RESEARCH ABSTRACTS FROM UNDERGRADUATE RESEARCH EXPERIENCE 2017 (URE17)

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URE17 Abstracts

DESIGN AND FABRICATION OF LOW-COST MICROFLUIDIC DEVICE FOR BIOPHYSICAL MEASUREMENTS

Authors: Abi Mendez, Monika Tadrous, Wylie Ahmed
Faculty Advisor: Wylie Ahmed

Microfluidics is a technique to manipulate fluids at the micro-nanoscale using micron-sized channels that can be fabricated from a variety of materials (PDMS, silicone, paper, etc.). The goal of this project is to design and fabricate a low-cost microfluidic device that can manipulate micron-scale particles, and control pH levels to study the force kinetics of biological molecules such as R-bodies, a pH-sensitive protein found in the bacteria of paramecium that function as a molecular piston that is able to destroy cell membranes upon activation. Characterization of the channel of the microfluidic device and fluid flow of passive particles was completed via video microscopy and digital image analysis. In this report, we summarize the design and fabrication of a microfluidic device using the Shrinky Dink method pioneered by Michelle Khine.

PURIFICATION AND COPPER BINDING OF ALPHA-2-MACROGLOBULIN

Authors: Alejandra Garcia, Theodros Kidane, and Maria Linder
Faculty Advisor: Maria Linder

Many years ago, copper was thought to be transported by the blood to tissues by only the protein albumin. Previous research in the Linder laboratory found that there was another protein that also transferred copper to the liver and was later found to be alpha-2-macroglobulin. Not much is known about how alpha-2-macroglobulin and copper interact, and how many copper atoms bound. To begin to answer these questions, alpha-2-macroglobulin was purified from human and pig blood plasma. The purification process that was followed was from Salvatore Pizzo's lab from Duke University. The Pizzo purification method included PEG 8000 precipitation, zinc affinity chromatography with zinc charged Chelating Sepharose resin, and large pore size exclusion chromatography on Sephacryl S300. SDS-PAGE and Native PAGE were conducted to test the purity of the purified alpha-2-macroglobulin. SDS-PAGE showed a large band at 180kDa, which meant that the human alpha-2-macroglobulin was the right molecular size. The native-PAGE conducted on human alpha-2-macroglobulin indicated that there were two different sized molecules present and further purification was needed. Pig alpha-2-macroglobulin migrated further in SDS-PAGE and in native-PAGE compared to human alpha-2-macroglobulin, indicating that the molecular size about 900 and 400. Samples of the purified proteins were then sent to a collaborator, Peter Faller at the University of Strasbourg in France, who is using EPR to determine how and how many copper atoms are bound to these proteins. The copper and protein content of the purified alpha-2-macroglobulin were also measured. It was calculated that for the human form there were about 4 copper atoms per alpha-2-macroglobulin tetramer while pig form there could be 4 copper atoms per alpha-2-macroglobulin dimer.

BULK AND SURFACE RESISTIVITY

Authors: Alejandro Torres and Juan Martinez
Faculty Advisor: Pratanu Ghosh

My project focused on the testing of different cement mixtures. Our job was to show that HPC was superior and more beneficial than the usual OPC that is used. After the cylinders of different cement mixtures were dry, we performed different tests to see their durability. The process that we used is called electrical resistivity. This process is a nondestructive way of testing the cement. We use different methods that measure the amount of electrical charge that is allowed to pass through the cement cylinder. By analyzing the cylinders, we were able to see which mixtures were more durable than others. By being able to find the best mixture we are able to help our cities to stop having to replace cement that corrodes much faster than HPC which is why our research was so important.

COMPARING LARVAL SETTLEMENT TO ADULT DISTRIBUTIONS OF NATIVE (*OSTREA LURIDA)* AND NON-NATIVE (*CRASSOSTREA GIGAS)* OYSTERS ACROSS TIDAL ELEVATIONS

Authors: Allison Hommel, Rick Torres Jr., Danielle Zacherl
Faculty Advisor: Danielle Zacherl

Oyster reefs have declined globally due to a variety of factors including human activity. Overharvesting has left little to no habitat substrate along the US west coast, and local oyster populations are functionally extinct. The Olympia oyster, *Ostrea lurida*, is native to the North American west coast, ranging from Sitka, Alaska, USA to Baja California, Mexico. The Japanese oyster, *Crassostrea gigas*, is a non-native species that was introduced to the US in the early 1900s for aquaculture. Previous research shows the two adult oyster species in estuaries at overlapping tidal elevations of 0.3 m MLLW and 0.6 m MLLW, with *O. lurida* preferring lower tidal elevations and *C. gigas* preferring higher tidal elevations. Larval settlement follows a similar pattern among the various tidal elevations. We hypothesized that the oyster larval settlement at Grand Caribe, San Diego Bay, San Diego, California, USA will parallel the adult distribution pattern for *O. lurida* and *C. gigas* at two tidal elevations (0 m MLLW and 0.6 m MLLW). To examine these two oyster species and determine whether their larval settlement matches their adult distribution, 15 X 15 cm tiles were laid out at two tidal elevations, 0 m MLLW and 0.6 m MLLW. Oyster settlers were counted to assess population densities per square meter per day. Larval settlement parallels adult distribution patterns in both species, yet *O. lurida* has a larger larval settlement. The data to date for this site indicate that *C. gigas* has a greater growth and survival rate than *O. lurida*; however, the latter species has experienced a recent pulse in reproduction and more data are necessary to generate a conclusion about larval settlement and adult distribution.

