifying Heat-Health Risk

Shaneal Findley (University of Central Florida)
Cyber Health GIS
Research Advisor(s): Daniel Goldberg, Tracy Hammond

Extreme heat is the deadliest weather-related condition in the United States. It is important to investigate the relationship between heat and human health as climate change will increase the frequency, duration, and intensity of hot weather and heatwaves. To assess the usefulness of heat stress indices in identifying episodes of hot weather that are detrimental to human health, we examined the relationship between Heat-Related Dispatches (HRD) and heat stress indices in one U.S. city. This study uses data from emergency 911 dispatches [referred to as heat-related dispatches (HRD)] Oklahoma City, Oklahoma. Oklahoma City's climate is temperate; however, the city can experience extreme droughts during the summer. We examined the relationship between HRD and daily temperatures: the maximum temperature (Tmax) and 13 common heat indices used to measure heat-stress and thermal discomfort: (1) National Weather Service Index, (2) Apparent Temperature (AT), (3) Humidex, (4) Temperature-Humidity Index (Schoen 2005), (5) Smoyer-Tomic Apparent Temperature, (6) Effective Temperature, (7) Wet Bulb Globe Temperature, (8) Relative Humidity Dry Temperature, (9) Discomfort Index, (10) Modified Discomfort Index, (11) Air Enthalpy, (12) Environmental Stress Index, (13) and the Natural Wet-Bulb Temperature. To assess the usefulness of heat stress indices in identifying episodes of hot weather that are detrimental to human health, we assessed the relationship between thermal comfort indices and heat-related morbidity. The results will show the correlation between the maximum temperature and the amount of EMS calls in a given day.

17. Quantifying the Effect of Sun Glare on Car Accidents

Catherin Franklin (Texas A&M University)
Cyber Health GIS
Research Advisor(s): Daniel Goldberg, Tracy Hammond

In 2015, poor visibility was a significant factor in more than six million car crashes in the United States, causing loss of property, injury, and death. Thus, there is a critical need to quantify how sun glare affects visibility when driving. In the absence of such knowledge the development of effective preventive strategies to address such accidents will likely remain elusive. To quantify the impact of sun glare on car accidents, we analyzed Connecticut road crash data from 2017. Using statistical methods, such as T-tests and Chi-squared tests, we found that driving during sun glare has a significantly higher crash rate (*number of crashes / (number of cars on the road * length of road)*) than driving during daylight. However, driving during sun glare was found to be safer than driving at night.

18. Identification of Competition Swimming Strokes Using Wearables

Piyush Tandon (Texas A&M University)
Cyber Health GIS
Research Advisor(s): Daniel Goldberg, Tracy Hammond

Obesity is influenced by metabolic factors, physical activity, and diet. Yet over 25% of US adults do not meet CDC physical activity guidelines. In addition to higher risk of chronic disease, obesity compounds stress on joints, making many aerobic activities difficult, such as running and playing most sports. Swimming is an aerobic activity that minimizes stress on joints, which allows people to engage in physical activity while minimizing any other health risks. Using technology to keep track of user exercises, such as identifying the swimming stroke, can help keep the user on the right track and motivated. Prior work using standalone accelerometers has had reasonable success with stroke recognition. Our work focuses on a more lifestyle-compatible approach using the accelerometers found in the smartphones and smartwatches they may already own, which should help user health tracking become feasible for widespread usage. This work describes the results comparing smartwatch and smartphone accelerometers across five different stroke types, highlighting which machine learning techniques are the most effective and why.

19. Wearable Haptic Navigation System for Blind and Visually Impaired Users

Heather Adams (Texas A&M University)
Cyber Health GIS
Research Advisor(s): Daniel Goldberg, Tracy Hammond

More than 21 million adults who live with partial to complete vision loss in the United States who face increased hazards while performing everyday activities. Traveling to new destinations can be a daunting and difficult task for blind or visually impaired (BVI) people. To make navigation easier and less intimidating, a haptic vest was paired with a smartphone app called TaktiGo to make a new navigational tool for BVI users. Haptic vests rely on vibration cues to indicate navigation instructions which allows the vest and app to guide BVI users without occupying the ears or requiring heavy cognitive attention. TaktiGo draws location and direction data from a Google Maps API and translates the data into simple vibration patterns that guide the user. This technology is intended to supplement the tools and methods that BVI people already use to navigate to allow them to be more independent and safe while traveling. In this study, the haptic vest and TaktiGo app were tested by BVI participants and compared to navigation by audio cues. Ability to reach a destination and user satisfaction were considered in the results to show the success of the haptic vest technology.

20. Developing a GIS System for Firefighters

Wesley Till (Texas A&M University)
Cyber Health GIS
Research Advisor(s): Daniel Goldberg, Tracy Hammond

In 2017, a total of 60 firefighters died on-duty; 31 of these deaths were from overexertion, stress, or other related reason. Firefighters are often working with outdated and slow software at emergency sites which can lead to inefficiencies and dangerous situations when rescuing a team member from such circumstances. Thus, there is a critical need to develop more innovative software that can improve the efficiency and safety of firefighters while at an emergency site. Without such a development, organizing an approach to an emergency or a rescue will remain inefficient and could potentially cost lives. Our solution is to develop a GIS system which can take the radio transmissions between firefighters and mapping the situation on an interactive 3D model of the site.

21. Computer Assisted Spatial Reasoning Training Through Serious Gaming Using Visualizations and Sketch Recognition Techniques

Apelu Mcallister (Texas A&M University - Commerce)
Cyber Health GIS
Research Advisor(s): Daniel Goldberg, Tracy Hammond

Spatial thinking has been proven to be one of the key sets of cognitive abilities that form the foundation for multiple areas of STEM, despite its evident importance, many spatial reasoning trainings and assessments fail to address spatial thinking capabilities beyond multiple choice selection. Of those that do exceed selection, the evaluation of these unique assessments becomes an issue. This study aims to improve these two critical issues through the implementation of a "serious gaming" approach using sketch recognition techniques to resolve insufficient testing of spatial thinking capabilities beyond selection and untimely assessment evaluation issues.

22. De-Anonymization Methods and Risks of Publicly Availible Bikesharing Data

Michael Hammond (DePaul University)
Cyber Health GIS
Research Advisor(s): Tracy Hammond

Recent years have shown a sharp escalation in data security breaches around the world resulting in an increase in public awareness around data privacy concerns. The use of Location Based Services (LBS) that are prevalent in a growing number of applications and services contributes and presents new issues and risks to users. Specifically, there is a risk that publicly available data from bike-sharing networks could be de-anonymized and could pose a risk of a directed attack on an individual by a perpetrator or advertisers. Thus there is a critical need to understand exactly how data like this could be de-anonymized and to what level it could be used to target an individual. Using SQL databases so arrange and filter the data collected online we were able to isolate and identify select patterns that could be attributed to an individual. We then utilized WEKA, a machine learning software to see if there was a possibility of creating a single prediction method for the end destinations of riders based off of given factors. By doing this we were able to achieve varying levels of accuracy depending on how many and what factors were involved in the prediction process.

23. Mir363-3p Treatment Has No Effect on Cognitive Function in Middle-aged Female Rats at 100 Day, but CA1 Cell Atrophy May Contribute to Post Stroke Vascular Sementia and Cognitive Impairment

Katherine Hajdu (Texas A&M University)
Texas A&M College of Medicine Summer Research Program (TAMHSCCOM)
Research Advisor(s): Farida Sohrabji

Stroke is the leading cause of serious disability in the United States with over ¼ of survivors developing either vascular cognitive impairment (VCI) or vascular dementia (VD). Thus, we hypothesize that administration of mir363-3p treatment, which we have shown as a neuroprotectant for stroke in middle-aged female rats, will improve the long-term cognitive outcomes post stroke in these rats. Sprague-Dawley female rats were subjected to stroke using stereotaxic injection of a vasoconstrictor, Endothelin-1, and randomly assigned to two treatment groups: scrambled oligos or mir363-3p mimic. At 100d, all animals were subject to the Novel Object Recognition Test (NORT), a test of cognition. Rats were then anesthestized and injected with a retrograde tracer, Fluorogold, into the left and right striatum. After 4 days, the rats were overdosed with anesthetic, perfused with saline and formaldehyde. The brain was cryosectioned and fluorogold-labeled cell in the CA1 hippocampus of the left and right hemisphere were analyzed for size and label density. Our data shows that there was no differences in the number of retrogradely labeled cells. Thereafter, cells were binned into large medium and small and then analyzed by 2 way ANOVA for cell size and treatment. Large bin cells were mostly found in the sham animals whereas medium and small sized cells in stroked (scrambled and Mir363) animals. This suggests stroke may cause progressive cell shrinkage in the CA1 hippocampus, which could attribute to VD and VCI and may in a longer time period of time could show behavioral changes in the rats.

24. Mice Lacking Vimentin Exhibit Decreased Angiogenic Responses in Early Pregnancy

Pete Gueldner (University of Texas at San Antonio)
Texas A&M College of Medicine Summer Research Program (TAMHSCCOM)
Research Advisor(s): Kayla Bayless

Angiogenesis is the formation of new blood vessels from preexisting structures. Angiogenesis occurs during wound healing, tumor growth, and most severely, pregnancy. Sufficient angiogenesis is vital to a healthy pregnancy and results in better delivery of nutrients required for fetal growth, whereas insufficient angiogenesis can increase chances for preecclampsia and fetal growth restriction. Previous studies suggest the intermediate filament protein, vimentin, is essential for angiogenesis *in vitro*. Vimentin-null mice deliver an average of four viable pups per litter, while wildtype mice have six pups per litter. In this study we utilize mouse uterine tissue samples collected during timed pregnancy studies in vimentin-null and wildtype mice and compare angiogenic rates among these mice at day 5.5 of pregnancy. We believe that vimentin helps stabilize transmembrane receptors necessary for the initiation of new blood vessel growth. To measure angiogenic responses, we cut tissue samples using a cryostat, stained using hematoxylin and eosin to identify sections containing implantation chambers, performed immunofluorescent staining of tissue sections, created binary masks and quantified signal intensity using NIS Elements AR and ImageJ and imaging using an epifluorescent microscope. Using ImageJ, an acute area is identified to measure the amount of endothelial cells surrounding implantation chambers, where endothelial cell staining using PECAM-1-specific antibodies indicated angiogenic vessels. Another calculation is performed to normalize the endothelial growth to outer erosion area of implantation chamber. Results show that vimentin-null mice undergo significantly less angiogenesis during decidualization than wildtype mice. Future studies will investigate additional timepoints for a more thorough analysis.

25. Taxonomy and Diversity of Little-known South African Grasshopper Genus *Eremidium* (Orthoptera: Lentulidae)

Carla de Loera (Texas A&M University)
EXCITE (Expanding Scientific Investigation Through Entomology) REU
Research Advisor(s): Hojun Song

South Africa is home to many unique habitats that harbor numerous endemic species. Our project focuses on studying grasshopper diversity in two parallel chains of habitat islands in the most ancient continent. The first is a thousand-mile arc of high mountain habitats in the far south consisting of a great mountain massif whose eastern edge has eroded into a line of high precipices and isolated rock fragments, thereby forming a line of alpine islands. The second is a string of mountain forests constituting perhaps the most complex archipelago in the world, stretching from the tip of the continent four thousand miles to the horn of Africa. The preliminary study of the flightless grasshoppers inhabiting these regions indicates that there is previously unknown and enormous species diversity awaiting discovery. The overall goal of this project is to understand the total diversity of grasshoppers in the family Lentulidae in this amazing and complex landscape and the diversification processes shaping this diversity. However, because the species of *Eremidium* are externally quite similar, there is no reliable identification key available. Previous taxonomic work contains insufficient information for identification, and therefore, there is an urgent need to revisit the taxonomy of this group. In this study, we present an overview of taxonomy of this interesting grasshopper genus and an identification key to species.

26. Analysis of Actin Knockdown in the Central American Locust, *Schistocerca piceifrons* (Orthoptera; Acrididae), Using RNA Interference

Samantha Franklin (Texas A&M University)
EXCITE (Expanding Scientific Investigation Through Entomology) REU
Research Advisor(s): Hojun Song

Locusts are a worldwide agricultural pest, and the Central American locust, *Schistocerca piceifrons* (Orthoptera; Acrididae), swarms twice a year in Mexico. Actin is an intracellular, cytoskeleton protein present in all eukaryotic cells and has an essential function in maintaining cell structure and shape. Knockdown of this gene would be lethal to these locusts. We used RNA interference technique by producing dsRNA targeting actin, and subsequently injected it into the abdomen of 5th instar locusts. The effect of dsRNA-injection on the expression level of actin was compared to controls every day until all injected locusts had died (approximately 5 days after injection), using real-time quantitative PCR. The effect of actin knockdown on locust survival was determined by injecting 62 individuals with dsRNA targeting actin.

27. Sex Difference in Pollen Consumption in Diptera: Calliphoridae

Betty Hernandez (Texas A&M University)
Independent Project
Research Advisor(s): Julianna Rangel, Aaron Tarone

In the light of decreasing number of honeybees, concerns about crop pollination have risen. Recent studies show that blow flies could be potential pollinators. Previous research done by a former student shows there is consumption of pollen in and out of a lab setting. One question not answered was if there is a difference between male and female consumption of pollen? At the beginning of the experiment, wild flies were captured around College Station, TX. Afterwards, the flies were separated by date/location captured, species, and sex. The blow flies were then dissected and grouped into fives. Pollen acetolysis was conducted on each group, then mounted on slides. Preliminary data shows a difference in male and female consumption. However, further work needs to be done to show if there is a significant difference.

