THE NINTH ANNUAL

UCMERCED

UNDERGRADUATE SUMMER RESEARCH SYMPOSIUM

FRIDAY, AUGUST 07, 2015

WELCOME KICKOFF: 8:30AM IN CLASSROOM & OFFICE BUILDING (COB 120)
POSTER SESSION: 11:30AM - 1:30PM IN LIBRARY LANTERN (KL 155)
ORAL PRESENTATIONS: 9:00AM - 3:00PM IN KL 296, KL 362, KL 396, KL 397

Sponsored by the Undergraduate Research Opportunities Center

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AUGUST 7, 2015

UC Leadership Excellence Through Advanced Degrees (UC LEADS)

The following student scholars are part of UC Merced's Leadership Excellence through Advanced Degrees (LEADS) Program. The goal of the UC LEADS research and graduate preparation program is to educate California's future leaders by preparing promising students for advanced education in science, technology, engineering and math (STEM) fields. The program is designed to identify upper-division undergraduate students with the potential to succeed in these disciplines, but who have experienced situations or conditions that have adversely affected advancement in their fields of study.

For more information, please visit http://uroc.ucmerced.edu/uc-leads

Environmental DNA Sampling Water Drone

Rodolfo I. Barranco, Brendan Smith, and YangQuan Chen, PhD; School of Engineering, University of California, Merced

Collecting water samples from rivers and lakes in an efficient and cost effective manner is important for the study and preservation of freshwater species. Species Identification is achieved through the collection of water samples that are then transported to a lab and filtered for environmental DNA (eDNA). However, current methods for sample collection and species identification are expensive and time consuming. In this paper, and intelligent water collecting payload is presented and verified through field experiments, leveraging the numerous advantages of unmanned aerial systems (UAS). The water collecting system improves upon previous sampling methods in that the operator remains on the shore, rather than physically collecting water samples by hand, while the UAS lands on the surface of the water. The payload then samples and filters the water, in-situ, thus shortening the turn around time from sample collection to species identification. The presented method payload design and development employs polylactic acid (PLA) additive manufacturing methods (3D printing) to make the payload lightweight and easy to manufacture. The system is tested in the lab and validated in outdoor experiments. These experiments show that the water sampling method presented in this research is more efficient than other current water sampling methods.

Energy Consumption in Origami-based Sheet Metal Forming

Lourdes Diaz and Ala Qattawi, PhD; School of Engineering, University of California, Merced

Origami-based Sheet Metal forming (OSM) is an innovative manufacturing process that is expected to exceed customary metal forming processes in terms of reducing cost, and improving material and energy use. Traditional metal forming processes are losing stature in the industry as they fail to optimize the manufacturing process of metal sheets. On the other hand, OSM forming requires less waste of material and can be produced at low costs. However, energy consumption is still a big concern as the energy required for this process has merely been explored. In the OSM process, sheets of metal are perforated with bending lines using a laser cutting machine. These bending or discontinuity lines aid the folding process of the metal sheet which is often folded manually using simple hand tools. However, there is limited information about the energy spent in producing OSM products. This research aims at studying the energy requirement to fold OSM parts by using simulation-based models to measure, record, and analyze energy consumption. Moreover, the proposed work applies experiments to test the energy consumed by laser cutting and bending machines. The results of these experiments are expected to optimize the design of OSM parts and provide guidelines of the most energy-efficient fabrication practice in terms of laser cutting and bending operations.

Angiotensin Receptor Blocker Increases Lipid Mobilization and Ameliorates Hyperlipidemia in a Rat Model of Metabolic Syndrome Fed a High Fat Diet

Jose A. Garcia, Andrew Lee, Ruben Rodriguez, and Rudy M. Ortiz, PhD; School of Natural Sciences, University of California, Merced

CD36 and lipoprotein lipase (LPL) are both transport proteins involved in lipid mobilization and triglyceride storage in various cell types; including adipocytes. Accumulation of excess lipids in non-adipose tissues leads to cell dysfunction or cell death. To address our hypothesis that ARB can improves lipid utilization, we measured body mass, retroperitoneal mass, adipose lipase activity, CD36 and LPL expression in five groups of rats; 1) Long-Evans Tokushima Otsuka (LETO) normal diet (ND)(n=6), 2) Otsuka Long Evans Tokushima Fatty (OLETF) ND (n=8), 3) OLETF high fat diet (HFD, 62% fat in food)(n=8), 4) OLETF + angiotensin receptor blocker (ARB) (10 mg olmesartan/kg??d ?? 6 wk)(n=8) 5) OLTEF HFD + ARB (n=7). Results demonstrate improvements CD36, LPL and lipase activity in OLETF relative to LETO. Body mass increased 38% in OLETF relative to LETO, ARB decreased by 20% relative to OLETF and HFD+ARB decreased by 37% in relation to HFD. ARB retroperitoneal fat decreased 16% in relation to OLETF and ARB+HFD decreased 72% in retroperitoneal fat compared to HFD. Results suggest ARB treatment increases lipid utilization and provides a source of treatment to ameliorate the pathogenesis of hyperlipidemia from a high fat diet.

West Nile Virus Infection Rates in Culex Mosquito Species

Stephanie Gamboa, Eunis Hernandez, Andrew Loera, Karen Cedano, Bianca Rodriguez, Jennifer Mendoza, and Andrea Joyce, PhD; School of Social Sciences, Humanities, and Arts, University of California Merced

The two main mosquito vectors of West Nile virus (WNV) in Merced County are the Culex pipiens species complex and Culex taraslis. The Culex species complex consists of several morphologically similar species which hybridize such as Culex pipiens and C. quinquefasciatus. The purpose of this project is to identify the frequency of these two mosquito vectors in different habitats in Merced County. In addition, we will determine the WNV infection rate of these two mosquito species based from the different habitats. Mosquitoes were trapped using CO2 baited traps, and then classified to species. Mosquitoes identified as the Culex pipiens complex or C. tarsalis were then tested for WNV. Mosquitoes were tested for WNV at UC Davis Center for Vector Borne Disease, and will also be tested at UC Merced using the Rapid Analyte Measurement Platform (RAMP) Reader. To date, our 2015 mosquito trapping results revealed that Culex pipiens were the most abundant. It is the C. pipiens are anticipated to have the highest WNV infection rate. The frequency of West Nile virus infection rates for the Culex pipiens complex and Culex tarsalis will be determined weekly and compared among the five habitat types in the county. Habitats with higher WNV infection rates may be prioritized for mosquito control efforts in order to reduce the abundance of insect vectors of WNV.

New Design of Pneumatically Powered MRI Compatible Device for Stroke Rehabilitation

Jesus E. Partida, Melih Turkseven, and Jun Ueda, PhD; George W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology

Hemiparesis is the muscular weakness on one side of the body experienced often times by stroke survivors when brain cells are deprived of oxygen. This condition impacts their quality of life and rehabilitation must be sought to improve the symptoms. The previous project achieved a pneumatically powered Magnetic Resonance Imaging (MRI) compatible robot that practiced a specific rehabilitation procedure. This procedure is meant to promote the connection between the individual's motor cortex and damaged upper limb. This is done by delivering mechanical stimuli to the individual's upper limb. However, the previous prototype was not space-efficient. This summer a new device was prototyped to address this critical issue. The new device is composed of two MRI compatible pneumatic cylinders. In addition, the device is MRI compatible due to the use of incorporating exclusively non-magnetic material into the design. These parts include 3D-printed parts made of Acrylonitrile butadiene styrene (ABS), bearings made of plastic and glass, a hammer tip composed of synthetic rubber, a brass rod, and nylon gears and screws. Space efficiency is achieved through a new mechanical transmission where two cylinders are positioned horizontally and used to rotate a bar on a shaft to deliver a blow to the individual's upper limb. The effectiveness of the design will be experimentally confirmed in the future

Property Characterization of Steam Activated Biochar

Jose A. Rubalcava-Cruz, Sergio Pineda, PhD, and
Gerardo C. Diaz, PhD; School of Engineering, University of California, Merced

Activated carbon is usually utilized in filtration systems for air, as well as, water pollutants. The main source of activated carbon is coconut shells, which are converted to biochar and then to activated carbon through industrial scale application of high temperature steam. Since this product is usually imported, it is estimated that 2 billion dollars are spent in a year purchasing this product. This project intends to find out if biochar from local biomass can be activated producing similar properties as the commercially available activated carbon. The conversion of biochar to activated carbon was performed using reactor designed specifically for this purpose at the University of California at Merced. The operating conditions of the steam-reforming reactor were determined by means of a series of tests with air and steam that determined parameters such as flow rate, operating temperature, and weight loss of the biochar sample. The flow rate of the steam was determined by using an orifice-tube configuration that was calibrated using air and steam as working fluids. The resultant activated carbon was compared with commercial grade activated carbon to determine its porosity, surface area, and fixed carbon. Using an electron microscope, the activated carbon produced with the reactor operating at low-temperatures near 250 degrees Celsius showed the formation of larger pores compared to that of the commercial grade activated carbon.