FEEDING THE DEVIL: EXPLORING FILTER PERFORMANCE IN GIANT DEVIL RAYS

Authors: Christopher Ruiz, Raj Bolla, Dr. Misty Paig-Tran
Faculty Advisor: Misty Paig-Tran

Devil rays are highly efficient filter-feeders that are capable of separating microscopic planktonic particles (~50 microns) from water. These filtration mechanics are of great interest because devil ray filters do not clog nor need to be replaced over their entire lifespan of 20 years. No known human-made filter on the market today is capable of running for extended periods of time without suffering from problematic clogging, which leads to expensive and time consuming clearing of the filters. Biomimetic devil ray filtration can provide huge benefits in sustainability from waste water filtering to medical applications.

SENTIMENT ANALYSIS

Author: Corey Case
Faculty Advisor: Abhishek Verma

Sentiment Analysis takes large amounts of data to derive an opinion from that data using a variety of tools. The purpose of this analysis is to take key words and possible thoughts from a movie review and compare it to the person's opinion who is writing the review to provide an accurate rating data cluster. The analysis would also need to account for satirical tools, such as sarcasm, negation, and ambiguity also to differentiate a good review and a sarcastic review with similar keywords.

In this case, the analysis done takes mass datasets IMDB reviews in order to decide if a movie is generally good or bad. These are common review systems for people when looking at possible movies, that being said, using mass data mining systems would be exceedingly useful to understanding positive, negative, neutral, and satirical reviews. This particular dataset is to be labeled into five sectors, negative, somewhat negative, neutral, somewhat positive, and positive. Stanford University analyzed this and formed a source code with mostly accurate information using deep learning, vector modeling as well as recursive modeling (Socher, 2).

This system also examines the entirety of a sentence and ordering of the words. This gives us a clear, decisive, and most importantly, an accurate system to understand the true entertainment value of a given movie based on the reviews, without actually seeing each and every review. This kind of system would help review system optimization as well as well as for people looking at these mass reviews (Maas, 1).

EFFICIENCY OF SOLAR PANELS: BLACK ROOF VS. GREEN ROOF

Author: Daniel Ramsey
Faculty Advisor: Garret Struckhoff

Solar energy is one the newest technologies poised to make an impact on future generations. In particular, Photovoltaic flat-panel solar panels have been the most common type of solar panels that have seemingly connected an unlimited amount of sunlight and useable energy for the public and industry alike. This technology is promising, but not perfect. Photovoltaic cells, the "power-producers" in flat-panel solar panels, have been thought to have the tendency to decrease in efficiency when they are exposed to higher temperatures. More sunlight may have more power potential, but we are limited by the amount of heat affecting the cells; this is our challenge to overcome. In this experiment, the method of using a green roof as way of providing a cooler surface for solar panels in efforts of increasing the PV cell efficiency will be explored. To test this hypothesis, a green roof was compared to a black roof, consisting of asphalt rock and pea pebbles on black membranes.

EFFECTS OF DIETARY COPPER INTAKE ON LEVELS OF COPPER ASSOCIATED WITH SMALL COPPER CARRIERS (SCC'S) AND CERULOPLASMIN IN PIG PLASMA AND URINE

Author: Daniela Gonzalez
Faculty Advisor: Maria Linder

Copper is a trace element in mammalian organisms that may be damaging if homeostasis is interrupted such as in Wilson disease or copper deficiency. Small copper carriers (SCCs) in blood plasma may rise when there is excess copper (Wilson disease), and this may provide an additional mechanism of copper excretion because the normal route for excretion via the bile is blocked. In contrast, levels of blood plasma ceruloplasmin will fall when there is copper deficiency. Pigs normally have higher levels of SCC in their blood plasma than other mammals, which could mean they excrete more copper via the urine. The focus of these studies was to determine the ideal copper concentration in pig diets for optimal health and growth and to determine whether an increase of copper intake or decrease of copper intake in pig diets influences production of ceruloplasmin and small copper carriers (SCCs). Low and medium copper diets gave similar results for total plasma and total urine copper. High diets slightly increased total plasma copper and almost doubled urinary copper. Plasma SCC-copper levels did not relate to dietary levels of copper, and was a small proportion of the total copper. In contrast, almost all urinary copper was in the form of SCC and was higher with high copper diets. There was no obvious difference weather Cu_2O or $CuSO_4$ was used. Ceruloplasmin enzyme activity indicated that the lowest copper diet did not result in copper deficiency. Size exclusion chromatography did not sufficiently separate the main copper proteins to detect other possible differences. We conclude that the lowest levels of copper fed the pigs was adequate for their nutrition, that some of the excesses copper was lost in the urine; and that levels of plasma SCC will not necessarily correlate with levels of urinary SCC.