28. Markers of Sex Determination in Blow Flies

Michelle Jonika (Texas A&M University)
Independent Project
Research Advisor(s): Aaron Tarone

Calliphoridae is a large family of insects, and contains species *Lucilia sericata* (Diptera: Calliphoridae) (Meigen), *Cochliomyia macellaria* (Diptera: Calliphoridae) (Fabricius) and *Chrysomya rufifacies* (Diptera: Calliphoridae) (Macquart). These species are important medically and economically, and are commonly used in forensic investigations. In forensics, development data for species is used to predict time of colonization (TOC) estimates. However, there is sexual dimorphism in blow fly development and it is poorly understood. The difference in physical traits, as well as gene expression, may result in development disparities between sexes. For this reason, it is important to optimize a sex identification assay to aide in predicting more accurate TOC intervals for *L. sericata*, *C. macellaria* and *C. rufifacies*. Sex determination is an important assignment made in development. In the case of calliphorids, most undergo transformer (*tra*) splicing and resulting doublesex (*dsx*) splicing gives rise to downstream sex-specific characteristics. This may cause differing development in males and females leading to imprecise TOC estimates when not accounted for. Using known primer sets for *tra* and *dsx*, an assay for sex identification can be optimized. The newfound information on sex, in combination with published transcriptomes, can result in sex-specific interpretation of gene expression, yielding more accurate data sets for species.

29. Visual Literature Review of Lack of Equity in STEM Education

Aamir Fidai (Texas A&M University), Bryan Martinez (Texas A&M University),
Amanda Pina (Texas A&M University), Albert Sutdu (Texas A&M University)
Aggie Research Program
Research Advisor(s): Robert Capraro

The K-12 educational system in the United States of America is based on the pillars of equality. The overarching focus of this system is to provide every child in the United States with a school to go to in the morning, a classroom to sit in, some teachers, free books, some extracurricular activities, and in some cases free lunch. But the quality of education offered to and received by the students differs greatly based on their race, ethnicity, gender, geographic location, and socio-economic status. This difference represents a distressing equity disparity. The undergraduate student researchers participating in this project engaged in a systematic literature review to identify the main causes of the lack of equity in STEM education and the impact this inequity has on the students in the long run. To facilitate a better understanding of the problem of inequity and its causes in STEM education, the research participants developed a poster styled after the visualization technique called “Mind Mapping”. This diagrammatic method of presenting ideas was promoted by British psychologist Tony Buzan in 1974 and is still considered one of the most effective ways of communication ideas. In this poster, preliminary results of the systematic literature review are presented, and key areas of focus are identified.

30. Increasing Incidence of Anaplasmosis and Ehrlichiosis in the United States, 2012-2016

Adam Baker (Texas A&M University), Zakary Derouen (Texas A&M University),
Michael Mogg (Texas A&M University)
Aggie Research Program
Research Advisor(s): Hsiao-Hsuan Wang

Anaplasmosis and human ehrlichiosis are tick-borne diseases that have been increasing in incidence in the United States during recent years. Ehrlichia chaffeensis and E. ewingii are the primary bacteria that cause ehrlichiosis in humans. Anaplasmosis, caused by the bacterium Anaplasma phagoctyophilum is also a febrile disease. Anaplasmosis and ehrlichiosis infections are reported to Centers for Disease Control and Prevention (CDC) through the National Notifiable Diseases Surveillance System (NNDSS). This report analyzed the cases of anaplasmosis and ehrlichiosis presented by the NNDSS from 2012 to 2016. In total, there were 15,778 new infections by A. phagocytophilum, 6,786 by E. chaffeensis, and 101 by E. ewingii during 2012-2016. The incidence rates (IR) for each of these infections were 10.36 cases per million persons per year for A. phagocytophillum, 4.46 cases per million persons per year for E. chaffeensis, and 0.08 cases per million persons per year for E. ewingii. The demographic group most commonly reported for all three types of infections were white males between the ages of 40 and 64. A. phagocytophilum infection was most abundant in the northern midwest region, particularly Wisconsin, Minnesota, and Iowa, as well as the Atlantic coastal northeast U.S. E. chaffeensis infection was most abundant in the southeast and midwest regions, particularly in Arkansas, Missouri, Tennessee, and Oklahoma, as well as much of the U.S. east coast. Ongoing surveillance and reporting of tick-borne diseases are critical to inform public health practice and guide disease treatment and prevention efforts.

31. Robots, Programmable Toys, and Microcontroller Interventions in STEM Education

Aamir Fidai (Texas A&M University), Atharva Kulkarni (Texas A&M University),
Kevin Wiseman (Texas A&M University)
Aggie Research Program
Research Advisor(s): Robert Capraro

STEM (Science, Technology, Engineering, and Mathematics) education needs new innovative approaches to engage each learner. The traditional methods of teacher lecturing and students taking notes and then engaging in rote practice only to be able to regurgitate that information on a test is not suitable for the realities of the 21st century. The use of robots and programmable toys increase both students' academic achievements and their interest in STEM courses. Using robots and programmable toys is one way of making STEM education more fun and accessible to all children. Along with the use of robots and programmable toys, the "Maker movement" has brought creativity, interactivity and access for all grade levels. In STEM education courses this term includes the use of microcontrollers to build devices to employ project-based learning, learning through data collection and other interactive and engaging uses. In this research project the undergraduate student researchers engaged in a Meta-Analysis of classroom interventions which used robots, programmable toys, or microcontrollers in a STEM classroom setting. This poster presents the preliminary results of the meta-analysis along with the effect sizes for the overall and individual impacts of each type of intervention.

32. Enhancing Performance of Biomedical Coatings by Controlling Their Assembly and Structure

Samantha Hernandez (Texas A&M University)
Aggie Research Program
Research Advisor(s): Svetlana Sukhishvili

Layer-by-layer (LbL) assemblies of responsive polymers are promising platforms for highly localized, stimuli-controlled delivery of bioactive molecules. An efficient way to enhance functionality of biomedical coatings, is to incorporate upper critical solution temperature micelles (UCSTMs), whose cores can retain bioactive molecules, including antibiotics, and release them in response to temperature. This work focuses on exploration of how film assembly conditions affect film structure and response. UCSTMs consisting of a poly(acrylamide-co-acrylonitrile) core and a polyvinylpyrrolidone (PVP) corona, were prepared with hydrogen-bonding partners (tannic acid [TA], and poly(methacrylic acid) [PMAA]). The influence of ionic strength and pH of micelle assembly solution, and micelle corona length on LbL assembly was studied via exploring evolution of dry film thickness, as well as studies of film swelling. A decrease in assembly pH and/or increase in solution ionic strength both enabled thicker film growth, while the use of micelles with longer coronas caused a decrease in film thickness per bilayer due to the increased availability of bonding sites between PVP and the binding partner, which strengthened interactions. Film functionality, assessed as temperature-induced swelling measured by in situ ellipsometry, in conjunction with analysis of micellar coverage density and morphology analyzed by scanning electron microscopy, was significantly enhanced when films were assembled in neutral pH solutions in the presence of salts. Finally, correlation between internal structure of films, determined by neutron reflectometry with films which contained several marker deuterated layers, and film functionality will be discussed.

33. Effect of Serum Cotinine Levels on Mean Telomere Length by Race/Ethnicity: A Smoking Gun Using Time-Varying Effect Modeling

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Research Advisor(s): Francisco A. Montiel-Ishino

Significance: Human telomere length is primarily used as an indicator for biological aging as each time a cell divides, telomeres shorten. Research on how tobacco use and exposure affects mean telomere length over age by racial/ethnic group is scarce. *Methods*: Time-varying effects modeling (TVEM) allows the observation of change over time from active tobacco use and environmental tobacco smoke on telomere length. We used the National Health and Nutrition Examination Survey (NHANES) for continuous years 1999 to 2002 to observe the effects of active tobacco use and environmental exposure - measured through serum cotinine - and mean telomere length for adults 19 to 80 years of age (N=7827; M=1.03, SD=0.28). Models were run by Mexican American, other Hispanic, Non-Hispanic White, Non-Hispanic Black, and Other/Multi-racial to allow for time-varying group differences and controlled for sex, SES, education, and ever-smoker. *Results*: The results indicate a high level of mean telomere length (mTL) differences between different racial/ethnic groups. The association of serum cotinine levels and mTL vary across age by racial/ethnic groups. Serum cotinine levels had the strongest observed effect on Mexican American mTL across time. There was a significant increase in mTL at age 31 with a mean score of .0037 with another significant increase at age 52 with mean score .0078. *Conclusions*: Findings reveal a further need to focus additional support and resources to intervene upon disparate health outcomes from tobacco use and smoke exposure for already vulnerable groups and focusing efforts for particular adult age groups.

34. Increasing Incidence of Spotted Fever Group Rickettsioses in the United States, 2012-2016

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Spotted fever group (SFG) rickettsioses include cases of Rocky Mountain Spotted Fever (RMSF), R. parkeri rickettsiosis, Pacific Coast tick fever, and rickettsialpox. SFG rickettsioses are notifiable conditions in the United States caused by the highly pathogenic Rickettsia rickettsii and the less pathogenic rickettsial species such as Rickettsia parkeri, Rickettsia philipii, and Rickettsia akari. This report summarizes surveillance data from 2012 to 2016 for SFG rickettsioses. Incidence decreased from the record high 1.44 cases per 100,000 person-years (CPY) in 2012 to 1.08 CPY in 2013, however, incidence increased each year thereafter (1.18, 1.31, 1.33 CPY in 2014, 2015, and 2016, respectively). From 2012 to 2016, cases of SFG rickettsiosis were reported more frequently among males by gender, white by race, and non-Hispanic by ethnicity. The increasing reported incidences of SFG rickettsioses likely resulted from increased reporting of tick-borne diseases, including those caused by less pathogenic species. Thousands of cases of SFG rickettsiosis occur every year, but it is unclear how many of those cases are RMSF and how many resulted from less severe spotted fevers. Improving the ability to differentiate between spotted fever group rickettsia species is urgently needed.

35. Germination and Metabolite Study of Onion Seeds after Nanoparticle Priming

James Semper (Texas A&M University)
Independent Project
Research Advisor(s): Bhimu Patil, G.K. Jayaprakasha

With rising population and more health-conscious consumers, the need for increased farm productivity has increased. This study investigates the effect of different priming agents on onion seeds (Legend and 50147). The conditions compared in the study include no priming as a control, hydropriming, turmeric nanoemulsion priming, citrus nanoemulsion priming, silver nanoparticle priming, and gold nanoparticle priming. All priming agents were created using green chemistry techniques to emphasize sustainability. To analyze the viability of each treatment, three major points were observed. These points include a germination study in an incubator, an emergence test in a greenhouse, and a metabolite study on collected samples. Our research shows very promising results in all trials. In the incubator study, all treatments except the turmeric nanoemulsion demonstrated higher germination rates than the control and hydropriming. In the greenhouse study, the treated seeds also demonstrated higher germination rates. By Day 7, emergence rates were 10% to 38% higher in the treated Legend variety over the control. The 50147 variety had a narrower gap of 1.33% to 12% higher rates in the treated seeds over the control. The treatments also differ in their metabolite concentrations, as is evident from LC-MS data. These results suggest the high potential of nanoparticle and nanoemulsion priming in crops.

36. Using the In Vitro Gas Production Technique to Investigate Effects of Quebracho (*Schinopsis balansae*) on Greenhouse Gas Production and Diet Digestibility in Steers

Jordan Adams (Texas A&M University)
Independent Project
Research Advisor(s): Luis Tedeschi

Within ruminant production, interest in natural feed additives as a means of mitigating CH_4 emissions and meeting consumer demands for animal products has become of great interest on a global scale. Therefore, this study investigated the effect of Quebracho (QT; *Schinopsis balansae*) condensed tannins upon CH_4 production and digestibility using the in vitro gas production (IVGP) technique. A Latin square design with four steers (233.6± 6.8 kg) fed a high-roughage TMR diet in which each animal received QT at either 0, 1.5, 3 or 4.5% DM across four feeding periods. Steers were adapted to diets for 11 days and rumen inoculum was collected on day 12 via esophageal tubing. The IVGP technique was performed to determine the effects of rumen inoculum when incubated with the corresponding diet. Methane production, neutral detergent fiber digestibility (NDFD), and *in vitro* dry matter true digestibility (IVDMTD) were measured. A random coefficients model was utilized with period and animal as random effects within the model. For both NDFD and IVDMTD, QT 0 and 1.5% had the greatest digestibilities, whereas QT 4.5% had the lowest ($P < 0.05$). However, a reduction in CH_4 and adjusted CH_4 values with increased QT inclusion was observed ($P < 0.001$). There was no difference for CH_4 when expressed as ml/g of NDFD, but treatments 0 and 1.5% had greatest CH_4 per grams of IVDMTD ($P < 0.001$). We concluded that supplementation of QT at 3% DM provided the greatest efficiency when accounting for digestibility and CH_4 production.