California Alliance for Minority Participation (CAMP)

The following student scholars are participants in UC Merced's CAMP program. The Louis Stokes California Alliance for Minority Participation (CAMP) in Science, Technology, Engineering and Math, is a statewide initiative funded by the National Science Foundation (NSF) to strengthen the quality and quantity of underrepresented students receiving baccalaureate degrees in science, technology, engineering and mathematics studies at the University of California (UC). CAMP offers extensive resources and unique opportunities for students to excel in their respective fields of study. The CAMP program began at UC Irvine in 1991; currently, nine UC campuses participate in the program.

For more information, please visit http://uroc.ucmerced.edu/camp

Explorations of Cycling Newton's Method

Victoria Arias, Michael Stobb, and Roummel F. Marcia, PhD;
School of Natural Sciences, University of California, Merced

Newton's Method is a numerical technique for finding approximations to roots of a function. Although Newton's Method requires solving for the derivative of the function being evaluated, its main advantage is its quadratic convergence. However, converging to a single point is not always guaranteed; Newton's Method will fail if it enters a cycle, or if it diverges to positive or negative infinity. In order to test the convergence behavior of Newton's method, we provide an example where Newton's Method converges and diverges, depending on the initial point. Furthermore, we investigate a particular behavior called "cycling", which occurs when the algorithm gets caught in a loop, and cycles back to the initial point. Since generating examples for which Newton's Method cycles is challenging due to how finite-precision arithmetic affects our calculations, we focus on presenting examples that will cycle even in a finite-precision environment. Our goal is to explore these special cycling cases in order to test the robustness of Newton's Method.

Thermal Management of Electric Vehicle Batteries Using Aluminum Minichannels

Carter R. Brown, Jian Xu, PhD, and Yanbao Ma, PhD; School of Engineering, University of California, Merced

Effective thermal management of lithium ion batteries is critical to the safety and longevity of electric vehicle (EV) power supplies. In this study, active cooling using aluminum minichannels and circulated water was applied to a Li-ion battery module. An insulation layer was used to isolate the battery module from the environment. Heat management influenced by the effects of various insulation thicknesses, thermal conductivities, battery discharge rates, and water flow rates was investigated using COMSOL Multiphysics. The maximum temperature, temperature differences, and average temperature of the batteries was collected in order to determine optimal size and thermal properties of the insulation. The results of this study will be experimentally validated in the future and expanded to larger modules which can lead to better and less expensive cooling systems for EV batteries.

Synthesis of Novel Non-Innocent Ligands for Metal-Catalyzed Hydroformylation

David Delgadillo, Ramiro Barraza, and Ryan Baxter, PhD; School of Natural Sciences, University of California, Merced

Many pharmaceuticals such as salicylic acid acetate, Aspirin, are composed of esters, aldehydes, and carboxylic acids. Hydroformylation is one of the processes used to synthesize these organic functional groups; which encompasses the addition of a formyl group and a hydrogen atom to a carbon-carbon double bond. The concern with the current formylation process is that the catalysts are either inefficient or are very expensive. In this presentation I will discuss my work on a variety of symmetric and asymmetric chiral non-innocent ligands. These non-innocent ligands have been shown to be redox active, which allow the ligands to participate in the movement of electrons within a catalytic cycle. With that being the case, we are investigating these non-innocent ligands and their catalytic abilities in order to optimize the mechanistic selectivity in asymmetric hydroformylation. It is significant to research non-innocent ligands because they offer novel catalyst alternatives that are efficient and inexpensive. Producing more efficient and affordable catalysts for hydroformylation would reduce the use of precious metals such as Rhodium and improve the availability of organic functional groups by expanding catalytic resources.

Angiotensin Receptor Blockade Improves Non-esterified Free Fatty Acid and Triglyceride Accumulation in a Rat Model of Diet-induced Obesity Fed a High Fat Diet

Amy Hang, Andrew Lee, and Rudy M. Ortiz, PhD;
School of Natural Sciences, University of California, Merced

Consumption of a high fat diet (HFD) overburdens the liver's storage of fatty acids, contributing to non-esterified free fatty acid (NEFA) and triglyceride (TG) accumulation, thus, leading to the development of hepatic steatosis and metabolic syndrome (MetS). Treatment with angiotensin receptor blocker (ARB) was previously shown to decrease hepatic lipid content, possibly improving hepatic steatosis. However, the impact that ARB treatment has on fatty acid storage and the development of hepatic steatosis in a model of MetS fed a HFD are unknown. To test the hypothesis that ARB decreases hepatic fatty acid storage in a model of MetS fed a HFD, the following groups were studied: 1) Long-Evans Tokushima Otsuka (LETO; control) normal diet (ND), 2) Otsuka Long-Evans Tokushima Fatty) OLETF ND, 3) OLETF HFD (62% fat in food), 4) OLETF ARB (10mg olmesartan/kg/day), and 5) OLETF HFD+ARB. HFD treatment increased body mass (14%) and liver mass (9%) relative to OLETF. HFD+ARB treatment decreased body mass (48%), liver mass (9%), plasma NEFA (17%), plasma TG (41%), and hepatic TG (32%) compared to HFD. These results demonstrate that ARB decreases hepatic TG accumulation in rats fed a HFD but were unable to completely restore them to control levels, suggesting that other obesity-associated factors are contributing to the impairment.

CD36 Increases After Thyroid-Stimulating Hormone Infusion during Prolonged-Fasting in Northern Elephant Seal Pups

Lillian Horin[1], Bridget Martinez[1], Daniel Crocker, PhD[2], and Rudy Ortiz, PhD[1]; [1]Department of Molecular and Cell Biology, University of California, Merced; [2]Department of Biology, Sonoma State University;

During prolonged-fasting, northern elephant seals (Mirounga angustirostris) rely on fatty acid oxidation to meet their energetic demands. Furthermore, they experience an up-regulation of cellular thyroid hormone (TH)-mediated components with fasting duration, an atypical response to food-deprived mammals. Although the relationship between TH-signaling and fasting in northern elephant seals has been revealed, the functional relevance of TH-mediated signaling during prolonged food deprivation is unknown. To assess the association between THs and lipid metabolism, we will measure changes in CD36, a protein that facilitates entry of long-chain fatty acids into the cell, in response to thyrotropin (TSH). To address our hypothesis that protein expression of CD36 increases with TSH-induced increase in TH, and the increase will be more rapid and pronounced during the late fast, we will measure the relative expression of CD36 after TSH infusion in early (n=4) and late-fasted (n=4) pups. We anticipate that the increase in CD36 in the late-fasted pups will be greater than the early-fasted pups, and that the increases will occur at 60 and 120 min post-infusion, respectively, suggesting that THs contribute to the regulation of lipid metabolism via CD36 in northern elephant seal pups. A greater understanding of the contributions of TH to lipid metabolism may provide enhanced insight on TH-based therapies for metabolic disorders."