COMPUTATIONAL ANALYSIS OF VENTRICULAR OSCILLATIONS USING THE VAN DER POL EQUATION

Dei Gomez, Jordan Golemo, Breanna McBean, and Kyle Kishimoto
Faculty Advisor: Anael Verdugo

In this study, we examined the Van der Pol (VDP) equation and its applications to biological oscillations. We used the VDP equation to model the left and right ventricle action potential

duration (APD) and the action recovery intervals (ARI) of the heart from previously published experimental findings. The computational analysis was accomplished by examining both the linear and nonlinear cases of the VDP equation. Analyzing the linear case allowed us to predict the behavior of the solutions based off of different initial conditions and parameters. The nonlinear analysis was used to fit more realistic changes in the dynamics of the APD oscillation amplitude. We found that the APD and ARI ventricular oscillations were approximately modeled with the VDP equation.

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SYNTHESIS OF LEVOMILNACIPRAN USING CONTINUOUS PROCESSING AND BIOPROCESSING - REDUCTION OF ESTER INTERMEDIATE

Author: Delwyn Effendi
Advisor: Amanda Evans

Levomilnacipran is an active pharmaceutical ingredient that contains a central chiral cyclopropane ring, a three-carbon chemical structure found in many pharmaceutical compounds. It is a potent serotonin and norepinephrine reuptake inhibitor that is currently being prescribed as a treatment for major depressive disorder in adults. The application of bioprocessing and continuous flow strategies to the synthesis of active pharmaceutical ingredients (APIs) can provide increases in processing efficiency, optimal stereoselectivity, and improved sustainability in a multitude of organic synthetic processes, including levomilnacipran synthesis. A four-step, telescoped, continuous processing/bioprocessing strategy for making levomilnacipran is being developed in our group. One of these steps includes the reduction of the ester intermediate, ethyl (1R,2S)-2-(ethylcarbamoyl)-2- phenylcyclopropane-1- carboxylate. All recent discoveries will be reported here.

CREATING HYBRID GRAVITATIONAL WAVEFORMS OF BINARY NEUTRON STAR MERGER SIMULATIONS

Author: Derek D. White
Faculty Advisor: Jocelyn Read

While gravitational waves have already been detected from the merger of binary black holes, no binary neutron star mergers have yet been detected. Like binary black holes (BBH), investigations of binary neutron stars (BNS) rely on numerical simulations for the most accurate understanding of waveform dynamics at merger. Driven by BBH detections, infrastructure for this analysis has been developed primarily for BBH. However, BNS have not yet been fully incorporated. Using a standalone Python script, numerical binary neutron star mergers from third parties can now be converted into a format that can be uploaded and used inside the collaborative LIGO Algorithm Library (LAL) and Python Compact Binary Coalescence (PyCBC) gravitational wave research projects and the first generation of hybrid waveforms has been generated using this system.

COMPARISON OF ALGAL GROWTH IN LABORATORY MONOCULTURES AND ECOSYSTEMIC CULTURES CULTIVATED IN BREWERY EFFLUENT

Authors: Jackson Flanagan, Jeff Leister, Derek Tran, Anthony Apodaca, Garrett Struckhoff
Faculty Advisor: Garrett Struckhoff

Algae has been shown to provide competitive lipid production and has been proven to be a viable alternate producer of biodiesel. In this study, various algal cultures were collected and grown in a solution of diluted brewery effluent. The goal of the study was to determine if micro algal ecosystems would prove to be better suited to growing in the brewery effluent than laboratory monocultures. These wild algal cultures were collected in both areas that were exposed to wastewater runoff and areas that were not. Spectrophotometry data was gathered to track the growth of each algae culture through the duration of the experiment. Spectrophotometer readings ranged from 0.4 to 1.6. Values topped off after 3 days at which they maintained consistent values. It is suspected yeast outcompeted the algae in nearly all the bioreactors, affecting the growth of the algae and the spectrophotometry data.