37. The Suitability of Autoclave or Pressure Cooker in Comparison to ANKOM ^{200} for Determination of NDF

Madeline Rivera (Texas A&M University)
Independent Project
Research Advisor(s): Luis Tedeschi

The utilization of *in vitro* gas production (IVGP) technique requires the determination of neutral detergent fiber (NDF) residue to assess fiber digestibility. The determination of NDF using standard procedures is not feasible with the IVGP because of the sample size; thus an autoclave or pressure cooker is needed. This intra-laboratory experiment was conducted to determine if the calculated NDF values from an autoclave or pressure cooker are equivalent to the industry standard using an ANKOM^{200}. Two sets of 18 bottles were prepared using alfalfa hay. The first set was placed in the pressure cooker at 105°C for 60 minutes and the second set was placed in the autoclave at 121°C for 15 minutes. After the pressure cooking, bottles were filtered using a vacuum filtration system and dried with Whatman 54 filter papers, and weighed after 48 hours in a 105°C oven. To compare to the ANKOM^{200}, 22 F57 ANKOM bags were filled with the standard feedstuff, and two blanks were utilized by standard operating procedures. Each technique was replicated three times. Blanks were not run through either in-vitro bottle technique, instead ten Whatman 54 filter papers were filtered with diH_2O followed by acetone and dried similarly. There were differences among methods (P = 0.016). The pressure cooker yielded higher NDF residue values as compared to the autoclave, 46.9 vs. 45%, respectively. However, neither method differed from the ANKOM^{200}, 45.9%. It appears that both the autoclave and pressure cooker are adequate determinants of NDF residue.

38. Biomechanical Evaluation of Two Suture Methods for Distal Bicep Tendon Rupture Repair

Douglas Fuller (Texas A&M University)
Biomechanical Environments Laboratory (BMEL) Undergraduate Research Program
Research Advisor(s): Michael Moreno

Distal bicep brachii tendon ruptures occur when the distal bicep tendon completely detaches from the radial tuberosity, severely restricting range of motion. A common repair method is the extramedullary cortical button technique: suturing the detached tendon to a metal button and feeding the construct through a drilled hole in the tuberosity such that the button is secured on the posterior side of the radius. Two alternative suturing methods are mechanically investigated. The first suture method, the single tension slide, involves weaving a single needle down the middle of the distal tendon such that a single suture thread is attached to the button. The second method, the double tension slide, involves two self-tightening sutures (one on each side of the tendon) such that two suture threads attach to the button. Twenty paired, contralateral cadaveric elbows are randomly assigned to one of the two suturing methods and then subjected to cyclical loading for 3600 cycles at 1 Hz, moving from full extension to 90º flexion. Following the cyclic loading, each elbow is locked at 90º flexion and ramped to failure. It is hypothesized that the double tension slide will provide a higher load to failure than that of the single tension slide, because the double tension slide covers more area, presumably reducing stress on the tendon. The first round of pilot testing has been completed with a 411.25 N failure load for the single tension sample. Although data is currently insufficient for a conclusion, the pilot indicates a successful testing methodology.

39. Investigation of Mechnoregulatory Pathways Involved in Protein Expression of Lymphatic Endothelial Cells

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Research Advisor(s): Michael Moreno

Lymphedema is a common complication following many cancer treatments as damage to lymphatic vessels from surgery may cause impairment to lymphatic flow. Regulation of flow is crucial as the lymphatic system is responsible for various immune and transport roles within the body. Treatments for lymphedema are limited as research surrounding the mechanisms responsible for lymphatic behavior is scarce. Current studies on the flow mechanisms of lymphatic vessels make use of lymphatic endothelial cells (LECs), which comprise the innermost lining of these vessels. However, current studies may not adequately mimic the physiologic conditions which many LECs experience, thereby giving results that may not reflect the mechanics accurately. In this study, we attempt to mimic the physiologic conditions experienced by LECs by applying the most commonly experienced mechanical forces (shear and stretch) simultaneously. Human LECs were cultured to confluence on fibronectin coated silicone membranes, then placed in a dynamic bioreactor capable of mimicking physiological shear stress (5 dynes/cm^2) and stretch (20% percent at a rate of 0.5Hz) experienced by lymphatic vessels. It’s to be mentioned that the mechanical parameters used are adjustable and independent thereby allowing for a wide range of data points to be collected. We then hope to quantify the molecular effects of these mechanical forces using RT-PCR and Western Blotting to isolate involved signaling proteins such as CD31, Prox1, and eNOS as typically reported in literature. We expect these results to shed light on the effects of mechanoregulation on lymphatic flow in hope to further identify therapies capable of treating lymphatic impairment.

40. Quarterback Biomechanics: The Effect of Foot Contact Position during the Throw

Cassandra Cantu (Texas A&M University)
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Research Advisor(s): Michael Moreno

Little research has been conducted on the throwing biomechanics of quarterbacks, therefore, there is a need to gain a better understanding of their fundamental motion. This study investigates the development of middle school and high school quarterbacks in order to improve throwing techniques to optimize performance and decrease the risk of injury. Every part of the body contributes to the kinetic energy required for the throwing arm to execute a pass, starting from the feet. The foot placement at ball release impacts pelvis alignment which positions the quarterback's body towards the target, contributing to the kinetic chain of energy from the feet to the throwing arm. Hip alignment with the shoulders at the moment of release plays an important role in the amount of stress placed on the throwing arm. A 12-camera VICON motion capture system was used to acquire 3D positional data on specific anatomical markers during common foot patterns to receiver routes. The Nexus software program was utilized for marker reconstruction. A custom python script was created to analyze the position of the feet and to determine their influence on the throw. General trends of middle and high school quarterbacks are expected to provide insight into the biomechanics of the throwing motion. The high school level players are hypothesized to have better foot alignment due to having more experience with the motion. An in depth statistical analysis of the data for both age groups will be performed to test this hypothesis. By finding the techniques that minimize stress on the throwing arm, coaching points can reflect these theories to decrease potential injuries.

41. Pain Scale and Management Software Market Analysis

Olivia Moss (Texas A&M University)
Biomechanical Environments Laboratory (BMEL) Undergraduate Research Program
Research Advisor(s): Michael Moreno

Pain Management is a vital part of the healthcare industry, but the gold standard pain measurement remains an analogue paper scale in which a patient places a pencil mark on a linear scale, and a healthcare provider manually measures with a ruler. This method does not lend itself to either frequency of measurements or patient self measurement. Yet, there is an increasing need for higher frequency data concerning a patient's pain post surgery or for those suffering from chronic pain. A digital pain scale has the potential to positively impact both patients and healthcare providers by providing higher frequency data, and our prior work has demonstrated the accuracy of these types of measurements. The purpose of this work is to assess the market potential for a digital pain scale application that would enable patients to self report pain levels using a digital visual analogue scale (dVAS). Market analysis will be performed to explore the potential and possibilities of a pain management software, including but not limited to patients of common surgeries, surgeons, and pain management specialists. This research will allow a pain management software equipped with a dVAS to be developed and commercialized to best serve patients and physicians dealing with pain management.

42. Geometry Optimization of Cruciform Specimens in Biaxial Mechanical Testing

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Biaxial mechanical testing is a commonly used method to characterize the mechanical response of cruciform shaped specimens. One difficultly of this type of testing is the lack of homogenous mechanical behavior within the center cross-section of the cruciform, referred to as the region of interest, when the specimen's arms are under tension. In this study silicone rubber cruciform specimens with different center fillet radiuses and arm length-width aspect ratios were analyzed with a finite element simulation, FEBio. Deviations from a uniform stress-strain distribution within the region of interest were determined. Geometrically optimized specimens underwent biaxial tensile testing to determine the validity of simulated designs. From analysis between numerical and experimental results the specimen fillet radius and aspect ratio are correlated to changes in the homogeneousness of the region of interest. With more uniform centers of interest more accurate mechanical testing results may then be obtained from optimized specimens.

43. Biomechanical Analysis of Running: A Comparison

Ann Mendiola (Texas A&M University)
Biomechanical Environments Laboratory (BMEL) Undergraduate Research Program
Research Advisor(s): Michael Moreno

Running biomechanics has been extensively studied, showing that speed and shod or barefoot running have an impact on ground reaction forces (GRFs). These impacts can be correlated with overstress in the joints and muscles, which lead to running related injuries. The purpose of this study is to compare the GRFs, the stride length and duration with corresponding frequency, the stance/swing ratios and the symmetry indices of different level runners under different conditions (shod or barefoot, speed and foot strike pattern). One female and three males, under 30 years old ran at their preferred speed with preferred shoeing (barefoot or running shoes). 3D running data was collected with an 8 camera Vicon motion capture system and with 4 AMTI force plates. Using Matlab, vertical GRFs, stride length and duration, and swing and stance phase ratios were calculated. The symmetry index was calculated for all the parameters. It is anticipated that the barefoot runner will have shorter stride lengths and durations as well as a different vertical GRF curve due to an adopted running pattern to efficiently absorb the impact shock. Swing and stance phase ratios will be similar if the subjects are running at similar speeds. The symmetry indices of the parameters will show if the runner is compensating one leg for the other, which can resurface previous injuries or incorrect techniques. The intention of this research is to compare biomechanical parameters between barefoot or shod runners that can influence running patterns and give insight for future projects regarding injury prevention.

44. Multimodal Assessment of Reactivity and Self Regulation in Infants

Lara Andres (Texas A&M University)
Independent Project
Research Advisor(s): Kaya de Barbaro

A study was conducted on 8 infants ages 3-10 months in which we did home sessions with video recoding folowed by a 24-hr naturalistic video recording. The 90-minute home session consisted of a sensory challenge in which babys were exposed to novel stimuli (noisy toys, playground noises, lemon juice) and in the 24-hr session we collected sleeping data to assess baseline for physiological measures. Infants wore a MOVISENS motion an physiological sensors for both sessions. We were interested in assessing the relationship between reactivity and self regulation in infants throughout their first year of development. For the behavioral assesment we coded for behavioral indices of reactivity and self regulation. For the physiological indices of regulation, we looked at two parasympathetic indices of self regulation: vagal tone and HrvHf (heart rate variability high frequency). This experiment is ongoing, but from these eight participants results showed no significant correlation between our behavioral codes and physiological data. However, for infants who self regulated there was a significant negative correlation between HR reactivity (bpm) and observed self regulation. Investigating the congruence between physiological and behavioral indices of self regulation could allow for the ability to make inferences about the propensity of multiple psychopathological dissorders (Beauchaine et al., 2013).

45. Optimizing a Wind Tunnel for High Air Velocity Testing of Shrouded Probes

Andrew Fearing (Texas A&M University)
Independent Project
Research Advisor(s): Maria King

Continuous emission monitor systems (CEMs) are used throughout the nuclear industry to monitor stacks and ducts for the presence of radioactive particulate matter. Validation of the performance of a sampling system requires the characterization of the performance of the sample extraction and transport system. The American National Standards Institute, ANSI/HPS N13.1-2011 specifies minimum standards for nuclear facility duct air monitoring, either with sharp-walled isokinetic or shrouded probes. Standard isokinetic sampling probes have a number of drawbacks for continuous sampling in turbulent or off-axis airflows, leading to over or under-sampling. Additionally, impaction on probe walls causes consistent under-sampling, especially for liquid aerosols. Shrouded probes are an alternative sampling method that substantially reduces or eliminates errors due to changing air velocity, turbulence, or probe wall losses. Our research uses a customizable wind tunnel with variable turbulence and off-axis capabilities with liquid droplet aerosol particles to ensure industrial shrouded probes meet HPS and ANSI sampling standards. Originally capable of only 5 m/s airspeeds, our project is aiming at increasing the wind tunnel's capabilities to 20 m/s by designing and inserting a reduction nozzle upstream of the shrouded probes. The nozzle efficiency for increasing the velocity will be verified using both computational fluid dynamics and empirical testing. The goal of this research is to create a versatile, accredited wind tunnel facility for the high velocity (6 – 72 km/h) testing of industrial emission probes.

46. Biomechanical Characterization of Early Human Projectile Weaponry

Ryan Walford (Texas A&M University)
Independent Project
Research Advisor(s): Michael Moreno

The Clovis era, approximately 13,000 years ago, was once thought to mark the arrival of the first early Americans. This accepted hypothesis however, is challenged by possible evidence such as the Manis Mastodon Rib—a 1977 archeological discovery in Washington state that features a 13,860 year old mastodon rib with a foreign osseous projectile embedded 2.1 cm into the mastodon rib. The foreign projectile is hypothesized to be the point of a primitive hunting tool such as the atlatl, and may suggest human activity 860 years earlier than the Clovis era. The objective of this study is to mechanically characterize the projectile's mass & kinetic energy required to impale the projectile into the rib, in order to help assess the plausibility of human activity as opposed to natural causes. A pneumatic projectile launcher was created from custom design in order to recreate low-velocity (<100m/s) ballistics mechanically similar to early hunting weapons. A micro CT scan revealed the morphology of the projectile tip, which was recreated with wood and bone analogue. A high-frequency force transducer recorded the impact force of the projectiles as they were accelerated into a SawBones bone analogue and bovine bone tissue at a specified mass and impact velocity. The projectile launcher can characterize projectiles from both the atlatl and primitive bow.