Coordinating Attention in Parent-Child Social Interactions

Jaspreet K. Johal and Eric A. Walle, PhD; School of Social Sciences, Humanities and Arts, University of California, Merced

Infants' ability to coordinate attention with their caregiver in reference to objects in the environment is an important aspect of development. Previous research indicates that walking infants are better at following adult attentional cues than crawling infants, independent of age. The present study examined a possible mechanism that might account for this difference. Twelve-month-old crawling (n=15) and walking (n=18) were observed interacting with their caregiver during a naturalistic observation. Duration of episodes of infant-caregiver joint engagement was coded. Additionally, a joint-attention paradigm assessed infants' ability to follow an experimenter's gaze to locate an object on 8 separate trials. Hierarchical multiple regression examined the main effects of infant locomotor development (i.e., crawling vs. walking) and average duration of joint engagement with the caregiver for predicting performance in the gaze-following paradigm. Infant locomotor development (ß=0.37, p=.03), but not average time of joint attention episodes, predicted infant performance in the joint attention assessment. A significant interaction between infant locomotor status and average duration of joint attention episode was also present, ß=1.47, p=.048. Walking infants who had longer average episodes of coordinated joint engagement with the caregiver performed better in joint-attention, but the reverse was apparent for crawling infants. Further experiments can be performed to investigate possible explanations to these findings. By testing infants' ability to regulate attention and avoid distractions may help explain why walking infants had longer average episodes of joint attention.

Contributions of Adrenocorticotropic Hormone Infusion to Glucorticoid-Receptor Mediated Lipolysis of Northern Elephant Seal Pups

Pablo Juarez, Jose Pablo Vasquez-Medina, Debby Lee, Daniel E. Crocker and Rudy M. Ortiz, PhD; School of Natural Sciences, University of California, Merced

Northern Elephant Seals (NES) experience a prolonged 2-3 month fasting period and rely primarily on the oxidation of fatty acids to meet its energetic needs. This fast is characterized by an increase in cortisol and non-esterified fatty acids (NEFA's). However, the functional relevance of this increase in cortisol and its influence on the glucocorticoid receptor in NES is not defined. We hypothesized that ACTH infusion increases lipolysis in NES. The contributions of cortisol and its receptor (GR) were assessed by exogenous infusion of ACTH and/or concurrently blocking the glucocorticoid receptor in the following groups: 1.) Control, 2) ACTH 3) GR-blocker (mifepristone), and 4) ACTH+GR-blocker. Plasma and adipose biopsy samples were collected at days 0 (T0;immediately prior to infusion) and 6 (T6). Mean plasma cortisol concentrations decreased both 41% (263±36 vs 154±13nM) in the ACTH-infused group and 21% in the combo group (215±82 vs 169 ± 41nM), but remained constant in the control (142±12 vs 155 ± 52) and GR-blocker (210.±74 vs 201±33) groups. Mean NEFA levels increased 38% (0.84 ± 0.13 vs 1.16 ± 0.06mM) in the ACTH-infused group suggesting glucocorticoids contribute to increased lipolysis. Collectively, this data suggests that the fasting-associated increase in cortisol is an important contributing factor in stimulating lipolysis through the glucorticoid receptor.

Investigating Quantum Dot Self-Assembly in a Cholesteric Liquid Crystal

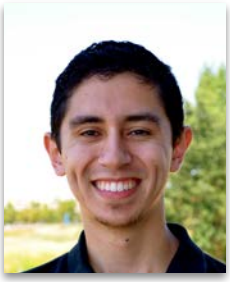
Kyle Kabasares, Devon Zerbe, Tayebeh Rahinasab, and Linda.S. Hirst, PhD; School of Natural Sciences, University of California, Merced

An ongoing goal in condensed matter physics is directly controlling the self-assembly of quantum dots (QDs) into specific structures while maintaining their original electronic and optical properties. One method of controlling the self-assembly of QDs is to disperse them within a liquid crystal (LC) medium and apply a variety of thermal stimulations. Recently, our lab developed a method of creating spherical, vesicle-shaped QDs within a nematic LC. Vesicle formation depends on the QD concentration in the LC as well as the LC's intermolecular dispersion forces and thermal properties. In this project, we investigate the dispersion of CdSe/ZnS (core/shell) QDs in a cholesteric LC (CLC) medium and predict the QD aggregations to cluster near the LC defects. By varying parameters such as QD concentration and temperature, we exploit the CLC's sensitive optical and thermal properties. To observe these effects, we apply spectrophotometry, polarized optical microscopy, and fluorescence microscopy. These techniques highlight the aggregation of QDs within the host CLC and identify how LC phase transitions determine where QD aggregates form. This work illustrates the possibility of new LC-based QD devices, and we will continue by exploring the lasing potential of our sample.

Silver-Catalyzed Synthesis of Fluorinated Pharmaceutical Precursors via Radical Pathways

Ramon Martinez, Alyssa Hua, Jerry Vue, and Ryan Baxter, PhD; School of Natural Sciences, University of California, Merced

Research and development of pharmaceutical precursors have always been integral components in the advancement of organic synthesis. Especially with direct a-alkylation of heterocyclic aromatic compounds via metal catalyzed C-H radical reactions, which offer a controlled pathway to form these pharmaceutical precursors. Recently, addition of fluorinated hydrocarbons to aromatics is showing some great changes to the pharmaceutical industry because fluorinated natural compounds show outstanding properties including: modulating basicity/ acidity of parent molecule, lipophilicity, and modulation of metabolic stability. The process of direct a-alkylation through radical species is carried out in a mechanism similar to Michael addition of nucleophiles and electrophiles; in which the radical species formed is the nucleophile and the electron deficient aromatic is the electrophile. These reactions are typically metal catalyzed and controlled in order to synthesize desired molecules, but most procedures used today are not viable in large scale or even small scale synthesis, because procedures call for inert atmospheric conditions, large molar quantities of substrates, or use of expensive catalysts. In this research conducted, we have investigated methods that will allow us to optimize a general procedure that is both viable, efficient, and most of all applicable to many combinations of heterocyclic aromatics and a-proton sources. Our research focuses on using silver nitrate as the catalytic source and on adjustment of reaction variables in order to achieve the optimized procedure. With this generalized a-alkylation procedure we are synthesizing fluorinated precursors, which usually take multiple steps, in just one concise aqueous step.



Time Dependent Multiple Scattering of Light Through Random Media

Christian A. Montes and Arnold D. Kim, PhD;
School of Natural Sciences, University of California, Merced

We extend the Kubelka-Munk equations to include time dependent problems. We use this extension to model the diffuse reflectance due to a short pulse of light incident on a scattering and absorbing medium. By analyzing this problem, we develop a method to recover absorption and scattering properties of the medium from time-resolved measurements of backscattered light. The key to this problem is a careful analysis of the time scales inherent in the problem. By applying this approach to the generalized Kubelka-Munk equations, we can explain the existence of two time scales in the diffuse reflectance that have been recently found experimentally.

Examination of Symbiotic and Antagonistic Relationships between the Fungus *Candida albicans* and Bacterial Species

Guillermo Najarro, Portillo Jr., Megha Gulati, and Clarissa J. Nobile, PhD; School of Natural Sciences, University of California, Merced

The human body is home to many kinds of microorganisms, such as fungi and bacteria. In addition to existing in the non-pathogenic form, some microorganisms also exist as pathogens. When the balance of the microbiota is disturbed in the human body, these pathogens are given the opportunity to infect and populate. The most common opportunistic pathogen of humans is Candida albicans, which attaches to biotic and abiotic surfaces, and creates complex structures called biofilms. C. albicans biofilms are three-dimensional microbial communities consisting of different C. albicans cell types encased in a self-secreted extracellular matrix. The structure makes it difficult to clinically treat C. albicans due to the protection it offers. The biofilm can also house other pathogens, like Staphylococcus aureus, indicating that these species could exist in a symbiotic relationship with C. albicans. Additionally, it is possible that other members of the human microbiota limit the growth of C. albicans. Example bacterial species that are capable of such antagonistic interactions with C. albicans are the Lactobacillus species. These species are capable of secreting chemicals known to inhibit the growth of pathogens. Here, we explore the interactions between C. albicans and potential synergistic and antagonistic bacterial species in the context of biofilms. The anticipation is that the growth of C. albicans will be stimulated by the presence of S. aureus; while the growth of C. albicans with Lactobacillus species will be inhibited. Understanding how microorganisms interact in the human body will be highly relevant to the treatment of infectious disease.