DESIGN AND CREATION OF SHRNA VECTOR PCS6/U6-P21-GFP

Author: Jocelyn Leon
Faculty Advisor: Nilay Patel

ShRNA helps degrade the mRNA of our gene of interest, CDKN1A which codes for P21. When this shRNA is transfected into HeLa cells, there is a decrease in P21 protein levels. P21 can encourage cell cycle arrest when it is stimulated by certain events in its environment. P21 also acts as a transcription regulator. ShRNA has stable knockdown of the gene and for siRNA, it also can become diluted over time and can affect the future cell lines. The ShRNA cell line is more stable; the only drawback is that it takes more time than SiRNA. This project focused on creating a shRNA plasmid that targeted CDKN1A. The shRNA was designed with 3 restriction enzyme sites which were, Xhol l, Mlul, and Hind lll. The restriction enzyme site in the middle, Mlul, was added in between the poly A tail and shRNA sequence so that future shRNA sequences can be ordered without the poly A tail. With each future sequence being less than 60 bp we can reduce the cost. We inserted the P21 shRNA into our plasmid of interest, PCS6/U6 to create PCS6/U6 (U6) P21 downstream of the U6 promoter. In order to insert the GFP tag into this plasmid, we used primers with cut site overhangs, Avr ll and Kpnl to amplify the GFP sequence from the CMV.GFPmax. These two pieces, U6 P21 and the resulting GFP sequence, were then ligated together to form the final plasmid, U6 P21 GFP. In order to check for confirmation that we had the correct product after ligation and transformation, we had to conduct an RE digest using a dual cutting restriction enzyme, Hind lll. Once the plasmid was confirmed via RE digest, we transfected the plasmid into HeLa cells and took florescent images. Cells transfected with U6 P21 GFP expressed GFP and exhibited a decrease in P21 expression. ShRNA knockdown of P21 expression led to a decrease in signal. The GFP tag helps with checking for the transfection efficiency.

MINIMIZING THE CORROSION OF CONCRETE STRUCTURES

Author: Juan Martinez
Faculty Advisory: Pratanu Ghosh

Corrosion rate can be minimized by the use of high performance concrete (HPC) and investigation of its short and long-term durability by electrochemical reaction of corrosion. Reducing the amount of heat buildup in a concrete structure would improve the durability of concrete and would reduce induced corrosion by chloride. HPC has more enduring strength than the normal-strength concrete when exposed to high temperature. The durability of HPC mixtures substantially increase its electrical resistivity and improve long-term resistance for chloride ion penetration. Analysis of data shows maturity in strength and durability by electrical resistivity on concrete cylinders. Interpretation of comparison graphs shows development of the resistivity over time and variation of resistivity between different mixtures. The property of compressive strength was identified, as

was the surface electrical resistivity of HPC mixtures by evaluating the bulk and surface resistivity. This analysis also resulted in performance based quality control of concrete, diffusion of chloride in concrete, and corrosion of rebar in concrete. Data also included tests of electrical resistivity by probe spacing, geometric size of concrete specimen, and frequency the of concrete. Analysis implemented recent guidelines to estimate the corrosion initiation time by averaging the aging factor and the generation of heat. This resulted in better prediction of corrosion initiation time frame as it compares to other ones that have been tested.

SILENT MUSIC: REAL-TIME CONVERSION OF AUDIO SIGNALS TO VIBRO-TACTILE FEEDBACK

Author: Julio Amavizca
Faculty Advisor: Kenneth J. Faller II

Real-time Digital Signal Processing (DSP), embedded design and interfacing, and haptics are often unique and solitary course subjects in academia. We aim to combine these elements of computer engineering into a single, easily implemented project. The objectives of this research are to: 1) Provide an example for educators to include or introduce into their courses, and 2) to provide a platform that combines several elements of computer engineering concepts into a single project. This project focuses on creating an assistive device that allows people with loss of hearing to experience music through touch. This is done by using an embedded device which can process audio signals in real-time and convert them into digital packets of data. These are used to activate haptic motors which the user will wear to sense the music.

MECHANISTIC ASPECTS OF ACETAL FORMATION FROM CARBONYL COMPOUNDS UNDER CONDITIONS USED FOR OXIMATION REACTIONS

Author: Karen Abarca
Faculty Advisor: Peter de Lijser

Acetals are typically formed from aldehydes or ketones with two molecules of alcohol under acidic conditions. These functional groups are especially useful during organic synthesis since they are relatively stable in highly acidic or basic environments. During the synthesis of oximes for a project related to the structure and reactivity of radical intermediates formed from oximes and oxime ethers, our lab has found that an acetal was formed as a side product. Based on preliminary results the acetal formation was hypothesized to be dependent on the presence of certain groups on the benzaldehyde[1]. Acetals are normally formed in the presence of an acid catalyst; therefore a second hypothesis is that the hydroxylamine hydrochloride is acting as a catalyst for the formation of the acetal[2,3]. This project aimed to find the conditions that would yield the highest amounts of acetal, and to learn about the mechanistic aspects of the reaction as well as the behavior of the substituents. The furan substituent group was used to help determine the best conditions for formation of the acetal. Two different locants of these substituents were used to see if regiochemistry was important in the mechanism. These locants were tested under different conditions, including time (4h, 24h, 48h), temperature (25^{o}C, 85^{o}C), and concentration of the aldehyde, to find the best parameters for the acetal formation. The results showed that short time and high temperature (4h, 85°C) were the overall best conditions, despite an unclear pattern of what the optimal environment is. The 2-furanbenzaldehyde locant produced more of the acetal than the 3-furanbenzaldehyde, however, more studies must be done to confirm a regiochemical specific mechanism. These results will help in future projects where the mechanism of the acetal formation can be understood and developed.