47. Developing Biaxial Testing Protocols for Soft Tissues Using Rubber Materials

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Research Advisor(s): Michael Moreno

Tissue engineering has vital applications to clinical and physiological fields. Although there have been impressive accomplishments in this field, tissue engineered constructs still play a limited role in patient treatment. Considering the non-homogeneity and anisotropy of the soft tissue, both uniaxial and biaxial tensile tests need to be performed to better understand the mechanical properties of soft tissues. We previously designed and built a biaxial testing system. This system has been evaluated with a rubber material for uniaxial tensile tests. Throughout the experiments, we developed a successful testing method and the necessary protocols. In this study, the system will be evaluated through the biaxial mechanical testing of a rubber material and the corresponding protocols will be developed. The results will be analyzed using Ncorr, an image analysis software, to provide a full-field strain distribution. Both load control and strain control biaxial tests will be performed with a cruciform specimen geometry. The goal of this study is to evaluate the system with a rubber material and to develop protocols for biaxial mechanical testing of soft tissues.

48. Effect of Print Parameters on 3D Printed Tissue Scaffolds

Erica Huebner (Texas A&M University)
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Research Advisor(s): Michael Moreno

Tissue engineering is a promising approach for replacing damaged and diseased tissues. Although it has been the focus of extensive research since the 1980s, it is still rarely used for patient treatment, partially due to a limited understanding of how mechanical stimuli affect cell behavior. Cells are mechanotransducers, so external mechanical stimuli affect cell response. Therefore, 3D printing is an important method because it allows control over the mechanical properties of a printed scaffold. This process can be used to create tissue scaffolds that, after implantation, are replaced by the cells' naturally produced extracellular matrix as the scaffold degrades. Here, we study the effect of different print parameters on the mechanical properties of the printed scaffold. We used an envisionTEC® 3D-Bioplotter™ for its accuracy to print silicone scaffolds, choosing silicone for its printability and biocompatibility. To eliminate anisotropic effects, we printed models with alternating layers of parallel strands with a 90° shift between each layer. We determined that for a given needle diameter, strand thickness was increased by increasing the extrusion pressure and/or decreasing the travel speed of the needle. Porosity of the scaffold was increased by reducing strand thickness and/or increasing the distance between the strands in each layer. The information obtained from this study will allow us to produce scaffolds with different strand thicknesses and porosities, enabling future studies on how these parameters affect the mechanical properties of the scaffold.

49. Mechanical Testing of 3D-Printed Silicone Scaffolds

Darby Ballard (Texas A&M University)
Biomechanical Environments Laboratory (BMEL) Undergraduate Research Program
Research Advisor(s): Michael Moreno

Tissue-engineering is a growing, multibillion-dollar field of personalized medicine. The fabrication of a microscopic, repetitive structure known as a scaffold is the primary step in creating engineered tissues. In order to be truly biomimetic and replicate corporeal materials, the mechanical properties of the engineered scaffolds should match that of the native tissues. Currently, there is a limited quantity of workable, biologically-engineered tissues that can be applied *in vivo*. Biological materials are viscoelastic, nonlinear, and anisotropic. A single stiffness value is not sufficient to properly characterize these materials and their properties. Three-dimensional printing offers a way of accurately controlling the mechanical properties of the scaffolds. In this study, we examine all parts of the generic stress-strain curve and attempt to understand how the different scaffold parameters affect their mechanical responses. By altering the print parameters (i.e., extrusion pressure, print speed, porosity) we hope to obtain different mechanical responses from the scaffolds. The scaffolds were created with different strand thicknesses and porosities to provide multiple samples for testing. They were then subjected to uniaxial tensile tests to obtain traction-stretch curves. Student t-Test method was used to determine the statistical significance of the alteration of these parameters on the mechanical properties of the scaffolds. These developments will significantly improve the clinical viability of the engineered tissues. Being aware of how physical properties affect developing cells is essential to tissue engineering.

50. The Analysis of Ankle Flexion and Extension in Middle School and High School Quarterbacks

Meagan Makarczyk (Texas A&M University)
Biomechanical Environments Laboratory (BMEL) Undergraduate Research Program
Research Advisor(s): Michael Moreno

The throwing mechanics of football have not been studied in depth compared to the other overhead throwing motions in sports, therefore, the coaching of football is not universal. This study evaluates the development of youth quarterback biomechanics by assessing the three most common pass types. A 12-camera VICON system with 4 AMTI force plates have been used to acquire positional data on 16 different subjects equipped with reflective markers. Customized python scripts have been developed to analyze postional data, angular velocities, and joint angles such as ankle flexion/extension. The kinetic chain is essential to the outcome of the quarterback throw because it describes the build up of potential energy that is then translated into the kinetic energy when the quarterback throws the ball. The quarterback throw requires the entire body in such a way that the energy from the lower extremities aid in the effectiveness of a pass. In this research, the motion of the ankle can increase the gravitational potential energy of the football, which is why the lower extremities are vital to the outcome of the throw. This data will supply researchers and coaches with information of what movements and routes are the most effective in the build up of potential energy in the kinetic chain as well as the differences in throw outcomes in middle schoolers and high schoolers with reference to the kinetic chain. With this research we hope to find the proper techniques to train and strengthen the flexion potential of the ankle.

51. Pioneering Analysis of the Canopy Boundary Layer Using UAV Technology to Collect Vertical Profiles over a Pre-Montane Tropical Rainforest

Elizabeth Prior (Auburn University)
Costa Rica REU
Research Advisor(s): Kelly Brumbelow, Gretchen Miller

Canopy boundary layer (CBL) is present directly over the forest canopy. The CBL varies thermodynamically and meteorologically from the rest of the above atmosphere because of the evapotranspiration of the forest. The height of the CBL along with other factors such as wind, air temperature and dew point can vary due to time of day and weather patterns. Investigation of the CBL over a tropical pre-montane transition forest was conducted to analyze its condition throughout the day and also for atmospheric comparison to land development. Understanding the CBL is essential for future global climate models since atmospheric anthropogenic alterations of the environment are being indirectly caused by rapid deforestation. While this experiment aims to measure and analyze the CBL, it was also used to pioneer the usage of unmanned aerial vehicle (UAV) for atmospheric/meteorological remote sensing and data collection methodology. The UAV was equipped with sensors to measure air temperature, relative humidity and dew point. The UAV allows for quick and specific access to sampling locations and for all of the variables to be measured over vertical profiles. Flights were scheduled at different locations throughout the day over the forest surrounding the Texas A&M Soltis Center. Vertical profiles were also measured over the Texas A&M Soltis Center to determine how development has affected the presence of the CBL. The UAV flights were successful in gather atmospheric data above the forest canopy at varying elevations during both clear and cloudy conditions.

52. Measuring Mass Fluxes of Nutrients to a First-Order Stream within a Pristine Mountain Rainforest in Costa Rica

Lia Gomez (Iowa State University)
Costa Rica REU
Research Advisor(s): Peter Knappett

Costa Rica's montane rainforests form an integral part of the economic, social, and environmental well-being of the country. They supply water for agriculture, hydroelectric power, and human consumption. Release of nutrients to streams from rainforests is poorly studied. This information will inform an ongoing public debate over the importance of restoring rainforests in areas formerly cleared for farming. The primary objective in this study was to measure the mass fluxes of nutrients to a first-order mountain stream within a pristine rainforest. The sampling site is within the Texas A&M Soltis Center in Alajuela State, Costa Rica. To measure volumetric and mass fluxes, and identify the sources, a 75 m reach was sampled upstream and downstream at 2-hour intervals over a 48-hour period. Four shallow wells (<2 m) were augured down to bedrock. Two persistent seeps were sampled. Labile parameters, including oxygen, nitrate, ammonia, and sulfide were tested on-site using a spectrophotometer. Multi-meters were deployed at the upstream and downstream sampling locations to continuously measure physico-chemical parameters. Twelve major ions were analyzed with an ion chromatograph. Using End-member Mixing Analysis (EMMA) 7 source waters with unique chemistry supplied water to the stream along the study reach: 1) rain water; 2) fresh groundwater; 3) medium total dissolved solids (TDS) groundwater; 4) high TDS groundwater; 5) right bank seep; 6) left bank seep; and finally 7) upstream. The anticipated outcome is a separated hydrograph showing volumetric and mass fluxes from each of the source waters over the 48 hour period.

53. The Effect of Tropical Land Use on Soil Carbon Dynamics

Maria Rivera (San Jacinto Community College)
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Research Advisor(s): Georgianne Moore, Gretchen Miller

Soils are the largest terrestrial carbon (C) sink, storing two to three times as much C as the atmosphere and above ground vegetation. Land use change accounts for a significant amount of CO_2 emissions in tropical ecosystems, perhaps due to its impact on soil structure. The majority of soil C is associated with soil aggregates of different size classes that have different potentials for C storage. Here we investigated the effect of different tropical land uses on soil C dynamics. We measured soil respiration, and bioavailable C and nitrogen from three soil aggregate classes across three common tropical land uses; agricultural cropping system, forest plantation and transitional premontane rainforest. We found that land use type had a significant effect on mean CO_2flux ($r^2 = 0.84$, $p = 0.04$), with the highest fluxes occurring at the forest plantation and the lowest fluxes occurring at the transitional premontane forest. Bioavailable nitrogen also differed by land use (r2= 0.74, $p < 0.0001$) with the greatest amounts observed in the transitional premontane rainforest and the highest amounts occurring in the agricultural cropping system, suggesting that soil nitrogen may be important for soil respiration. Land use and aggregate size class had no effect on bioavailable C, possibly due to the high variability observed within each land use type. Our results suggest that more replicates are needed to accurately test for land use change effects on bioavailable C and that tropical forest plantations may contribute significantly to global C emission.

54. Tree Growth and Species Diversity in Premontane Neotropical Forests in Costa Rica

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Research Advisor(s): Georgianne Moore, Eugenio Gonzalez

The Central American land bridge is among the most biodiverse regions on the planet, where species from both the North and South American continents intersect. Established sites in Costa Rica at high and low elevations, such as the Monteverde Preserve (1500 m) and La Selva Biological Station (100 m), have been well studied for biological diversity. However, studies that compare species and other forest characteristics along elevational gradients are needed to understand how these forests may be affected by changing climate conditions. The Soltis Center is a new research site located in the premontane forest (450-650 m) adjoining the Children's Eternal Rainforest Preserve. Within the preserve, we established two new forest inventory plots at the Estación Pocosol (900 m). At the Soltis Center, we re-surveyed two of the four permanent inventory plots (2500 m^2) to observe species diversity and growth. We found that the average annual growth rates were 1.24% and 1.22% in plots 2 and 3, ranging up to 18%. The size distribution at each plot appears as an inverse-J shaped curve, typical of uneven-aged stands. This concurs with the frequent minor disturbances in this area, such as landslides, which create small canopy gaps that allow for new growth. 10.27% of trees in the Soltis sites were unique species, and the Shannon Diversity Index was 3.77 ± 0.17. This is similar to other montane sites in Costa Rica and will be compared with sites along an elevational gradient from La Selva to Monteverde.

55. Correlation of Fog Patterns and Plant Functions in a Transitional Tropical Rainforest

Alexander Duffy (Texas A&M University)
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Research Advisor(s): Georgianne Moore, Gretchen Miller

Fog is a common phenomena in the tropical forests of Costa Rica. Fog patterns could be altered due to climate change, therefore understanding the effects of fog presence on forest physiology is important. We hypothesize the presence of fog in a premontane transitional forest suppresses the forest's uptake of CO2 and release of H2O. To this end, meteorological and phenological measurements were collected at the Texas A&M Soltis Center in Costa Rica. Temperature, precipitation, solar radiation, and atmospheric pressure were measured at five minute intervals. A digital camera directed at the forested hillside recorded images at 30-minute intervals during daylight. For this analysis, we examined images from January 2018 and May 2018, noting date, time, image quality, fog presence/absence, and approximate visibility. We then examined the relationships between fog presence, time of day, and weather conditions. In January, which falls in the 'dry' season in Costa Rica, fog is more common in the mornings and tends to decrease in frequency towards midday. In the afternoons, fog is consistently less likely to be present. In May, during the wet season, the presence of fog is more bimodal, with lower (but significant) presence in the mornings and increasing and peak presence in the afternoons. Extended periods of fog are associated with non-increasing temperature, non-decreasing relative humidity, and lower solar radiation, but had no clear relationship with atmospheric pressure.

56. Analysis of Functional Traits in *Carapa guianensis* Along Different Environmental Gradients

Manuel Flores (Texas A&M University)
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Research Advisor(s): Georgianne Moore, Eugenio Gonzalez

Tropical rainforests contain some of the highest biodiversity in the world, which can vary greatly in terms of topography, elevation, and climate. To understand biodiversity changes along environmental gradients, convergent evolution has been studied extensively to identify key plant traits that vary along those gradients. This project investigated physiological trait variation within a select tropical tree species, *Carapa guianensis*, that thrives in a wide range of elevations and climates within Central America. Replicate leaves on three sample trees of *C. guianensis* were measured at approximately 450-640 m (TAMU Soltis Center) and 900 m elevation (Pocosol Biological Preserve). We measured leaf photosynthesis (LI6400 gas exchange system) and stomatal densities to develop non-linear regression models across a range of light conditions, which enabled us to analyze photosynthetic optimums and minimums at contrasting elevations. We hypothesized that stomatal density would be higher at increasing elevations due to compensation for more frequent cloud cover, and that differences in climate, particularly air temperature and solar radiation would affect optimum photosynthesis. We found that *C. guianensis* trees located in lower elevations were more photosynthetically active and more responsive to changes in light than those sampled at higher elevation sites. Holistically, these data suggests that lower elevations with higher temperature can significantly drive critical plant processes, which warrants further experiments, not only exploring functional traits, but climatic changes that drive them, as well.