A Study of Prussian Blues for Rechargeable Batteries

Sophia Ortiz, Mary Xiong, Luke Reed, and Erik Menke, PhD; School of Natural Sciences, University of California, Merced

Rechargeable lithium-ion batteries are an important source of electricity, and have lead to numerous advances in mobile electronics. However, lithium-ion batteries are expensive and heavy when compared with other energy storage mechanisms, such as gasoline or natural gas. To address this, we have been working with copper Prussian blue as a potential cathode material for aluminum batteries. Previous work was performed in a high and low concentration electrolyte, and this summer we wanted to test the intermediate concentrations, as well as different analogues for the Prussian blue, such as nickel, manganese, and cobalt. Here, I will report on our work synthesizing Prussian blue analogues and our electrochemical testing results, which showed that Prussian blue in higher concentration electrolytes held more capacity than the lower concentrations, but at the cost of reproducibility.

Development of a LabVIEW-Based Data Acquisition System to Record and Test a Copper-Based Mini-Channel Solar Water Heating System

Keith Saechao, Paulo Jeremias Van Duong and Gerardo Diaz, PhD; School of Engineering, University of California, Merced

There have been many researchers and scientists who have helped further advance the design and applications of solar collectors, but few have considered the use of mini-channel tubes in solar collectors. Proposed in 2008, this collector design has been manufactured and tested at UC Merced for operation in single phase and steam generation mode. Our objective was to generate steam and determine the steam generation rate of these collectors. Experimental tests require to accurately measure and record the inlet and outlet temperatures of the collector, ambient temperature, operating pressures, flow rates and solar irradiance during tests. Prior to this project, an aluminum-based mini-channel solar collector was designed, manufactured, and tested by Diaz's group utilizing a LabVIEW-based data acquisition system to record the set of variables needed and to control the operation of the solar water-heater system. Operation in steam generation mode required the development of a new LabVIEW-based data acquisition software to measure and record operating variables that are relevant in two-phase flow conditions. A new data-acquisition tool was developed for this project and the results of our project showed that the collector was able to generate steam in a range between 2.4 - 2.8 [g/min], with outlet temperatures of the steam near 106 degrees Celsius at solar irradiance levels of 820 [W/m^2], and operating pressures near 460[kpa], with the flowrate of the water at 10.2 [L/min]. The data collected is being used to calculate the thermal efficiency of steam generation.

Investigating Cryptic Species of Green Stink Bugs

Ryan Torres and Andrea Joyce, PhD; School of Natural Sciences,
University of California, Merced

Chlorochroa uhleri is a species of green stink bug (GSB) in the insect family Pentatomidae. Feeding by GSBs contributes to damaging agricultural crops. These insects can be managed through the use of pheromones and biological control, rather than through pesticides. However, management strategies such as pheromones and biological control are typically species- specific. This project investigates whether there are cryptic species in this species of GSB. Cryptic species are species which appear identical to one another morphologically, but are genetically and behaviorally divergent. The genetic diversity among individuals in each of these species by sequencing the mitochondrial DNA cytochrome oxidase I gene (COI) Genetic divergence of 2-3% or more among individuals suggests there may be cryptic species. The results from our mitochondrial DNA work found evidence for cryptic species of GSBs. These results will improve the management of GSBs using pheromones or biological control, resulting in reduced pesticide use.

CAMP Joint Genome Institute Partnership (CAMP-JGI)

The following student scholars are participants in UC Merced's NSF CAMP partnership with the Joint Genome Institute, located in Walnut Creek, CA. The Department of Energy's Joint Genome Institute (DOE JGI) is managed by the Department of Energy's Office of Biological and Environmental Research (OBER) to produce high-throughput DNA sequencing and analysis in support of its missions in alternative energy, global carbon cycling, and biogeochemistry. CAMP offers extensive resources and unique opportunities for students to excel in their respective fields of study. This valuable partnership provides UC Merced CAMP students with the opportunity to experience research in a national laboratory setting.

Functional-Driven Single-Cell Genomics: Cellulose Degrading Mining

Bryan Rangel Alvarez, Tanja Woyke, PhD, and Devin Doud; Microbial Genomics Program, DOE Joint Genome Institute

The "Great Plate-Count Anomaly" depicted the world's skewed understanding of microbial metabolism and the rising gap between cultivated and uncultivated Bacteria. This gap reflects the limited amount of reference Phyla that are currently available. Cultured methods have long been implemented in accessing the genetic material from a diverse microbial community. Yet, these methods are limited in recovering precise genomes from the environmental species since not everything is known how to be cultivated. Single-cell genomics takes a culture independent approach, returning improved context for functional genes and pathways. By coupling single-cell genomics with an initial function-base selection, we aimed to create a method with high throughput and navigation within the microbial dark matter. We probed for organisms with specific cellulose decomposition function by sorting through their physical adherence to crystalline cellulose. With this method we aim to discover new life lineages. Within the candidate lineages we would probe for novel glycosidic degraders to augment bioenergy production.

The Discovery of Novel Phyla Through the Use of Existing Taxonomic Classifying Software

Cristhian A. Gutierrez, Zhong Wang, PhD, and Jeff Froula; Joint Genome Institute

With the upcoming of metagenomics, many argue the credibility of the Tree of Life and our current method of taxonomic classification. Some, like Professor Didier Raoult from the University of the Mediterranean, outright argue that there is no universal tree.1 However, others say that the Tree allows us to analyze a physical representation of Evolution and ancient life2 and provides a means to classify and sort organisms. Placing organisms in hierarchical categories helps scientists understand unique physical features, biological function, and phylotypic genetic compositions. These taxonomic categories allow us to highlight similarities and differences amongst known organisms. By fully understanding the distinguishing factors between taxa, we hope to classify and best organize unknown organisms. Here, we present a preliminary method that we hope will provide the framework in classification of novel life. Using supervised classifying methods we aim to filter known genomes from metagenomic datasets—thus providing a list of candidate novel, unclassified genomes. This process will help you sort through large datasets and extract candidate genomes, which can be further tested and examined.

CAMP Berkeley Lab Partnership (CAMP-LBL)

The following student scholars are participants in UC Merced's NSF CAMP partnership with the Lawrence Berkeley National Laboratory. Berkeley Lab fosters groundbreaking fundamental science that enables transformational solutions for energy and environmental challenges, using interdisciplinary teams and by creating advanced new tools for scientific discovery. CAMP offers extensive resources and unique opportunities for students to excel in their respective fields of study. This valuable partnership provides UC Merced CAMP students with the opportunity to experience research in a national laboratory setting.

A Compass for Navigating Bioimaging's Big Data

Elizabeth K. Arikawa, Benjamin P. Bowen, PhD, and Oliver Rubel, PhD; Life Sciences Division, Lawrence Berkeley National Laboratory

As mass spectrometry imaging continues to grow as a field, proper documentation of data becomes of increasing importance to these researchers. Metadata--- i.e., data about data---includes information associated with objects for the purpose of description, administration, and preservation. OpenMSI is a web-based visualization, analysis, and management system for mass spectrometry imaging data. As the site's user base increases, the need for useful metadata becomes increasingly relevant. OpenMSI currently lacks a way of collecting and storing metadata, limiting the site's growth. Using Django, a web development framework, we created a metadata app with a standardized form and database model. A database enables the data to be managed efficiently and to be stored for years to come. Django's framework provides a powerful and efficient way to facilitate the creation and manipulation of form data. By creating a hierarchy for the data, I separated the data into three forms: Project, Experiment and Assay. To make the form adaptable for future needs of OpenMSI, I used South, a database migration app, to allow for fields to be added, removed and/or modified. With this new metadata app, OpenMSI will be able to host more images and continue to grow their user base for years to come.

Developing Support for 3D Data in OpenMSI

Natalie N. Azevedo, Benjamin P. Bowen, PhD, and Curt R. Fischer, PhD;
Life Sciences Division, Lawrence Berkeley National Laboratory

Mass spectrometry imaging (MSI) is an emerging technology with potential to revolutionize disease diagnosis among other biological applications, but there are limited resources to view and analyze this data. OpenMSI is a web-based platform for viewing, analysis, and sharing of MSI data for 2D datasets of varying file formats. We focused on extending OpenMSI to support processed mode imzML files and 3D imzML files. imzML spectral data is stored in either continuous or processed form. In continuous mode all spectra share an m/z (mass/charge) axis while in processed mode each spectrum has a different m/z array. Continuous mode data is compatible with the existing framework; therefore, we are able to extend compatibility to processed mode data by converting it into continuous mode. To achieve this, a logarithmically spaced m/z axis is created that can be shared by every scan in a file. To accommodate 3D data, which is a series of aligned 2D image slices, a datacube (x,y,m/z) is created for each z position. Each datacube is then stacked to create a 3D image. The integration of processed and 3D imzML data with OpenMSI expands the availability of useful data to the mass spectrometry community.