UV PHOTOLYSIS STUDIES ON SELECTED SULFONAMIDES

Author: Lisa Danielle McGee,
Faculty Advisor: Sudarshan Kurwadkar

Sulfamethazine (SMN), Trimethoprim (TMP) and Sulfamethoxazole (SMZ) are antibacterials used in veterinary practice. This paper describes a method for their determination upon exposure to sunlight do the antibiotics

degrade, that is based on UV Spectrophotometer due to photo degradation is a key factor in dictating the environmental fate of antibiotics. Photodegradation efficiency is determined by many factors such as pH, composition, light source and the structure of the molecule. In this research, the study of 3 sulfonamides- Sulfamethazine, Sulfamethoxazole, and Trimethoprim, was investigated using Deionized water. Results of a series of runs indicated that all three antibiotics undergo photodegradation with sulfamethazine being least stable and trimethoprim being relatively more stable. Nearly 95% degradation of these antibiotics was accomplished within 4 hours of exposure time.

THE EFFECT OF SYNTHESIS CONDITIONS ON THE FORMATION AND CRYSTAL STRUCTURE OF PEROVSKITE OXYGEN TRANSPORT MEMBRANES

Author: Elizabeth Hitch
Faculty Advisor: Allyson Fry-Petit

Oxygen transport membranes (OTM) are a promising technology that improves current oxygen separation methods by lowering costs and increasing efficiency. OTMs are composed of metal oxides which transport both oxygen ions and electrons across a membrane. Perovskite materials have been proposed as OTMs. This project focuses on synthesizing three perovskites with varying composition using three different synthesis techniques. The compounds will be synthesized using a solid-state ceramic method and two different sol-gel methods that involve the use of citrate/EDTA and citrate/ethylene glycol to understand the effect of synthesis technique on the underlying structure. The structure of all compounds has been investigated using powder X-ray diffractometry. It has been shown that all three compounds can be successfully synthesized via all three synthesis routes and the details of the crystal structure analysis is ongoing.

ELECTRON SCATTERING WITH THE USAGE OF THE RELATIVE FLOW METHOD

Author: Manuel Mora
Faculty Advisor: Leigh Hargreaves

In this study, a gas handling mechanism was built in California State University, Fullerton in order to improve the apprehension of biomolecule data based on differential cross sections. The relative flow technique has been used previously, but there are certain limitations. One of which is asserting that the detector efficiency and electric flux change minimally, to the point where they can be regarded as constant between experiments. This is not the case, however, when working with certain biomolecules, especially polar molecules. We design and build an apparatus that will allow the electron spectrometer to sit in a bath of both gases being analyzed, and therefore asserting that the experimental conditions remain identical when analyzing the target gas. The purpose of this experiment is to refine and obtain more precise measurements by being able to account for molecular differences, such as dipole moments and electronegativity. An electron spectrometer is used in order to monitor the electron scattering angle and position.

DETECTING AND ELIMINATING DOS ATTACKING ON A SOFTWARE DEFINED NETWORK

Author: MHD Anas Alaya
Faculty Advisor: Yun Tian

Software defined networks (SDN) are widely spreading replacing conventional networks for many reasons including a convenient operating cost, an abstract view of the whole network throughout the control unit, and an efficient service with high performance. However, this special architecture is prone to various security risks because switches lose their ability to make decisions and wait for instructions from the controller; as a result, if the controller fails to respond or the switches lose communication with the controller, that region of the network might collapse. In this paper, we will study the effect of denial of service (DOS) attack on a software defined network and propose a quick and easy way to implement a defense mechanism.

NONEQUILIBRIUM DYNAMICS OF LIGHT-ACTIVATED COLLOIDS

Author: Ngoc La
Faculty Advisor: Wylie Ahmed

Active matter, with its ability to consume and dissipate energy, behaves differently from non-active matter. To study the non-equilibrium dynamics of active matter, we used synthetic light-activated colloids (Janus particles) that can be switched from active to non-active state by turning the blue light on or off respectively. The light-activated colloids are composed of a polymer with a hematite cube embedded on one side of the microsphere. Blue light activates the reaction between the hematite cube and hydrogen peroxide buffer, which provides energy for the colloids to be active [1]. The difference between active and non-active motion was visualized and quantified using video microscopy and digital image analysis. In these experiments, blue light was turned on and off to capture the transition between active and passive and quantify colloid dynamics. The results demonstrated that the light-off colloids exhibited solely Brownian motion as expected for non-active matter, while the light-on colloids exhibited a mixture of Ballistic motion and Brownian motion [2]. The diffusion rate and velocity of the light-on colloids were much higher than the light-off colloids, which indicated the dynamical properties changed depending on illumination with blue light. In this report, we characterize the active and non-active dynamics of self-propelled colloidal particles in response to blue light. Further studies will include the dynamics of active particles in micro-scale flows and quantification of force fluctuations.