57. Divergence in Lag Times Between Rainfall Events, Streamflow, and Shallow Water Table Response Across Two Nested Watersheds of Contrasting Spatial Scales in Costa Rica

William Nguyen (University of Maryland)
Costa Rica REU
Research Advisor(s): Peter Knappett, Gretchen Miller

Interflow, groundwater discharge, and rainfall runoff dominate streamflow generation processes in small watersheds. Watersheds within the tropical pre-montane transitional forests of Costa Rica are generally understudied. These hydrologic processes impact the storage and movement of water that supplies downstream agriculture and human consumption demands. One phenomenon of hydrologic processes is that they behave differently at various spatial scales. In this study, our objective is to characterize streamflow responses to precipitation as a function of watershed size near the Texas A&M Soltis Center located within the Peñas Blancas River Watershed in Alajuela State, Costa Rica. To study these processes in detail, a 75 m reach of a first-order mountain stream within a pristine rainforest was equipped with V-notch weirs upstream and downstream. Furthermore, four shallow piezometers were installed. All weirs and piezometers were equipped with pressure transducers logging every 10 minutes. Volumetric fluxes entering the stream were calculated through differential gaging. For comparison, a stilling well was also installed in the downstream Rio Chachagua. Precipitation amounts were obtained at 5-minute intervals from an on-site meteorological station. The time lags between precipitation events and peak hydraulic heads in the piezometers and peak discharge at each gaging station were calculated for three separate events in July 2018. We hypothesize that time lag is a function of drainage area. Preliminary data suggests that the Howler Monkey stream has a shorter lag time between peak rainfall and peak discharge than the Rio Chachagua.

58. Electromagnetic Geophysical Mapping of a Stream Channel in a Tropical Montane Forest, Costa Rica

Abigail Keebler (West Chester University of Pennsylvania)
Costa Rica REU
Research Advisor(s): Mark Everett

Headwater basins play a critical ecohydrological and geological role in shaping downstream systems. Streamflow generation processes shape the hydrology of tropical montane forests but are poorly understood. Stream channels are complex systems comprising fractures, sand, exposed bedrock, knickpoints, and woody debris, all of which control downstream flow patterns. While geomorphological observations are useful to understand streamflow generation processes and ecological implications, the subsurface component is often unknown. A field study was conducted to characterize the near-surface geology of a montane stream in Costa Rica. Electromagnetic induction (EMI) geophysical profiling at three frequencies (1,8,15 kHz) yielded data constraining the electrical conductivity of the streambed. The apparent electrical conductivity response of the streambed decreases, as does the signal complexity, moving upstream towards the headwaters basin. Geomorphological observations close to the headwaters include more exposed, less-conductive bedrock and less exposed, more-conductive sand; a steeper, narrower stream channel; more fallen logs; and increased interflow into the steam channel from rock seepage faces. Such along-stream variations indicate changes in the hydrological processes affecting streamflow generation from upstream to downstream. Horizontal (HMD) and vertical (VMD) magnetic dipole EMI data provide different insights on the nature of the subsurface due to their differing depth sensitivity functions. The EMI data (HMD-only, VMD-only and joint HMD-VMD) were inverted in terms of two-layer geoelectric models of the subsurface. The EMI geophysical method is shown to be a useful tool for reliably mapping the conductivity-thickness product of the upper layer of tropical forest stream channels.

59. Leading Straight to the Source: Determining the Origin of Lead Contamination at McMurdo Station

Rebecca Odell (Vassar College)
Observing the Ocean REU
Research Advisor(s): Lisa Campbell

While much of Antarctica remains pristine, areas surrounding scientific research stations have experienced anthropogenic impacts for over half a century. The United States Antarctic Program’s McMurdo Station, the largest human outpost on the continent, is no exception. Localized pollution from petroleum hydrocarbons, lead, and other metal contaminants is a major human impact. Prior to the 1990s, station operations experienced less environmental regulation, making much of the soil contamination historic and its exact origins uncertain. This research employs geospatial analysis techniques to investigate potential sources of lead pollution at McMurdo Station including leaded fuel, paint, and batteries. Kriging and Geographically Weighted Regression provided insight on the spatial relationship between lead and petroleum hydrocarbons. Analysis of paint as a pollution source for soil lead utilized concentric buffer zones with distance from structures. Samples in areas with statistically high lead contamination were investigated for correlations with high levels of other pollutants. By placing results from Geographic Information System (GIS) analysis in their historical context, sites of lead pollution and their potential sources are pinpointed at McMurdo Station. This research identified a specific bulk fuel tank as an historic source of leaded fuel contamination and historic operations at the nuclear power plant site as a possible source of non-fuel related lead pollution. Understanding the primary sources of lead contamination and establishing a baseline of lead pollution can help inform management practices with the goal of decreasing the introduction of lead into the McMurdo Station environment.

60. Natural and Contaminant Trace Metals in Galveston Bay Sediments

Hannah Adams (University of Southern California)
Observing the Ocean REU
Research Advisor(s): Jessica Fitzsimmons

Trace metals are defined as metals that are present in seawater between concentrations of 1 fmol/kg and about 10 mol/kg, and many species of these metals are not very soluble in water, thus depositing to the sediments. These metals are often important for supporting life, however at a certain threshold concentration unique for each element, they can be toxic to humans and the ecosystem. While these elements are naturally present in sediments, their concentrations can be enriched due to human input. In August 2017, Hurricane Harvey dumped 1.0434 m of rain into the city of Houston, TX over the course of three days. This water flooded the city, resulting in an increase in pollutants and other debris that was drained into the Galveston Bay, an important estuary that flows into the Gulf of Mexico. In order to study the concentrations of natural and contaminant trace metals in the sediments, these sediments were collected during five different cruises into Galveston Bay, and each sample was leached with a hydroxylamine and hydrochloride and digested with nitric acid and hydrofluoric acid. This exposed the labile and refractory materials, thus allowing us to determine which metals had been deposited since Hurricane Harvey and how they dispersed throughout the bay in the months following this event.

61. Analyzing Salinity Structure in an Unsteady Estuary Using Salinity Variance and Total Exchange Flow

Dylan Schlichting (University of Maine)
Observing the Ocean REU
Research Advisor(s): Robert Hetland

Estuarine salinity structure is mainly influenced by the input of freshwater, episodic wind-generated currents, and exchange flow at the mouth. Understanding processes influencing salinity structure has management applications in population dynamics and material transport. The Regional Ocean Modeling System was used to hindcast six years of salinity structure in Copano Bay: a broad, shallow, unsteady estuary within the Mission-Aransas Estuarine Research Reserve. Salinity concentrations averaged between 5 g kg^{-1} and 40 g kg^{-1} during high and low river discharge events, respectively. Prior work found that high river discharge and exchange flow are primarily responsible for the large salinity range, but through an observational lens. Here, we provide a more quantitative description of the salinity structure via salinity variance and total exchange flow (TEF). Salinity variance ($s'^2 = (s - \bar{s})$) was calculated as a metric for stratification within Copano Bay. Volume-averaged salinity variance is twice as large in East Bay as in West Bay, indicating that East Bay is more stratified than West Bay. If river discharge is high, vertical salinity gradients up to 15 g kg^{-1} are common at the boundaries, despite an average depth of 2.7 m. During periods of low river discharge, the exchange flow is the dominant force influencing salinity structure. The TEF was calculated to understand how intruding ocean water interacts with less saline estuarine water. The TEF separates the salt flux at the mouth into inflowing and outflowing components. TEF results suggest Copano Bay is considered partially mixed during periods of high river discharge and well-mixed otherwise.

62. Did a Freshwater Lens Influence the Microbial Community After Hurricane Harvey at the Flower Garden Banks National Marine Sanctuary?

Joseph Hayes (The University of Wisconsin - Madison)
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Research Advisor(s): Jason Sylvan, Shawn Doyle

Large scale microbial ecology of coral reefs is an area where little is known, even with recent advances in microbial ecology techniques that help assess the health of the reef. In 2016, there was an (unforeseen?) massive mortality event at the East Flower Garden Banks, part of the Flower Garden Banks National Marine Sanctuary (FGBNMS) in the Gulf of Mexico. Estimates suggest that the event bleached twenty percent of all coral and sponges found on the Eastern Flower Garden Bank. Prior to the mortality event, there was a freshwater plume that made its way to the FGBNMS, associated with the "Tax Day" (April 17th-18th, 2016) floods of Houston that same year. Using water chemistry, models, and biological indicators, scientists are still uncertain what happened. No microbial ecology assessments were made prior to the 2016 research cruise at the FGBNMS. The next summer, Hurricane Harvey hit Houston (August 25th -29th, 2017), and dumped massive amounts of freshwater into the Gulf. Researchers feared that another massive mortality event would occur. Using the same 5 by 5 grid that was used in the previous 2016 cruise, we collected water samples from 29 locations, performed DNA extractions and PCR analysis on 140 water samples. The research brings to light the microbial ecology of the FGBNMS and serve to link the massive amounts of freshwater effects has on the micro and macroscopic ecosystem.

63. Hurricane Harvey's Effect on Colored Dissolved Organic Matter in Galveston Bay

Samuel Polis (Texas A&M University)
Observing the Ocean REU
Research Advisor(s): Gerardo Gold

At over 1,500 km2, Galveston Bay is the largest bay in Texas. It is fed by two main rivers: The Trinity and San Jacinto. The watershed of Galveston Bay includes urban, agricultural, and industrial regions, including both Houston and the Dallas-Fort Worth areas. On August 25th, Hurricane Harvey hit the middle Texas coast as a class 4 hurricane. A cruise to study CDOM in Galveston Bay was undertaken on June 2017. As an unplanned study, Hurricane Harvey's possible effects on CDOM were studied by four further cruises taken into Galveston Bay. The time series of these studies stretch for a year, from June 2017 to June 2018. This time series is the first in understanding the long-term dynamics of a hurricane impact on CDOM in a shallow, unstable estuary such as Galveston Bay. Colored dissolved organic matter (CDOM) plays important roles in many disciplines: the carbon biogeochemical cycle, satellite-based estimates of primary productivity, and the production of a shadow effect on phytoplankton. Hurricane Harvey had a major impact on CDOM: an increase in high molecular weight, terrestrial organic matter indicated by a decrease in the spectral slope and an increase in the humification index, and a 4-fold increase in total CDOM (indicated by the absorption coefficient at 350 nm). Our hypothesis was that the results for June 2018 would be very similar to those of June 2017, but the June 2018 results are completely different from the other months. This suggests the bay has not fully recovered from Hurricane Harvey.

64. A Spicy Gulf: Observational Study of Hypoxia in the Northern Gulf of Mexico

Robert Helsel (Rutgers University)
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Research Advisor(s): Steve DiMarco, Henry Potter

The Mississippi River drains 41% of the continental United States, dumping an average of 5,296 km^3 freshwater into the Northern Gulf of Mexico annually. This leads to the formation of the world's second largest hypoxic "dead zone", an environment with insufficient oxygen for life to thrive. The low-density freshwater causes vertical stratification that leads to hypoxia every summer, exacerbated seasonally by agricultural nutrient runoff from the Mississippi River Valley. As determined by previous modelling studies, hypoxic water can be advected into the mid-water and create complex layering with oxygen maxima embedded within hypoxic zones. This research extends that knowledge observationally, establishing connections between dissolved oxygen and ocean spiciness (a parameter that quantifies density-controlled variability in salinity and temperature). Between 2010 and 2016, a boat-towed, undulating, winged instrument was deployed in the study area 121 times to collect data on density, salinity, temperature, oxygen, and other oceanic parameters. Oxygen maxima embedded in hypoxic zones were found to contain clear spiciness peaks. Temperature and salinity anomalies responsible for this spice could feasibly be used in tandem with other tracers to provide observational support for previous studies. However, this relationship was unique to water with embedded oxygen maxima, while differing relationships occur depending on position in the water column. Investigation of these apparent modal differences in this multivariate dataset could lead to a more robust understanding of hypoxia's behavior in the Gulf.