Redesigning the User Interface of the OpenMSI Website

Ashley B. Cato, Benjamin P. Bowen, PhD, and Oliver Ruebel, PhD;
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Scientists are collaborating and sharing large amounts of data more than ever before. Often, scientists in specialized fields create dedicated websites tailored to the needs of their community. An example is OpenMSI, a web-based tool for visualization, analysis, and management of mass spectrometry imaging (MSI) data. With such sites, growth and adoption by increasing numbers of scientists mean that new ideas and usage patterns sprout, which in turn demands new capabilities for the site. Early adopters' use of OpenMSI led to it now hosting over five terabytes of data, a deluge that has become difficult for users to navigate. To address this problem, we redesigned the interface of the site, introducing new functionality for sorting files, displaying files, and navigating the site. The code base we implemented will make it easier for others to administer, improve upon, and understand. The end result will be an updated website that promotes an even better user experience than it once had.

Maximizing Access to Research Careers (MARC)

The following student scholars are part of the Maximizing Access to Research Careers - Undergraduate Student Training in Academic Research (MARC U*STAR) Program at UC Merced. The MARC U*STAR Program is funded by the National Institutes of Health (NIH). The program seeks to increase the number of highly-trained biomedical and behavioral scientists in leadership positions to significantly affect the nation's health-related research needs. MARC U-STAR provides support for undergraduate students who are underrepresented in the biomedical and behavioral sciences to improve their preparation for high-caliber graduate training at the Ph.D. level.

For more information, please visit http://uroc.ucmerced.edu/marc

Exploration of Electronic Structures of Nitrogen-Radical Precursors for use in Amination

Susana Calderon, Erik Menke, PhD, Ryan Baxter, PhD, and Hrant P. Hratchian, PhD; School of Natural Sciences, University of California, Merced

Selective amination refers to the introduction of amine groups into organic systems, which is a highly versatile yet challenging synthetic practice common in pharmaceutical synthesis. As such, it is important to find cheaper and more effective methods of creating amine groups. Nitrogen-radical synthesis is a route we have taken in order to make amine groups from accessible stock compounds. We are faced with the challenges of understanding how and predicting where Nitrogen-radical precursors will create radicals by cleavage of Nitrogen-Oxygen bonds. Using computational methodologies, we will explore the electronic structures of readily available Nitrogen-radical precursors in a controlled environment and seek novel applications for selective addition of amine groups based on their radical formation.

The Activation of Endothelial Cells By Angiotensin II Increases PDI Secretion

Joshua Cazares and Jose R. Romero, PhD; Division of Endocrinology, Diabetes and Hypertension, Brigham and Women's Hospital, Department of Medicine, Harvard Medical School

The Renin-Angiotensin-Aldosterone-System (RAAS) is important in controlling volume homeostasis and blood pressure. Angiotensin II (Ang II) is a principal effector molecule that has been shown to binds to AT1 receptors on endothelial cells leading to increased oxidative stress and inflammation. Endothelial cells secrete protein disulfide isomerase (PDI). PDI, is a multifunctional protein that functions as a chaperone during protein folding and has been shown to initiate and regulate thrombus formation. However, the role of Ang II on PDI is unknown. We hypothesize that activation of endothelial cells with Ang II can lead to increases in PDI levels. We studied the effects of Ang II on the EA.hy926 human endothelial cell line and measured PDI activity using a fluorescence plate reader. We used endothelin-1 (ET-100nM) as a positive control for a time course up to 24hrs. Following 4 and 24hrs we measured fluorescence intensity was recorded and plotted as function of time to calculate the conjugate reduction rate. Our results show that PDI activity increases following incubation of EA.hy926 cells with Ang II 100nM or ET-100nM ($P<0.05$, $n=6$); an event that was blocked by losartan, an AT1R antagonist. Activation of endothelial cells with Ang II was associated with increased MCP-1 expression ($P<0.05$; $n=3$). We conclude that activation of endothelial cells leads to increased secretion of PDI. Consequently, activation of RAAS represents a novel mechanism for regulation of PDI

Glucagon-like Peptide-1 Receptor Activation and Angiotensin Receptor Blockade Decrease NADPH Oxidase 4 Protein Expression and Urinary Albumin Excretion in a Model of Metabolic Syndrome

Benny Escobedo and Rudy M. Ortiz, PhD; School of Natural Sciences, University of California, Merced

Diabetic Nephropathy is associated with oxidative stress and increased urinary albumin excretion. Angiotensin receptor type 1 (AT1) blockade improved renal oxidative stress via downregulation of NOX 4 and improved overall kidney damage by reducing albumin excretion. Glucagon-like peptide-1 receptor (GLP-1r) activation decreased glomerular NOX 4 expression and albumin excretion in streptozotocin-induced diabetic rats. To test the hypothesis that the combination of AT1 blockade and GLP-1r activation decreases oxidative stress and subsequent kidney damage, we measured renal NOX 4 protein expression and albumin excretion in five rat groups: 1) untreated, lean LETO (n=7), 2) untreated, obese OLETF (n=9), 3) OLETF + angiotensin receptor blocker (ARB; 10 mg olmesartan /kg/d; n=9), 4) OLETF + GLP-1 mimetic (Exe; 10 ug exenatide/kg/d; n=7), and 5) OLETF + ARB + exenatide (combo; n=6). Renal NOX 4 protein expression is expected to increase in OLETF compared to LETO; whereas, ARB and Exe are expected to decrease it, and combo treatment is expected to decrease it the most. Albumin excretion increased in OLETF compared to LETO; whereas, ARB and Exe decreased it, and combo treatment decreased it further. These data suggest that AT1 blockade and GLP-1r activation improve oxidative stress, highlighting the impact of the activation of these receptors in the pathogenesis of diabetes-associated renal impairments.

Understanding the Paracrine role of Adipose Stem Cells on Macrophage Phenotype

Alejandra Preciado[1], Kabir S. Dhada[2], Laura J.Suggs, PhD[2]; [1] School of Natural Sciences, University of California Merced, [2] Department of Biomedical Engineering, The University of Texas at Austin

Peripheral artery disease is a type of cardiovascular disease caused by the narrowing of arterial veins, which prevent blood flow and oxygen from reaching certain extremities of the body. Progression of the disease leads to a high risk of critical limb ischemia, which can ultimately lead to the permanent loss of a limb. As a result, revascularization procedures are conducted in order to salvage damaged tissue and prevent amputation of potentially necrotic limbs. Although, revascularization procedures promote the restoration of blood flow it invokes additional oxidative stress and acute vascular damage to neighboring muscle. This calls for an effective treatment for acute vascular damage caused by revascularization procedures for peripheral artery disease. A most promising treatment is implanting stem cells. Mesenchymal stem cells (MSCs), which are multipotent stem cells derived from bone marrow (BM-MSCs) and adipose tissue (A-MSCs), are known to promote the secretion of angiogenic growth factors. Macrophages are divided into two essential phenotypes which are characterized by the different roles they play in wound healing. M1 phenotype are the immune system regulators that promote inflammation. M2 phenotype promote anti-inflammation and modulate the healing process. The main aim of the present study is to understand the cross talk and mechanistic role that ACSs play in the infiltration of Macrophage phenotype. It is hypothesized stem cells can control the phenotypic switch towards M2 macrophages by delivering stem cells at the right conditions. The present study demonstrates how an in vitro 3D hypoxic environment influences the secretion of different factors that promote macrophage chemotaxis, when compared to previous in vitro 2D studies. PCR extraction will be conducted in order to test for specific M1 (IL-1β, TNF-alpha, i-Nos, IL-12) and M2 (IL-10, Arg-1, PPAR, IGF-1) cytokines.