AGING STUDY: DETERMINING LIFE PHASE OF *DROSOPHILA* USING BRILLIANT BLUE DYE

Authors: Ryan Alvarado[1] ▪ Kasia Bitner[2] ▪ Yasamin Heydary[1]▪ Sabeeca Vadakkan[1] ▪ Parvin Shahrestani[1]
Faculty Advisor: Parvin Shaherstani

Most models of longevity have been built under the assumption that aging is a single, continuous process. However, by studying the aging process of *Drosophila melanogaster*, scientists have developed a new model of longevity in organisms. The new model referred to as the 2PAC model[(6)] incorporates the presence of multiple distinct phases within the aging process. In *Drosophila*, aging appears to be a discontinuous process that can be separated into two distinct phases. Through researching these phases, we can better predict longevity, learn more about the functions of aging, and possibly impede the fatality of its symptoms. This article outlines methodology which capitalizes on the physiological differences between *Drosophila* at different phases of life and utilizes food dye to distinguish between them. By utilizing these methods, we can efficiently study the cellular and molecular differences in flies at different stages in life. The objective of this paper is to outline and modify these methods in the most accurate and time/cost efficient manner possible. Additionally, in order to add coherency between labs undergoing similar research, a point is made to connect "Phases of Aging" studies with "Death Spiral"[(2,3,5)] studies and develop understanding between the two subjects.

IDENTIFICATION OF DROSOPHILA MELANOGASTER GUT MICROBIOTA

Author: Sabeeca Vadakkan
Faculty Advisor: Parvin Shahrestani

The gut of Drosophila melanogaster is a model system that allows understanding of various functions of the gut of sexual populations in general. One of the main features of the gut is that it holds microbiota that play a role in the overall physiology of the fruit fly. Although methods have been created to allow and identify the microbiome of Drosophila, these methods require equipment and certain conditions that many labs are hard-pressed to sustain. The purpose of this paper is to recognize and adapt a protocol that would allow the gut microbiome of Drosophila melanogaster to be identified using culture-dependent techniques, so as to introduce this method to CSUF labs for future studies.

THE IMPACTS OF NOISE POLLUTION ON WESTERN BLUEBIRD (*SIALIA MEXICANA*) TERRITORIALITY

Authors: Sama Ruda, Natalia Doshi, Kiarra Lyons, William J. Hoese
Faculty Advisor: William J. Hoese

Noise pollution may alter wildlife due to possible negative impacts of nearby traffic affecting neighboring habitats. Western bluebirds (*Sialia mexicana*) provide us with the opportunity to investigate how noise pollution impacts wildlife. Recent studies of wildlife responses to noise pollution have ultimately identified changes in animal behavior. We document the effects of noise pollution on bluebird territory size and behavior, specifically patrolling. We hypothesized that the male bluebird located in a noisy area would be smaller than the male located in a quiet area. We measured noise levels at multiple nest boxes along a noise gradient of quiet to loud areas. We present models of territory sizes of loud and quiet nest boxes (n=14). Boxes were located at three Orange County Regional Parks (Ralph B. Clark, Ted Craig, and Yorba Regional Parks) that are exposed to a variation of noise levels. Our results showed there was a weak relation to noise pollution on the territory size and patrol of western bluebirds. This research can help advance future studies and improve our understanding by initiating further investigation of how noise pollution can affect wildlife territoriality.

PERFORMANCE EFFECTS OF GEOMETRY ON ELECTROHYDRODYNAMIC PROPULSION

Authors: Samantha Koenig, Stephanie Flores, Muhammad Faisal Bin Khalid Waliullah, Dr. Chean Chin Ngo
Faculty Advisor: Chean Chin Ngo

Early-stage electrohydrodynamic propulsion is undergoing research as an alternative energy system for aircrafts and jets, due to its projected performance advantages over conventional methods of thrust. EHD has the potential to reduce drag and increase the thrust-to-power consumption ratio. The goal of this research is to understand the effects of different parameters, including geometry, gap distance, and multiple stages, on the production of thrust and power requirements for the lifter. EHD propulsion calculations require the assumption of symmetry; therefore, the foremost models tested incorporated triangular, square, and circular geometries. Using a DC power supply, up to 30 kV of electric potential energy was applied to these geometries via emitter electrodes, with gap lengths between the emitter and collector varying from 2.0 to 3.8 cm. Single and duel-stage thruster devices were tested for the voltage at which stable lift and sparkover occurred. Using the same governing equations as previous research done by Faisal, theoretical values for thrust and power consumption were calculated. An ideal lifter has a high thrust force acting upon it and lower power requirements. The results show that larger values for a thrust-to-power consumption ratio indicate best efficiency. A comparison of the thrust/power consumption to the mass lifted, indicates that the most capable lifters had a gap distance of 2.3 cm and 2.5 cm, and were of a triangular or square geometry. It is also noted that lifters with an additional balsa support within the aluminum collector skirt for added symmetry performed better than those without. The results for dual-stage models were subjected to weight limitations. The power supply available had a smaller voltage than the one used in the previous studies, done by MIT, and was a limitation to this experiment. Additionally, models were unable to be scaled down successfully less than a collector radius of 0.30 m, due to short circuits causing a dangerous sparkover. This limited the available configurations to be tested. In conclusion, the triangular lifter with added symmetry and a gap distance of 0.023 m was more efficient than any other geometry or gap distance. New methods are needed to increase the symmetry of lifters in the future. Continued research should involve attaining experimental results for velocity to calculate thrust, increasing the voltage applied, and increasing the number of power supplies used.