65. Physical Tracers and Modeled Connectivity at the Flower Garden Banks

Molly Kerwick (Rensselaer Polytechnic Institute)
Observing the Ocean REU
Research Advisor(s): Kristen Thyng

The Flower Garden Banks National Marine Sanctuary is a NOAA National Marine Sanctuary atop three salt domes—East Bank, West Bank, and Stetson Bank—that sit on the edge of the Texas-Louisiana continental shelf. They are the northernmost coral reefs in the Gulf, and their proximity to the Mississippi-Atchafalaya river plume makes them of great interest. There was a die off of the lower two meters of East Bank in July 2016 thought to be influenced by the flooding in Houston that occurred Spring 2016. It is hypothesized that turbid freshwater from Houston reached the banks, limiting photosynthesis and increasing respiration. It is further hypothesized that deep upwelled water from the southeast covered the bottom portion of the reef, preventing vertical mixing, which allowed the deeper water to go hypoxic. We choose to investigate the influence of freshwater at the banks in 2016 with a model of the Texas and Louisiana continental shelves that was developed using the Regional Ocean Modeling System (ROMS). ROMS is a modeling system using the Navier-Stokes equations to simulate current velocities, temperature, and salinity in a region. Simulations of drifters using a particle tracking model (TracPy) within a 1994-2016 hindcast from the shelf model show water movement trends on the Texas-Louisiana shelf. TracPy and the shelf model were used to investigate freshwater influence at the banks in July 1994-2016. Two-dimensional simulations show greater connectivity between freshwater regions and the banks in July 2016 than average, supporting the hypothesis that freshwater had an effect on the die off.

66. Setting a Baseline for Dissolved Methane in Galveston Bay

David Gonzales (Pace University)
Observing the Ocean REU
Research Advisor(s): Shari Yvon-Lewis

Methane is a greenhouse gas that is ~23 times more potent than carbon dioxide. Natural waters tend to be a source of methane to the atmosphere (Reeburgh, 2007). The source of that methane can be natural methanogenesis in sediments or in anoxic microenvironments in the water column, or it can be anthropogenic from natural gas emissions. Methane emissions from the highly anthropogenically influenced Galveston Bay have not been assessed previously. A recent survey of methane concentrations in Galveston Bay was performed. Water samples from just above the sediments had concentrations of methane ranging from 18.2 – 181.8 nmol L^{-1} while surface water concentrations ranged from 16.0 - 291.1 nmol L^{-1}. Air samples were also analyzed to allow for the determination of sea-to-air fluxes of methane. The average atmospheric concentration was 1.33 ppm.

67. Method Development for the Simultaneous Extraction of Emerging Contaminants and DOM in Seawater

Ashley Pavia (Marymount Manhattan College)
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Research Advisor(s): Yina Liu

Contaminants of emerging concern (CEC) such as perfluorinated alkyl substances (PFAS) (predominately used as flame retardant) and pharmaceutical and personal care products (PPCP) are found in different levels in surface water and drinking water sources. These CEC enter the environment primarily through municipal waste water effluent and human activity. Particular concerns over these chemicals have been expressed as their presence can hold the potential for adverse toxicological effects to both wildlife and humans. Dissolved organic matter (DOM), often coexist with CEC in the environment, affects the solubility of contaminants and thus play important role in the mobility of CEC. Extracting the target PFAS and PPCP compounds and DOM simultaneously from environmental matrices was the objective for the method development. We tested solid phase extraction (SPE) cartridges with six different chemical resin sorbents for extracting DOM, PFAS, and PPCP from fresh and seawater samples and determined the most efficient method for extracting CEC and DOM in different water matrices. We followed EPA guideline of SPE extraction efficiency range of 70-130% when assessing the performance of the tested SPE cartridges. Our results showed that Agilent’s Bond Elut PPL cartridge can recover the most CEC and DOM simultaneously, while Waters HLB and WAX cartridges were specifically recommended for PPCP and PFAS, respectively. Using the selected SPE cartridge, we tested PFAS and PPCP levels in different water samples (e.g. drinking water, recreational water, and Galveston Bay seawater).

68. Post-Harvey Carbonate Chemistry at the Flower Garden Banks Coral Reefs

Lauren Barrett (Bloomsburg University of Pennsylvania)
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Research Advisor(s): Kathryn Shamberger

In August 2017, Hurricane Harvey released more than fifty inches of rain over Houston, Texas. The freshwater from this storm drained into the Gulf of Mexico, potentially threatening marine ecosystems that are sensitive to low salinity. In October 2017, seawater samples were collected from Galveston Bay to the Flower Garden Banks (FGB) National Marine Sanctuary, which contains the northernmost tropical coral reefs in the Gulf of Mexico. Water samples were analyzed for total alkalinity (TA) and dissolved inorganic carbon (DIC) using a Marianda VINDTA 3C. Salinity, temperature, and depth data were collected *in-situ* using a CTD. Despite the brief 10% salinity decrease observed in the sanctuary in late September 2017, CTD data from the October 2017 cruise indicate that the salinity recovered to normal values of about 36. The aragonite saturation state (Ω_{ar}) reflects the stability of aragonite, the form of calcium carbonate that corals use to generate skeletons, in seawater. Ω_{ar} values of 3 or greater are generally considered supportive for coral reef calcification. Surface water Ω_{ar} for all stations ranged from 2.98 to 4.39 and Ω_{ar} decreased with depth down to 1.66 at 292m. The Ω_{ar} at the depth of the coral reefs at East and West Bank were 3.94 and 4.04, respectively. These data indicate that Hurricane Harvey did not negatively impact the coral reef ecosystems of the FGB. Currently, water chemistry at the FGB is relatively uncharacterized and these data provide one of the most comprehensive evaluations of carbonate chemistry to date.

69. Evolutionary Transcriptomics of Understudied Amphinomida

Irene Martinez (Texas A&M University at Galveston)
Louis Stokes Alliance for Minority Participation (LSAMP)
Research Advisor(s): Jessica Labonte, Elizabeth Borda

Species of the Phylum Annelida are essential as model organisms in the studies of biology, neurobiology, evolution, ecology, and phylogenomics. Prior work concentrated on gathering genome-wide data by means of whole and mitochondrial genome sequencing and RNA sequencing. This has produced innovative perceptions into the development of Annelida, including hypotheses related to the relationship of taxa correlating with the base of the Annelid tree of life. Amphinomida does not conform to conventional arrangements amongst other polychaetes and was found to be in an ancestral position, creating probably implications in the early evolution of Annelida. Therefore, the central purpose of this study is to analyze and annotate select genes of biological significance from previously understudied clades of Amphinomida in phylogenomics, Euphrosinidae (*Euphrosine capensis*) and Archinominae (*Chloeia pinnata*), as well as to augment our knowledge of the species belonging to Amphimonida (*Paramphinome jeffreysii, Eurythoe complanata, Pareuythoe californica,* and *Hermodice carunculata*). The evaluation of data representing all known clades of Amphinomida will allow for a comprehensive assessment and offer a new understanding of the evolution of this elusive taxon relative Annelida, as well as other bilatarian organisms.

70. Feeding Ecology and Movement of Bull Sharks (*Carcharhinus leucas*) in Galveston Bay

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Research Advisor(s): David Wells

Estuaries serve as nurseries, feeding grounds, and parturition to elasmobranchs, such as bull sharks. *Carcharhinus leucas* are one of the few species of sharks that can tolerate a wide range of salinities from freshwater to marine environments, and inhabit the Galveston Bay estuary in northern Texas. However, estuaries face many anthropogenic threats such as overfishing and pollutants that could alter a crucial ecosystem for bull sharks. Understanding the movement and feeding ecology of this species is essential for proper conservation measures. A variety of techniques were utilized to help expand our understanding. To trace migration patterns, bull sharks were captured with gill nets and brought on board where a surgical procedure followed to insert a tag in the peritoneal cavity. An array of acoustic receivers (Vemco VR2W) were deployed throughout Galveston Bay to evaluate movements and habitat use. Stomach contents and stable isotope analyses were utilized to examine shifts in ontogeny, sex, trophic levels, and identification of prey items. Preliminary analysis of stomach contents revealed the major source of their diet consists of teleost fishes. Primary prey categories for bull sharks included the families Ariidae (%IRI= 21.5) and Sciaenidae (%IRI= 20.1). Other families such as Ophichthidae, Mugilidae, Sparidae, and Clupeidae had a %IRI of 0-2. The results of this study will be used to inform management through a better understanding of the fundamental life stages of bull sharks in estuarine habitats.

71. The Assessment of *Megalops atlanticus* in the Galveston Bay and Oceanfront Via eDNA

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Louis Stokes Alliance for Minority Participation (LSAMP)
Research Advisor(s): Jaime Alvarado-Bremer

Tarpon, *Megalops atlanticus*, is a large species of fish that inhabits the coastal waters, bays, and estuaries of the Atlantic Ocean. Tarpon is particularly popular in the sport and recreational fisheries due to its endurance, size and flashy appearance. The frequency of tarpon catches in Galveston Bay began decreasing in the 1950's (Holt et.al, 2005) which brought concern about the status of the tarpon population. A record-breaking catch in late August of 2017 (TPWD, 2018) and more frequent catches by local anglers is confirming that tarpon is still in the area. To validate the presence of tarpon in Galveston bay, aside from fishing records and local sightings of the species, biological evidence was provided via methods of aquatic environmental DNA amplification and analysis. The biological evidence was confirmed using a primer that was designed to be specific only to the DNA of the species in question, tarpon. The primer was tested against the Basic Logical Alignment Search Tool (BLAST) database to confirm species specificity, followed by experiments using a serial dilution of amplified DNA form a preserved tarpon tissue sample, and finally by utilizing filtered water samples collected throughout the Galveston Bay and oceanfront. The results of this analysis will help validate the presence of tarpon in Galveston Bay and oceanfront areas and could possibly serve as an aid to approximate the abundance of tarpon in this region.

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72. Impact of Hurricane Harvey on the Off-Shore Currents of Galveston Bay

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Ocean and Coastal Research Experiences for Undergraduates (OCEANUS REU)
Research Advisor(s): Kyeong Park

Buoy current data indicate that anomalous off-shore currents dominated the inner shelf outside of Galveston Bay during and following Hurricane Harvey, a major hurricane that made landfall over the Houston area on August 26, 2017. As the largest precipitation event in the contiguous U.S. on record, Harvey provides a case study to gauge how coastal systems respond to extreme precipitation events. While the general trend on the inner shelf area is for the current to flow at 31.5° east-by-northeast, roughly parallel to the shoreline, the month following Harvey tended to flow 98.96° north-by-northwest, almost perpendicular to the shore. Wind stresses resultant of Harvey's passing to the south incurred strong velocities perpendicular to wind stress as the component of velocity correlated with Ekman flow increased by an order of magnitude during the Hurricane winds. Heavy streamflow from Trinity River then maintained the anomalous current for a total of 47 days (August 25th to October 11th). Similarly, the salinity was reduced by 16.16 PSU and SST was cooled by 4.7 °C within eight days. Analagous effects were not observed in other precipitation events in the 1996-2018 record, even adjusting for scale, further indicating the atypical nature of the hurricane.

73. 900-Year Annual Record of Hurricane Activity from Cay Sal Bank, The Bahamas

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Hurricanes are devastating natural disasters that act as destabilizing forces in natural and human ecosystems; however, ~150 years of observed North Atlantic hurricane records limits understanding of large-scale climatic drivers of hurricane activity. Blue holes, flooded sinkholes, are abundant throughout the Caribbean and can preserve high-resolution sedimentary archives of prehistoric ocean and climate conditions, including paleohurricane activity. Hine's Blue Hole (denoted CSAL1) is located on Cay Sal Bank, the westernmost carbonate platform in The Bahamas. CSAL1 experiences high sedimentation that alternates between fine-grained silt during background conditions and coarse-sand/gravel during hurricane events, potentially providing a particularly high-resolution reconstruction of regional hurricane activity. In 2016, nine sediment cores were collected along an east-west transect across CSAL1. Analysis of downcore sediment textural variability using sieving over a 63 μm mesh to determine mass of coarse sediment per cm^3 reveals evidence of storm deposits throughout the record. Radiocarbon-dated coral from the base of CSAL1-D7 (16.5 m) indicates this record extends ~1000 years before present, suggesting that CSAL1 may have recorded hurricane activity in this region at annual-resolution since ~1000 CE. We hypothesize that warmer ocean/climate conditions, such as those from 1300-1550 CE, support more frequent cyclogenesis and landfall of intense hurricanes landfalls in the Northwestern Caribbean; however, understanding these variations in hurricane activity in this region requires refinement of the CSAL1 age-model to temporally emplace sediment textural data. This study will help resolve long-term impacts of climate modulation on Atlantic hurricane frequency, improving hurricane forecasting to promote ecological, economic, and social resilience.

74. Analyzing Grain Size and Mercury Content Related to the Bathymetry of Matagorda Bay

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Research Advisor(s): Tim Dellapenna

The influence of bathymetry and proximity to shore on grains of sediment is well known throughout marine geology. The more short term island structures created inside estuaries by barrier islands may have differing influences on grain size on the islands themselves. This is important to understand for potential construction projects, dredging, as well as posing potential navigational hazards all rely on the consistency of the sediment involved in such operations. This research project hopes to study how grain size is influenced by the bathymetry and shore proximity of estuaries. A bathymetric survey of Matagorda bay was carried out and 124 hand samples were collected from different locations. The hand samples were analyzed using a Malvern grain size analyzer, sieved to determine the percent weight of shell material, and then were analyzed for mercury content. The grain sizedata will be overlain on the bathymetric map of the bay and an interpretation could be made. There are several unknown factors that could affect results. The biggest factor that would affect results is the flood deposit left by Hurricane Harvey which may alter the sedimentology of the estuary. Another possibility is that the shell material may alter results in another way. As the analyses continue, the results are pending.