Summer Cardio-Renal Undergraduate Research Experience (SeCURE)

UCM-UAB SeCURE

A UC Merced & University of Alabama, Birmingham Partnership

The following student scholars are part of the Summer Cardio-Renal Undergraduate Research Experience (SeCURE) Program at UC Merced. SeCURE is a 10-week, paid summer program that offers exciting hands-on research experience to for students with a desire to pursue careers in the biomedical sciences. The program is particularly targeted to students having no local campus access to biomedical research laboratories.

For more information, please visit http://uroc.ucmerced.edu

Suppressing Hypertension with Hydralazine, Hydrochlorothiazide, and Reserpine Preserves Autoregulatory Function in Deoxycorticosterone Acetate-salt Treated Rats

Haword Cha[1], Zhengrong Guan, MD, PhD[2], and Edward W. Inscho, PhD[2];
[1]School of Natural Sciences, University of California, Merced; [2]Medicine, Division of Nephrology, University of Alabama at Birmingham

Inflammation contributes to renal microvascular autoregulatory impairment associated with hypertension. Our laboratory recently found that anti-inflammatory treatment with pentosan polysulfate prevents impairment of renal autoregulation in mineralocorticoid-induced hypertensive rats despite persistent hypertension. Whether the autoregulatory impairment arises from inflammation, elevated arterial pressure, or directly from mineralocorticoid treatment is unclear. We hypothesize that suppression of hypertension with hydralazine, hydrochlorothiazide, and reserpine treatment protects renal autoregulatory function in deoxycorticosterone acetate-salt (DOCA-salt) rats. DOCA-salt treatment was induced by subcutaneous implantation of DOCA pellets in uninephrectomized rats (UNx) receiving HHR in the drinking water along with 1% NaCl and 0.2% KCl for three weeks. Systolic blood pressure was monitored weekly. 24-hour urine output was measured weekly using metabolic cages. Renal autoregulatory function was assessed in vitro using the blood-perfused juxtamedullary nephron preparation on day 21. Systolic blood pressure remained stable when compared to UNx rats. DOCA-salt rats treated with HHR did not develop hypertension, did not display signs of glomerular damage, and have a pressure-diameter profile of normal autoregulatory behavior. These results support our hypothesis that autoregulatory impairment in DOCA-salt hypertensive rats is caused by elevated arterial pressure rather than a direct effect of the mineralocorticoid-salt treatment.

Characterization of the Key Autoantigen, Aberrantly Glycosylated IgA1, in IgA Nephropathy

Jocelyne Fadiga[1], Colin Reily[2], Stacy Hall[2], Audra Laube[2], Bruce A. Julian[2], Matthew B. Renfrow[2], and Jan Novak, PhD[2]; [1]University of California at Merced; [2]Division of Gastroenterology and Hepatology, University of Alabama at Birmingham

INTRODUCTION: IgA nephropathy (IgAN) is a chronic kidney disease with up to 40% patients progressing to end-stage renal disease (ESRD). IgAN is characterized by IgA1-contaning immunodeposits in the mesangium. These immunodeposits, enriched for galactose-deficient IgA1 (Gd-IgA1), likely originate from the circulating immune complexes consisting of Gd-IgA1 bound by anti-glycan autoantibodies. Gd-IgA1 is produced by IgA1-producing cells due to abnormal expression of key glycosylation enzymes. Serum levels of Gd-IgA1 are associated with disease progression. Serum IgA1 is predominantly monomeric, with only about 10% in the polymeric form, as dimers or higher polymers. To better characterize the autoantigen, we analyzed the O-glycosylation of polymeric and monomeric IgA1 from serum and secreted by IgA1-producing cells. METHODS: IgA1 in serum and media of immortalized cells derived from healthy controls and patients with IgAN, and the mono/polymeric forms were isolated by affinity and size-exclusion chromatography. The molecular form of IgA1 was assessed by non-reducing SDS-PAGE and the degree of galactose deficiency by enzyme linked immunosorbent assay (ELISA) with lectin from Helix aspersa (HAA) and mass spectrometry. RESULTS: We tested separation of polymeric and monomeric IgA1 using several matrices at low-pressure vs. standard high-pressure liquid chromatography. We hypothesize that the lectin-reactive serum IgA1 (Gd-IgA1) is predominantly in immune complexes and free polymeric form and that most Gd-IgA1 produced by IgA1-secreting cells is a polymer. CONCLUSION: In IgAN, polymeric IgA1 forms are more reactive with Gd-IgA1-specific lectin. These finding will need to be validated using a larger cohort of subjects and analyses expanded by mass spectrometry profiling. KEY WORDS: IgA nephropathy, glycosylation, IgA1, O-glycans, chronic renal disease

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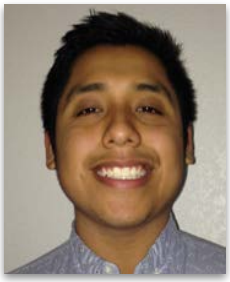
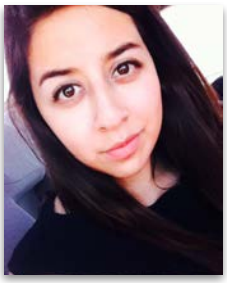


ET_B Receptors Promote Natriuresis in Response to an Acute Salt Loan in Mice

Marcos Lucero, Joshua S. Speed, and David M. Pollock, PhD; Medicine-Nephrology, University of Alabama at Birmingham, AL

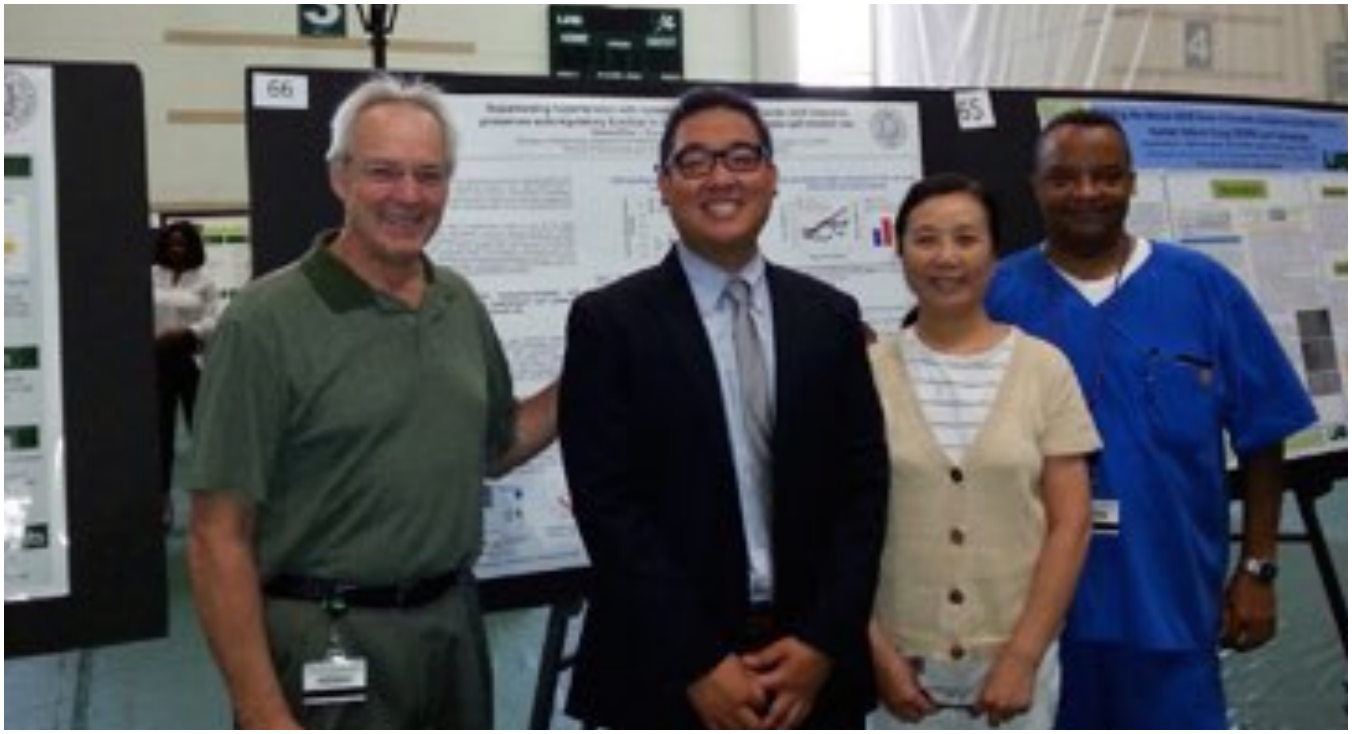
Loss of renal endothelin B receptor (ETB) function results in salt-sensitive hypertension and genetic mutation of the ETB receptor impairs the ability to excrete an acute salt load in rats. In order to probe the mechanisms, we designed experiments to develop a mouse model to determine whether loss of ETB function impairs the ability to excrete an acute salt load. Mice were treated with vehicle or the ETB antagonist, A-192621 (15 mg/kg given 3X at 24, 12, and 1 hour before start an acute salt load). At the onset of their inactive period (lights on) mice were given 65 mg of NaCl in 300 µL of H2O by oral gavage and urine was collected hourly for 8 hours. After gavage, mice treated with vehicle had a significant increase in Na+ excretion compared to mice given vehicle (H2O) at 2 hours (7.5±1.2 vs. 0.03±0.03 mg/2 hours respectively) and 4 hours (8.9±2.0 vs. 0.2±0.1 mg/2 hours respectively, n=4) post gavage. Interestingly, blockade of ETB receptors delayed the natriuretic response to a NaCl load, with the peak response of 9.3±1.4 mg/2hours occurring during hour 6. The peak response occurred at 2.5±0.3 hrs in untreated mice vs. 5.0±0.3 hrs in mice given the ETB antagonist. These data indicate that loss of ETB function in mice impairs the ability to excrete an acute salt load and provide evidence that genetically engineered mice may be an ideal model to probe the mechanisms by which ETB receptors maintain proper salt and H2O homeostasis.