EXPLORING SPACECRAFT ORBITS FOR A PROPOSED EARLY WARNING SYSTEM FOR LIGO

Sky Soltero
Faculty Advisor: Geoffrey Lovelace

The Laser Interferometer Gravitational-Wave Observatory (LIGO) made its first direct detection of gravitational waves September 14, 2015. LIGO can only see frequencies of gravitational waves above ~10Hz, because lower frequencies are dominated by seismic noise. A proposed detector in space, SHANTI [4], would be able to observe gravitational waves for frequencies below 10Hz because the space-based detector would not be limited by seismic noise. The SHANTI detector would allow scientists to see gravitational waves at lower frequencies than LIGO but at higher frequencies than eLISA, a proposed space-based mission. This would allow SHANTI to anticipate LIGO detections by observing the same waves earlier, at lower frequencies, before the waves achieved frequencies high enough for LIGO to detect them. SHANTI, like eLISA, would consist of three satellites arranged in a triangle at sides of 100 km length where eLISA, would have arm lengths that are millions of km long. The SHANTI satellites will be in an orbit that minimizes fuel requirements for course corrections, therefore, minimizing the mission cost. In this project, I compute the freely falling trajectories for the three SHANTI satellites, arranged in an equilateral triangle. Using a simplified Newtonian gravity model including only the Sun and Earth, I find that some orientations maintain the triangle's formation longer than others and therefore would require fewer course corrections to maintain their orbit.

UNDERFLOOR HEATING AND THERMAL ENERGY STORAGE SYSTEMS USING NATURAL POROUS MEDIA

Authors: Stephanie Flores, Samantha Koenig, Ahmed Al Edhari, Dr. Chean Chin Ngo
Faculty Advisor: Chean Chin Ngo

The subject of Thermal Energy has been a rising and an interesting subject during the past few years due to its broad applications in innovative technology for underfloor heating and energy storage systems, among other applications. In specific, porous media, such as sand, and pebbles, can create a thermal energy storage system using an energy supply that does not depend on weather conditions. The behavior of the heat transfer in such mediums, in addition to air, can create a system that is ideal for underfloor heating. The properties of the porous mediums such as permeability, thermal conductivity, and thermal storage capacity determine the flow and behavior of heat. High permeability, caused by large voids, allow the system to have a uniform disbursement of energy, therefore, allowing for a greater convection heat transfer mode. This system allows the top surface of the bed of large grain size or air to transmit heat longer, therefore, provide an alternative source of clean heat for home spaces, and reducing the cost of home expenses. Similarly, thermal conductivity and capacity were also considered to help establish the best thermal energy storage system. Through conduction heat transfer mode, small voids on porous mediums transmit and absorb the energy from the sun to be stored for later use. Due to the small grain size, these mediums have a greater ability to transmit heat, therefore, allowing the system to charge and discharge at its best performance. Similarly, following previous investigations [1], this research experience experimentally proved that sand is the best performance medium to conduct energy due to its low permeability that allows for a fast charging and discharging 2

process while maximizing the amount of energy stored based on its heat capacity. The system tested the storage of energy of sand and air, large white grain pebbles with sand and smaller yellow pebble size with sand. In which it was found that having half sand half air or big pebbles works better for an underfloor heating system while half sand and mall gravel allow for a better storage system. Based on the experiments the investigation of thermal energy storage using natural porous media can account for the high energy demand and help ease peak use load. Moreover, it can be used on road constructions since the underfloor heating system can prevent buildup of snow in the winters. Furthermore, future research looks at the design of a system which finds the balance of conduction and convection heat transfer for the best performance of underfloor heating and thermal energy storage.

SYNTHESIS OF LEVOMILNACIPRAN USING CONTINUOUS PROCESSING AND BIOPROCESSING (ENZ-FLOW)

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Cyclopropanes are three membered carbon rings that are common structures in many biologically-active compounds. They often include at least one chiral center, and this chirality can be readily and selectively generated using biocatalysis. We report the application of the combination of continuous processing technologies and the use of immobilized whole cell genetically-engineered biocatalysts toward the synthesis of active pharmaceutical ingredients (APIs) that contain cyclopropane rings ("Enz-Flow"). These innovative approaches for manufacturing such molecules are anticipated to provide improved biocatalyst stability in addition to increasing the sustainability and productivity of the processes relative to traditional batch/flask approaches. Optimized reaction conditions have been determined for using Enz-Flow methodologies to generate precursors to the API levomilnacipran, which is prescribed for major depressive disorder (MDD) and fibromyalgia syndrome (FMS).