75. The Effects of Crude Oil and Corexit on Silica-replete and Silica-limited *Phaeodactylum Tricornutum*

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Research Advisor(s): Antonietta Quigg

The Deepwater Horizon (DwH) oil spill of 2010 released four million barrels of crude oil into the Gulf of Mexico. In response, the dispersant Corexit 9500A was applied to fragmentize the oil slick as means of remediation. *Phaeodactylum tricornutum* is a marine diatom that has a silica frustule, serving as a shell. *P. tricornutum* has previously been found to be resilient in the presence of water accommodated fraction of oil (WAF) and chemically enhanced water accommodated fraction of oil (CEWAF) treatments. This study aims to investigate the role the silica frustule has in protecting *P. tricornutum* against WAF, CEWAF, and diluted CEWAF (DCEWAF) treatments. *P. tricornutum* were cultured in f/2 media with and without silica for five weeks and subsequently inoculated into WAF, CEWAF, and DCEWAF treatments. Growth rates showed that CEWAF treatments inhibited growth the most compared to WAF and DCEWAF, which had the highest growth rate. Photosynthetic activity was found to be highest in the WAF treatment and lowest in the CEWAF treatment. Silica-limited *P. tricornutum* results consistently deviated lower than their silica-replete counterpart, with the exception of the photosynthetic activity in the DCEWAF treatment. Samples analyzed for estimated oil equivalents (EOE) showed that the oil concentration declined over time in all treatments. Results suggest that *P. tricornutum* protect their photosynthetic apparatus against harmful conditions, suppressing growth until ideal conditions are again reached. Further research is needed to better understand how diatom physiology is being modified by these pollutants to protect the cells.

76. Comparison of Morphological and Genetic Identifications of Typhlatya Species Found in Anchialine Caves of the Yucatán Peninsula

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Research Advisor(s): Thomas Iliffe, Elizabeth Borda

Anchialine caves are submerged caves formed from limestone or volcanic rock that are connected to the ocean. They can be found around the world and are habitats for fauna such as crustaceans and fish. A genus of shrimp called *Typhlatya* have been found in anchialine caves located in various parts of the world. In Mexico's Yucatán Peninsula, four species of *Typhlatya* live in anchialine caves. Morphological identification of some of these species is difficult using the current *Typhlatya* species key. The goal of this study is to determine morphological characteristics that accurately identify *T. dzilamensis*, *T. mitchelli*, *T. pearsei*, and an undescribed species of *Typhlatya* found in the Yucatán Peninsula. Distinguishing morphological characters were determined for each species based on previous literature and identified via light microscope and scanning electron microscope (SEM). A character matrix and a tree were generated using the program Mesquite to compare the morphological characters and previous genetic data. Morphological and genetic identification of these species will help a larger study examining the biogeography and population connectivity of Typhlatya in the Yucatán Peninsula.

77. Deformable Submarine Landslide experiment for Tsunami

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Research Advisor(s): Juan Horrillo

In recent studies it has become a fact that if a moderate earthquake were to occur in the Gulf of Mexico it could cause submarine landslide that may generate a tsunami. However, the probability is very low for this occurrence. A submarine landslide is rapid downward movement of an ocean sediment on the ocean bottom slope. This causes a Tsunami due to the fact sediment pushes the water away from generation area. This wave moves fast and grows faster as they approach the shore. Our submarine landslide experiments will attempt to reproduce a more realistic submarine landslide event to improve and validate our existing numerical model used to construct inundationmaps along US coastline. If the experiment results are taken accurate, it will help us include in future better physics to simulate submarine landslide induced-tsunami. Our hypothesis is "How will a more realistic submarine landslide affect free surface?" And "How static and dynamic angle of repose of the sediment will play a role in the landslide dynamic and ensued wave?" The strategies we will be using to solve this project is: first, to construct a small scale prototype representing a submerged landslide. Submarine landslide induced-tsunami is very complex phenomenon. This works attempts to develop a more realistic (deformable) submarine landslide simulation than the models available in preexisting literature. However, submarine landslide are mainly modeled in laboratory experiments by utilizing rigid landslide; however they, can also be mimicked by using a dam break experimental mechanism. Submarine landslide laboratory experiments are essential for simulation component for the phenomenon. These experiments facilitate the construction and validatation of mathematical models. In future experiments to come, our experimental objective is to reproduce a potential outcome of the deformable submarine mass failure or landslide issuing a miniature tsunami.

78. Hurricane-Induced Alteration of Zooplankton Community Structure in a Subtropical Estuary (Galveston Bay)

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Zooplankton play a vital role in the structure and function of marine ecosystems due to their abundance, ubiquity, and ecological roles. In estuaries, zooplankton serve as primary conduits of energy transfer from phytoplankton to some commercially and ecologically important fish and invertebrates. Extreme wind, rainfall, and storm surge cause intense mixing and water circulation alteration. Storm-driven floodwaters in estuaries have been known to decrease salinity and increase nutrients and organic matter. Frequency of hurricanes are expected to increase during this century because of global climate change; therefore, more information is needed on the effects of sub-tropical storms on estuarine ecosystems. Hurricane Harvey (HH) impacted the Texas coast in August 2017, affected Galveston Bay (GB) near-shore estuarine ecosystems, altering the community structure in this region. To better understand the biological community in GB, zooplankton samples were collected monthly for two successive years in GB; before (2016) and following the events of HH (2017). Abundance (ind./L), taxonomic composition (rel. frequency), and diversity (Shannon's Diversity Index), were computed and compared for the two successive years. Investigating zooplankton dynamics provides information on the effects of HH to this important food web. Preliminary results show differences in species composition and abundance before and after HH, and are based on sampling conducted at 3 established sampling stations throughout GB. Definitive quantitative data will be analyzed and completed for a better understanding of hurricane driven impacts to zooplankton, in a shallow, subtropical estuarine ecosystem.

79. Physiological Effects and Pollutant Levels in Fish from Galveston Bay Following Hurricane Harvey

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Research Advisor(s): David Hala

The recent catastrophic flooding of Houston caused by the landfall of Hurricane Harvey (August 25th, 2017) led to massive urban runoff into Galveston Bay (GB). Approximately 1 trillion gallons of rain water fell onto Houston, with most of it draining into GB. This massive flooding event is suspected to have re-suspended polluted sediments, potentially releasing adsorbed 'legacy' contaminants, such as polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs). In this poster, the potential physiological effects of PAHs and PCBs on fish sampled from GB were studied. In partnership with Texas Parks and Wildlife (TPW), various fish species sampled prior to Harvey's landfall (11/2016), and two months following Harvey's landfall (11/2017) were analyzed for hepatic detoxification enzyme activities and pollutant body-burdens. Specifically, hepatic enzyme activities for cytochromeP450 1a1 (CYP1A1) and Glutathione-*S*-transferase (GST) was determined using spectrophotometry. The bio-accumulation of PAHs and PCBs in hepatic tissues of fish was also quantified using gas chromatography and mass spectrometry (GCMS). Comparisons of enzyme activities pre- vs. post-Harvey showed no significant differences in activities. Similarly, comparisons of pollutant body-burdens also showed no differences in hepatic PAH and PCB concentrations in pre- vs. post-Harvey samples. Despite this lack of statistical significance, PAH and PCB levels in fish hepatic tissues were within range of those reported for fish in GB. Therefore, it appears that Hurricane Harvey may not have significantly impacted pollutant (PAH and PCB) bio-accumulation in resident fish species, however more comprehensive studies are needed to assess potential impacts.

80. Re-evaluating Natural Disaster Experience Influence on Climate Change Concern

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Research Advisor(s): Ashley Ross

Past studies of public belief and concern for climate change has found that disaster experience is not a significant influence. Given the unprecedented intensity and resulting damages of the 2017 hurricane season, there is an opportunity to revisit how disaster experience may shape climate change beliefs. This study uses an online survey, conducted in 2017, of Gulf Coast residents to assess the association between experiencing these recent natural disasters and one’s concern for climate change. However, experiences are only one factor that influences climate change concern. Social identities or attachment to a group one is a member of also shape climate change beliefs. Studies have found that race and ethnic minority, religious, political party, and generational identities are associated with climate change opinions. To evaluate these relationships, an ordered logistic regression model was estimated in Stata. The dependent variable was level of climate change concern; the independent variables of interest included: 2017 disaster experience, coastal risk perceptions, race/ethnic minority group membership, evangelical religious beliefs, Republican Party affiliation, and Millennial Generation identity. The findings indicate that disaster experience positively influences climate change concern. Also significant was minority membership, Republican affiliation, and coastal risk perceptions. This study demonstrates that disaster experience, at least in the short term, influences climate change concern. Given that the risks associated with climate change are only growing in coastal communities, it will be important in the future to understand how to build on disaster experiences to sustain concern and motivate action that mitigates climate change impacts.

81. The Effects of Hurricanes on Port Operations

Dylan Folkman (University of Maryland)
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Research Advisor(s): Amir Gharehgozli, Joan Mileski

This paper studies the long-lasting effects of hurricanes on port operations. It focuses on the recent effect of hurricane Harvey on the Port of Houston. Hurricane Harvey pushed a large amount of sediment into the Houston Ship Channel, decreasing the depth of the port. As a result, larger vessels need to de-ballast the water from the ballast tanks in order to reduce their draft and enter the port. Arena simulation software is used to simulate the operations at the two main container terminals in the port, Bayport and Barbour’s Cut. Two simulations are created to model the port and its efficiency before Harvey versus after Harvey. The model before Harvey allows ships to enter the port, unload and load containers, and leave the port, while the after-Harvey model forces the large vessels to empty their ballast tanks. This can cause delay and reduce the number of containers to be unloaded and loaded at the port in the long term. When the entities are leaving the simulation, the total amount of containers that were to be unloaded and loaded by the vessel are counted, and the total revenue from the containers is calculated. Furthermore, the average waiting time, total amount of TEU (Twenty-Foot Equivalent Units) unloaded and loaded, and the total revenue were compared to determine if hurricanes have a deeper effect on ports that are susceptible to this specific natural disaster. These ports should have easier access to dredging equipment in order to minimize the total deficit from this issue.

82. Impact of Salinity and Sex on the Swimming Performance and Metabolism of Sheepshead Minnows (*Cyprinodon variegatus*)

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The sheepshead minnow, *Cyprinodon variegatus*, is a representative euryhaline species commonly found in Texas fresh- and saltwater environments. Fish exposed to different salinities may need to compromise other functions, such as growth, reproduction, foraging or migration due to elevated energetics demands for osmoregulation. What's more, there is evidence that sex-based differences exist in fish as reported for mammals. For instance, sex is shown to have different effects on energy demands in fish as males and females expend different amounts of energy on various physiological functions. The goal of this study is therefore two-fold and will study 1) how salinity affects fish and 2) whether sex-based differences are apparent in basic physiological functions such as swimming. To that end, swimming performance and oxygen consumption is assessed using swim tunnel respirometry. These two physiological end-points are useful as swimming is dependent on the interactions between multiple organ systems making it an integrative measure of an organism's physiological capabilities. Furthermore, oxygen consumption is a robust endpoint as it is a measure of an animal's overall metabolism [e.g. energy demanding processes such as osmoregulation will increase metabolism]. Other physiological end-points such as metabolic scope (aerobic capacity) and excess post-exercise oxygen consumption (anaerobic capacity) will further be determined alongside behavioral observations of swimming performance. Taken together data collected from this study have significant ecological relevance as the measured physiological end-points are informative of how well fish cope with environmental changes (e.g. salinity) and whether sex-based differences should be considered in future physiological studies on fish

83. Identification and Characterization of Novel Lysis Genes in Bacteriophage

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Research Advisor(s): Ry Young, Jolene Ramsey

Bacteriophages are viruses that specifically infect bacteria. Phages are highly selective toward their hosts. Phage lysis is the process by which bacteriophage rupture their host to release their progeny. This opens the avenue for phage therapy on plants, animals, and humans to assist antibiotic treatment. The focus of the study involves phages that infect gram-negative bacteria. Gram-negative bacteria have three layers surrounding them that phage have to overcome to accomplish lysis: the inner membrane made of a phospholipid bilayer, the periplasm made of peptidoglycan, and the outer membrane made of another phospholipid bilayer. Disruption of each of the bacterial layers corresponds to a specific lysis protein. The traditional proteins are holin, endolysin, and spanin, respectively. Some lysis genes can be identified bioinformatically but not all can, due to a lack of conserved motifs that prevent algorithms from identifying new genes. There are lysis genes in thousands of different phage species that bioinformatics alone cannot identify, each gene potentially lysing the host in different ways. Previous studies have shown that phage lysis releases fewer endotoxins from their host than antibiotics. Since phage lysis matters for therapy outcome, it is important to characterize lysis mechanisms. To safely use phages for therapeutic proposes, we need to learn how phage lyse bacteria. In this study, we present a method that allows for the experimental identification of novel lysis genes in phage genomes. This method employs complementation of suspect lysis-defective phage lambda with candidate novel lysis genes. Our assay screens for suspect lysis genes that recover the lysis phenotype in lambda lysogens with amber mutations in the lysis. Here we test gp29 of the phage petty, thought to be an outer membrane disrupting protein, and a gene library of phage Moabite to complement spanin deficient lambda strains. By supplementing where bioinformatics fails this method characterizes novel lysis genes that could be used in phage therapy.