Role of Vascular Endothelial Endothelin-1 on Renal Damage with High Salt Diets: Assessing Sex Differences

Iris D. Montes[1,2], Carmen De Miguel[1] and Jennifer S. Pollock[1]; [1]Section of Cardio-Renal Physiology and Medicine, Division of Nephrology, Department of Medicine, University of Alabama at Birmingham; [2]Department of Biology, University of California Merced

Dietary sodium intake is one of the main culprits in hypertension and kidney disease. Its effects are more prevalent in men than in pre-menopausal women of the same age. To assess sex differences in the role that vasoactive peptide endothelin-1 (ET-1) has in the development of hypertension and kidney damage, vascular endothelial cell ET-1 knockout (VEET KO) mice of both sexes (12 weeks old; n=5-7/group) were placed on high salt diets (4% NaCl) for 3 weeks. We hypothesized that the lack of ET-1 in the vasculature decreases the development of renal damage and this effect would be more prevalent in males. Water consumption, urine excretion, and urinary markers of renal damage were assessed at the end of the high salt period. Water consumption was uniform in both genotypes and sexes; however, urine production in male and female VEET KO mice was significantly reduced compared to Flox controls (Flox vs. VEET KO; Males: 2.6 ± 0.5 vs. 1.2± 0.4 ml/day; Females 3.0 ± 0.2 vs. 1.4 ± 0.2 ml/day; $p<0.05$). KIM-1 excretion, a marker of proximal tubule damage, was significantly decreased in female VEET KO mice, compared to female Flox controls (6426.1 ± 1432.6 pg/day vs. 2539.0 ± 796.4 pg/day; $p<0.05$), while there was no significant difference in both male genotypes. Results suggest that vascular endothelial ET-1 plays a larger role in the development of high salt-induced renal damage in males than in females.



Merced Historical Society Exhibit (MHSE) Scholars Program

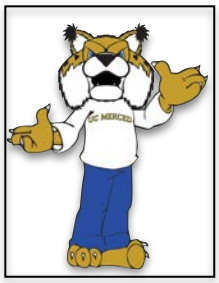
MERCED HISTORICAL SOCIETY EXHIBIT

The following student scholars are participants in the Merced Historical Society Exhibit (MHSE) Scholars Program. The Merced County Courthouse Museum houses 8500 square feet of exhibits, both permanent and rotating, which depict the history of Merced County as well as the settlers of the Great Central Valley. In the Fall, the Museum is celebrating UC Merced's 10th Anniversary with an exhibit documenting the history of the university and it's impacts on the local region and across the world. This unique partnership has helped MHSE Scholars gain valuable research experience and learn about the graduate school process.

Academics and Economics, UC Merced: A Decade of Building and Growing

Ramon Barragan and Mario Sifuentez, PhD; School of Social Sciences, Humanities and Arts, University of California, Merced

The University of California faced a serious issue when its Regents meet in the Winter of 1987; the expansion of the University of California had placed campuses in all areas of the state but one, the San Joaquin Valley. Economically depressed and falling behind in higher education, the San Joaquin Valley was perpetually lacking in its development, and due to this anemic state the Regents decided to build the tenth University of California campus there. As it stands today, the Merced Campus has developed into both an economic engine, and an expanding academic institute that seeks to ail many of the Valley's concerns and provide a reliable center for the communities of the Valley to leap forward.



Merced Historical Society Exhibit on the History of UC Merced

Adam R. Brown and Mario Sifuentez, PhD; School of Social Sciences, Humanities and Arts, University of California, Merced

The Merced Historical Society wishes to erect a 3 room exhibit on the history of UC Merced. This exhibit will include a comprehensive history of the construction, development, planning, academics, litigation, and social development of the campus from the time of its inception to the present day. My research includes gathering land use maps and construction plans in an effort to present a cohesive story about the construction and land use planning phases of campus development. This focuses immensely upon the early years of the campus development, and explores the multiple options and plans that UC Merced went through before resting on its current configuration. In addition, my research shall include an exploration of the Long Range Development Plan, also known as the 2020 Plan. This shall enter the exhibit as a "future UC Merced" display, and will serve as a good piece to compare to earlier development plans.

Merced Historical Exhibit: Legal Perspective

Joshua L. Lourence and Mario Sifuentez, PhD; School of Social Sciences, Humanities and Arts, University of California, Merced

The Merced County Courthouse Museum will open an exhibit on October 15, 2015 marking the tenth anniversary of the opening of UC Merced. It will have three major themes: economics, student life, and building construction. The first room will cover the efforts of the community and University of California to build a sustainable campus in the Central Valley despite hardship. The second exhibit will showcase the pioneering students and faculty who have trail blazed the new school. The final room will focus on the plans for the future of the campus. My research focuses on the environmental litigation that preceded the construction of the university and will therefore be displayed in the first room. The major case against the university was brought by two environmental organizations that claimed that the more than 3,000 page, multiyear environmental impact report was insufficient for the project. The failure of the challenge in both the superior and appellate courts is both a testament to the rigor of self-review the university used and the passion of the groups that brought the suit. This research will cover legislative and oral history as well. This exhibit will provide a new perspective of history for the people of Merced celebrating the deeds that that have brought excellent education and economic benefits to the small valley city.

Merced Historical Society Exhibit

Joshua Melendez and Mario Sifuentez, PhD; School of Social Sciences, Humanities and Arts, University of California, Merced

For the coming ten year anniversary of the University of California Merced's opening, the Merced Historical Society has been researching and planning a museum exhibit to shed light on the university's history which began in the late eighties. The exhibit will be comprised of three major chronological sections starting with the planning and early construction of the university, followed by a segment on the campus since it opened in 2005, and the final section details the future plans for the University. The exhibit is further subdivided into three major themes which include the economic, social, and environmental histories of the campus. Each theme carries a different narrative on the campus and offers a vastly different lens in which one may learn about the university's past and potential future. As part of the environmental history's research team, my individual focus centered around the environmental mitigation that the university implemented in an attempt to limit negative impact on the local wetlands. The future of the school's impact in regards to the 2020 plan and community project is the other major focal point of my contributions. In other words, I have tracked the progression of the schools planning as it addresses current and future environmental challenges. Moreover, the purpose of this project is really to highlight what the school came from and to follow its progression while offering several lenses in which to follow the story.