A 1,000 YEAR HISTORY OF SHELF SEDIMENTATION FROM MONTEREY BAY, CA, USA

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Shelf sedimentation responds to multiple processes such as climatic variability, sea-level changes, and human activity. These processes can all influence sediment delivery and deposition over a variety of time-scales from days to millennia. Understanding the interplay of these processes over the recent geologic record may help to predict changes in the future. This study looked to accomplish this by investigating shelf sedimentation in southern Monterey Bay over the past ~1,000 years. Monterey Bay was an ideal study site as the bay is subjected to climatic variability and oceanic upwelling, and the southern portion of the bay is proximal to the Salinas River the most dominant fluvial source providing a direct link to terrestrial processes. The two sediment cores were collected in 2014, and underwent a variety of sedimentological analyses including grain size, bulk density, and computed tomography (CT). Age control was provided thought radiocarbon dates at the base of each core. The most notable results were observed through the grain size analysis, in particular variations in sand content throughout the cores. The lower core sections were characterized by variable sand content with distinct peaks and abrupt decreases throughout, while the upper portion was consistently muddy, with an abrupt increase in sand near the surface. From these results, we conclude that sediment delivery to the shelf has mostly responded to major climatic periods. During warm/dry periods such as the Medieval Climatic Anomaly (MCA) and the Modern Warming (MW), shelf deposits were relatively enriched in sand, while during cool/wet periods such as the Little Ice Age (LIA) mud dominated the shelf deposits. This variability is believed to be the result of variations in the relative balance between sediment supply from land, and remobilization due to oceanic processes. During cold/wet periods supply is greater than remobilization resulting in mud, while during warm/dry periods remobilization dominates, preferentially removing muds, and leaving behind sand. This study demonstrates how shelf sedimentation has responded to climatic variations in the past, given us insight as to what to expect in the future due to climate change.

BLACKBOX: AN ALGORITHM FRAMEWORK FOR DEFENDING AGAINST DDOS ATTACKS ON SDN NETWORKS

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For many years, Distributed Denial of Service attack (DDoS) was the most challenging cyber-attack type for the defense systems. A DDoS attack prevents legitimate users from accessing to specific network resources by disrupting its connection to the network. Fortunately, the recent foundation of Software-Defined Networking

(SDN) technology provides us more opportunities to defend against DDoS attacks in more efficient manners. In this paper, we introduce Blackbox, an intelligence framework which allows security engineers to effectively develop their own algorithm for defense. In other words, Blackbox defines and keeps track of threat levels, detects, and responds to different aggressive attacks in real-time basis. It also works as the decision-maker of the network controller to direct the switches for manipulating their flow tables. For the experiment, we present how to adopt Blackbox framework to implement a simple version for mitigating the UDP DDoS flooding attacks. As a result, the experiment has proved our solution idea, the Blackbox, work efficiently on local area network emulation. It also shows that how easy to integrate the defense algorithms into the controllers through adopting Blackbox framework design**.**

SHEAR STRENGTH AND STABILITY OF PARTIALLY SATURATED CLAYEY SLOPES

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In order to mitigate or prevent landslides, geotechnical engineers study slope stability. To do so two type of experimentation was conducted to analyze slopes and their potential failures. The first experiment that was conducted was the rainfall induced landslide. This experiment required two model simulations that had a slope of 45° angle. The first model had a rate of compaction RC of 75% and the second model had a 65% RC. A comparison was made between Model 10 & Model 11 to see which one was most stable. The only thing that was changed in both models was the RC. The Compaction of Model 10 made it stronger because the amount of space between the soil particles was smaller making it harder for water to seep through, causing it fail.

COMPUTATIONAL STUDIES OF NITROPHENOL PHOTOLYSIS

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Aerosols are tiny clusters of particulate matter floating in the atmosphere. Brown carbon aerosols refer to organic material-containing aerosol particles that absorb visible and ultraviolet (UV) light and therefore contribute to global warming. This absorption of visible and UV light can also cause photochemistry to occur, producing reactive species that may contribute to atmospheric chemistry. Three compounds commonly found in brown carbon aerosols are nitrobenzene, meta-nitrophenol, and para-nitrophenol. The photolysis of these compounds is the focus of experiments in the Kidwell lab at the College of William and Mary which measure the energy of the nitrogen monoxide (NO) molecules produced when nitrophenol is photo-dissociated.

In collaboration with the Kidwell lab, we will use computational chemistry to provide a theoretical interpretation of the experiment results. The present work represents the first step towards this effort in which we used density functional theory (DFT) to obtain optimized minimum energy geometries, as well as the transition states between them on the ground electronic state and lowest energy triplet electronic state. In conjunction with the work underway in the Kidwell lab, this will aid in the development and improvement of atmospheric models that will more accurately describe and predict climate change and atmospheric chemistry.