84. Over-Expression Screen to Identify Suppressors of Growth Defects Caused by Deletion of SET1, a Gene That Encodes the Histone H3 Lysine 4 Methyltransferase In *S.Cerevisiae*

Joy Suh (Grinnell College)
Biochemistry REU
Research Advisor(s): Mary Bryk

The *SET1* gene encodes a histone methyltransferase that can add one, two, or three methyl groups to Lysine 4 of Histone 3 (H3K4). Previous work in the Bryk lab showed that H3K4 methylation is required for expression of the *HIS3* gene, which produces an enzyme in the histidine biosynthesis pathway. Set1-mediated methylation of H3K4 permits an increase in the steady-state level of *HIS3* mRNA when *S. cerevisiae* yeast cells are starved for histidine. Cells with a null allele of *SET1* (either *set1*Δ or *set1-Y967A*) have difficulty producing *HIS3* mRNA and the amino acid histidine. Thus, they exhibit growth defects when starved for histidine. When cultured on media lacking histidine (SC-His) that also contains a competitive inhibitor of the *HIS3* gene product, 3- aminotriazole (3-AT), *set1* null mutants grow more poorly than $SET1^{+}$ cells. The Bryk lab performed an over-expression screen to identify suppressors of growth defects caused by deletion of *SET1*. Lyndsey Price identified a plasmid containing several yeast genes from *S. cerevisiae* chromosome *V* that suppresses the growth-defect phenotype observed in *set1*Δ mutants on SC-His +3-AT. Using restriction digests and cloning, the genes on the plasmid are being tested individually or in pairs to identify the specific gene responsible for suppression. With the identification of the suppressor gene and its function, we will achieve a greater understanding of how Set1 and methylation of histone H3 facilitates expression of the *HIS3* gene.

85. Coa4 is Required for Copper Delivery to Cytochrome C Oxidase

Alison Vicary (Texas A&M University)
Biochemistry REU
Research Advisor(s): Vishal Gohil

Copper is required for the assembly and activity of cytochrome *c* oxidase (CcO), the terminal enzyme of the mitochondrial respiratory chain. As a multi-protein complex, CcO biogenesis involves many assembly factors necessary for the proper association of protein subunits and insertion of cofactors. Although the existence of these assembly factors has long been known, the precise roles of many of them have remained uncharacterized. Here we investigated the role of Coa4, an evolutionarily conserved CcO assembly factor with unknown function. We found that *coa4Δ* yeast cells have a respiratory growth phenotype correlated with impaired CcO assembly and activity, as well as reduced cellular and mitochondrial copper levels, all of which can be alleviated by exogenous copper supplementation. These results suggest that disrupted copper transport to CcO is the biochemical basis of the respiratory deficiency of *coa4Δ* cells. To place Coa4 in the copper delivery pathway, we performed a candidate-based suppression screen with 16 genes implicated in CcO assembly. Overexpression of *COX11*, a metallochaperone involved in copper delivery to the CcO subunit Cox1, rescued the respiratory growth of *coa4Δ* cells, suggesting that Coa4 acts upstream of Cox11. The sub-mitochondrial localization and sequence analyses of Coa4 suggested a redox role in the copper delivery process. In support of this idea, we found that glutathione supplementation or hypoxia treatment rescued the respiratory growth of *coa4Δ* cells. Taken together, these results uncover a redox role of Coa4 in the copper delivery pathway to the Cox1 subunit of CcO.

86. Forward Genetic Screen to Identify *bak1/serk4* and *mekk1* Mediated Cell Death Suppressors in *Arabidopsis thaliana*

Samuel Hayes (Texas A&M University)
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Research Advisor(s): Ping He, Libo ShanShan

Arabidopsis thaliana, a model plant organism, relies entirely on its innate immune system during infection. One component of the plant's innate immunity is programmed cell death. BAK1 and SERK4 are proteins that, among other roles, act as negative regulators of cell death in *Arabidopsis*. When *BAK1* and *SERK4* are knocked out, cell death is constitutively activated, and the plants have a seedling lethal phenotype. MEKK1 is a protein involved in *Arabidopsis* in immune system signaling. Similarly, when it is knocked out, cell death is constitutively activated, affecting the plant's phenotype. In the following study, a forward genetic screen was conducted to identify suppressors of *mekk1* or *bak1/serk4* mediated cell death. The screen required use of virus induced gene silencing (VIGS), to silence *BAK1/SERK4* or *MEKK1* in plants, and observation of the resulting phenotype. During this screen, two candidate suppressors were identified. These had knockouts of the genes PROTEIN PHOSPHATASE 5 (PP5), and LATE EMBRYOGENESIS ABUNDANT 26 (LEA26) separately. These proteins are involved in Arabidopsis' response to light, and embryo development, respectively. The *pp5* candidate is an *mekk1* suppressor, and the *lea26* candidate is a *bak1/serk4* suppressor. Repeated screens have demonstrated that the *pp5* candidate is a stronger suppressor of cell death than the *lea26* candidate. To confirm the validity of the *pp5* candidate, other *Arabidopsis* lines containing different knockouts of *PP5* will be tested for suppression. Alongside this, *MEKK1* and *PP5* will be silenced in wild type plants using VIGS, to see if suppression of cell death still occurs.

87. Characterization of Methyltransferases Required for the Biosynthesis of the O-Methyl Phosphoramidate Modification of the Capsular Polysaccharides of *Campylobacter jejuni*

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Research Advisor(s): Frank Raushel, Zane Taylor

Campylobacter jejuni is a Gram-negative pathogenic bacterium that is commonly found in chickens. Campylobacteriosis, or infection by *Campylobacter* bacteria (most often *C. jejuni*) is among the most common bacterial infections found in humans, and is a leading cause of food-borne gastroenteritis. Additionally, infection has been shown to rarely (1/1000) lead to the development of Guillain–Barré syndrome (GBS), a neurodegenerative disease, post-infection. *C. jejuni* produces a capsular polysaccharide (CPS) layer that serves as a means of environmental and autoimmune protection, in addition to advancing the organism's pathogenicity. The CPS of *C. jejuni* NCTC 11168H contains a unique O-methyl phosphoramidate (MeOPN) modification that is present on 70% of infections strains. Recently, several genes responsible for the MeOPN modification have been characterized: Cj1421 and Cj1422 have been shown to be responsible for transferring the phosphoramidate moiety to the sugar backbone of the CPS. L-glutamine kinase (Cj1418) catalyzes the ATP-dependent phosphorylation of the amide-nitrogen of L-glutamine to form L-glutamine phosphate, which is then then utilized by a CTP:phosphoglutamine cytidylyltransferase (Cj1416) to displace pyrophosphate from MgCTP to form cytidine diphosphate (CDP) L-glutamine. CDP-L-glutamine is then hydrolyzed by γ-glutamyl-CDP-amidate hydrolase (Cj1417) to form cytidine diphosphoramidate (CDP-NH2). CDP-NH2 is then phosphorylated by the ATP-dependent cytidine diphosphoramidate kinase (Cj1415) to form 3'-phospho-cytidine-5'-diphosphoramidate. The purpose of the current investigation is to characterize two functionally annotated methyltransferases- Cj1419 and Cj1420. Cj1419 and Cj1420 are the remaining enzymes to be characterized in the 8-gene cluster found to be responsible for the MeOPN modification of the CPS of *C. jejuni.*

88. DNA-Binding Protein RefZ Positions the Z-Ring Relative to the Chromosome during *Bacillus subtilis* Sporulation

Ryan Otto (Texas A&M University)
Independent Project
Research Advisor(s): Jennifer Herman

One of the earliest steps of *Bacillus subtilis* sporulation is a polar division that creates the forespore compartment, and proper DNA capture within this forespore is critical to sporulation. Regulation of the cell division protein FtsZ ensures that the forespore captures the appropriate amount of DNA at the start of sporulation. We investigated RefZ, a DNA-binding protein in the TetR family that is important for precise capture of forespore DNA and timely shifting of the Z-ring from midcell toward the pole during sporulation. RefZ binds five DNA motifs (*RBMs*) located proximal to *oriC* at/near the future polar division site. We found that a Δ*refZ* mutant overcaptures regions of the chromosome in the forespore, and misexpression of RefZ during vegetative growth inhibits cell division. We hypothesize that RefZ-*RBM* complexes inhibit FtsZ polymerization near *oriC* early in sporulation and later disrupt the medial Z-ring to promote the timely shift of FtsZ toward the pole and inhibit midcell division. To investigate whether RefZ's effect on the Z-ring is required for RefZ's role in forespore chromosome capture, we isolated and characterized 10 RefZ loss-of-function mutants (rLOFs) that are unable to inhibit FtsZ-mediated cell division when misexpressed during vegetative growth. These rLOFs phenocopy a Δ*refZ* mutant and overcapture regions of the chromosome in the forespore, supporting the hypothesis that RefZ functions to correctly position the Z-ring relative to the chromosome. Further investigation of RefZ's effects on FtsZ will lead to a better understanding of the coordination that occurs between cell division proteins and the chromosome.

89. Restoring Lung Growth with Mesenchymal Stem Cells: An Animal Model of Neonatal Lung Disease

Kayla Quim (Texas A&M University)
Independent Project
Research Advisor(s): Alvaro Moreira

Introduction: Each year, 15,000 US preterm newborns are diagnosed with bronchopulmonary dysplasia (BPD). This debilitating disease is characterized by overexposure to mechanical ventilation and supportive oxygen, and currently there are no curative treatments. The regenerative properties of mesenchymal stem cells, show a promising new avenue for treating BPD. The objectives of this study were to: i) Demonstrate that stem cells improve lung growth and development and, ii) Demonstrate effects of stem cells on lung repair processes. **Methods:** Mesenchymal stem cells were derived from human umbilical cords and administered in a hyperoxia-induced rat model of BPD. Lung growth and development was assessed using mean linear intercepts (MLI), alveolar surface area (ASA), and von Willebrand Factor staining (vWFS). In vitro, BPD was induced using rat epithelial cells exposed to 24-hours of hyperoxia and H_2O_2. The injured cells were then co-cultured with MSC conditioned media. Transforming growth factor beta (TGF-β) gene expression, cell motility, and cell proliferation were measures of lung repair processes. Results were expressed as mean ± standard deviation and analyzed with one-way ANOVA; p-value <0.05 denoted statistical significance. **Results:** Animals that incurred hyperoxic injury had a mean linear intercept of 66.2 ± 3.2 microns, while the group that received stem cells had a mean linear intercept of 58.0 ± 3.4 microns ($p<0.05$). Stem cell therapy also demonstrated improvement in ASA and vWFS. In vitro studies showed that TGF-β gene expression directly correlated to hydrogen peroxide induced injury. A reduction in TGF-β gene expression was shown after two hours of MSC-conditioned media treatment. Cell motility and cell proliferation improved after receiving MSC-conditioned media treatment. **Conclusion:** The findings in our studies indicate that stem cell therapy given to a hyperoxia induced BPD model, improves lung growth and development. In vitro studies demonstrate stem cells promote lung repair processes after injury.

90. Assessing the Functional Importance of Domains and Residues Within Atpot1b

Tyler Higbee (Texas A&M University)
Independent Project
Research Advisor(s): Dorothy Shippen, Borja Barbero

Telomeres are repeated sequences of non-coding DNA that function to protect chromosome ends. Telomeres are added by an enzyme called telomerase, composed of a reverse transcriptase subunit and an RNA template. Telomeres solve the end replication problem and prevent chromosome ends from being recognized as a DNA double strand break with the aid of telomere accessory proteins. One of the proteins that plays a key role in protecting telomeres in humans is Protection of Telomeres 1 (POT1). POT1 has a conserved function across many species. *Arabidopsis thaliana*, a member of the *Brassicaceae* family, contains 3 different POT1 variants. POT1a forms a complex to render an active telomerase and therefore has a major role at chromosome ends. On the other side, POT1b mutants do not display any telomere abnormalities, while showing phenotypes correlated with a defect in plant growth and germination. POT1b seems therefore as an example of a telomere related protein with moonlighting functions off the telomere and perhaps involved in plant development. To map the protein regions responsible for these off-telomere functions, we will attempt the rescue of POT1b mutant plants with different domain-expanding constructs of the allele. This work will further aid in the biochemical characterization of a non-canonical telomere-associated gene and provide insight into alternative functions of telomere related proteins.

91. Characterization of Alginate Microparticles From Air Sheath Particle Generator

Oluwaseun Fashina (Baylor University)
USRG
Research Advisor(s): Mike McShane

The development of effective management methods for chronic diseases is becoming more important as the prevalence of chronic disease increases. Implantable biosensors can improve management methods by allowing for more convenient and frequent monitoring of relevant biomarkers. This paper presents a method to produce alginate microparticles that can be incorporated into optical biosensors. The purpose of this system is to produce particles of uniform size with a narrow size distribution. The narrow size distribution ensures that each particle has the same concentrations of the enzyme and dye that are used to measure the analyte of interest. This system uses pulses of air at a predetermined frequency to interrupt a stream of alginate to form particles. The air pulse frequency and alginate flow rate were varied to study the effects on the resulting particles. 1 Hz and 2 Hz pulses resulted in more irregular clumping and fewer particles. For these reasons, 5 Hz and 10 Hz may be more promising for particle production. Optimization of this system could provide a faster and more controlled way to make particle.

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