University of California, Merced 10th Anniversary Exhibition, Merced Courthouse Museum

Sarah S. Spoljaric and Mario Sifuentez, PhD; School of Social Sciences, Humanities, and Arts, University of California, Merced

For this project we spent the past semester in the UCM archives researching the founding of the school and documenting everything in the archives. From that information we divided the exhibition into three rooms, the first the founding of the school, the second what the school is doing currently, and the third future plans for the school. In these three rooms we broke it down into four different categories for people to follow the different sections in making the school what it is today, economic, environmental, academic and student/ campus life. My section is the student and campus life. For the first room there will be information and pamphlets compiled from the archives, which discuss what, was promised by the school to incoming students and the origins of different campus organizations. The second room will be filled with student photographs of events put on by students, from greek life, clubs, community involved events, art events, and student driven projects outside of the classroom. For the final room focusing on where organizations are moving towards and what other extracurricular activities students would like to see from the campus. There will be quotes from students, photographs, videos, newspapers, and art all describing how they were able to make the most out of their time at UCM. This is an important story to tell because while the school developed for a variety of reasons we studied in the archives and are being represented in the exhibition student life is what brings the campus alive.

University of California, Merced 10th Anniversary Exhibition, Merced Courthouse Museum

Michael Steele and Mario Sifuentez, PhD; School of Social Sciences, Humanities, and Arts, University of California, Merced

My colleagues and I have the distinct privilege and honor of constructing and presenting to the public an exhibit at the Merced County Courthouse Museum that marks the tenth anniversary of the first class at the University of California, Merced. This exhibit is a chance for the public to get a special look at many of the decisions and events that went into the planning, construction and opening of the campus along many insights into what is currently happening at the university and ending with plans for the future of the university. These insights will be displayed for the public within three rooms which will be dedicated to different themes revolving around the university's history such as the legal aspects to the university's planning and construction and the environmental factors that determined when and where the university would be built. My part on this project dealt primarily with researching the efforts of the university to mitigate and protect various species of plants, animals and habitats that would potentially be impacted by the university's construction while building a higher center of learning highly desired in the region. Animals like the fairy shrimp and their vernal pool habitats were seen as items of paramount interest during the negotiations for the university's building and placement. With this exhibit we hope that the public will gain a deeper understanding of how this landmark moment in history came to be and how this history will continue as the university grows and expands

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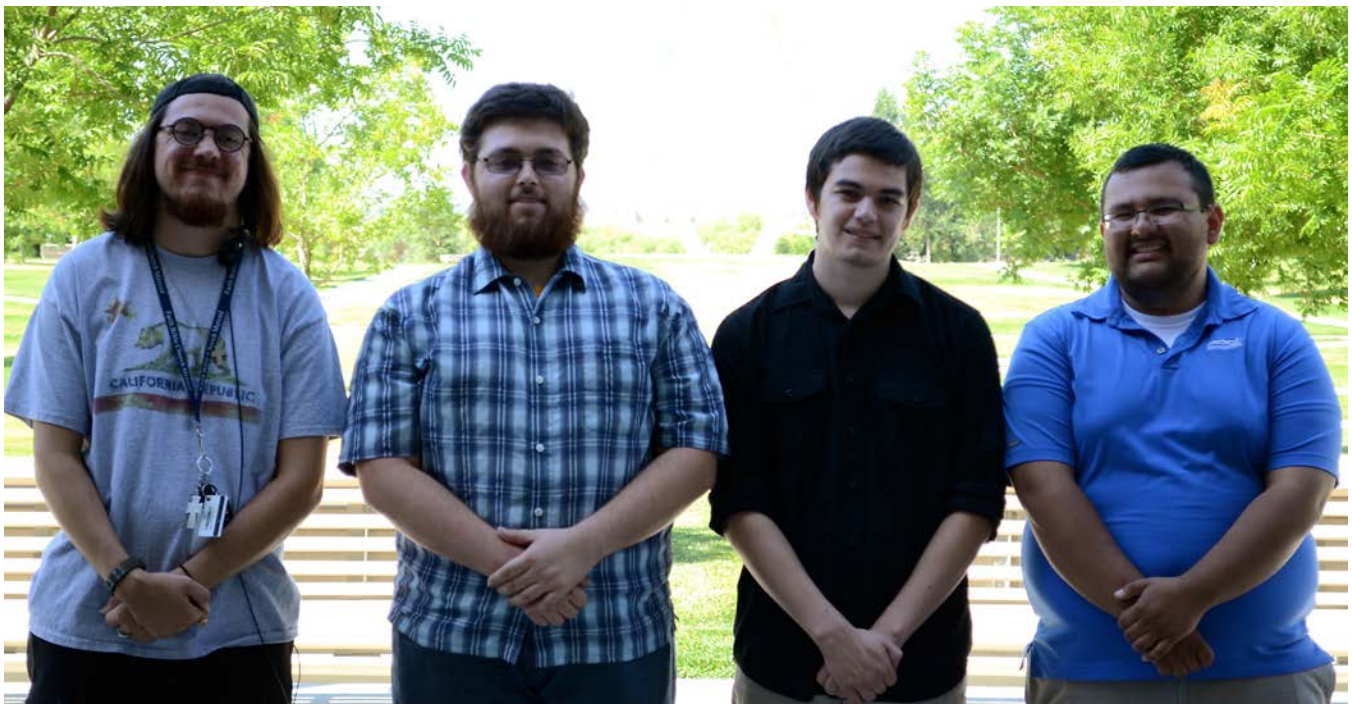

Applied Research in Modeling and Data-Enabled Science (ARCHIMEDES)

ARCHIMEDES

Applied Research in Modeling and Data-Enabled Science

In April 2014, UC Merced received funding from the National Science Foundation to host a Research Experience for Undergraduates (REU) program in applied mathematics for three summers. The REU program is called "Applied Research in Modeling and Data-Enabled Science", or ARCHIMEDES, and it focuses on data-enabled science and mathematical modeling. The objectives of the program are: to introduce students to scientific computing to strengthen programming skills, to use mathematical models to solve real-world problems, to apply computational tools to research-level problems, and to analyze results using data and translate into a scientific context.

The ARCHIMEDES program supports eight undergraduate students for nine weeks each summer as they learn and develop the mathematical and computational tools necessary for data-driven applications, and as they gain professional-level research experiences in preparation for careers in STEM fields. In the first week, students participate in a computational "bootcamp" designed to develop fundamental computational skills, preparatory to doing research during the rest of their summer program. The students then work intensely for the remaining eight weeks, in teams of four and with a faculty mentor, on projects with strong computational and modeling components. Students actively participate in weekly workshops and presentations to practice their communication skills. They will produce a technical report and a poster, and present at the Undergraduate Research Summer Symposium. The goal of the ARCHIMEDES program is to provide a rigorous and meaningful research experience in modeling and data-enabled sciences for undergraduate students in a team environment and improve the communication skills of future mathematical researchers.

Analysis of Exponential Integrators for Direct Numerical Simulation of Gravity Currents




Theresa J. Morrison, David A. Hesslink, Alina R. Levine, Julia K. Afeltra,
Francois Blanchette, PhD, and Mayya Tokman, PhD;
School of Natural Sciences, University of California, Merced

Gravity currents are density driven flows that are of interest in geophysical fluids. These flows can be simulated efficiently for low Reynolds numbers. For high Reynolds numbers, the ratio of viscous and inertial time scales is large, which creates stiffness within the system. As a result of this stiffness, these flows are difficult to integrate numerically. Explicit methods are computationally inexpensive per time step but impose strict stability restrictions on the size of the time step. Alternatively, implicit methods have less restrictive stability properties allowing for the use of a larger time step. However, implicit methods can be computationally expensive because they utilize an inverse evaluation of the function. Exponential methods approximate the solution by using an exponential-like function of the Jacobian. These methods have good stability properties, which are comparable to implicit methods. The computational cost per time step of computing the exponential can possibly be reduced for some problems with well known techniques. We present a comparative performance analysis of two methods on a two dimensional direct numerical simulation of gravity currents for a range of Reynolds numbers $500 < Re < 5000$. We implemented an implicit Backward Euler method and a new Exponential Euler method to investigate the computational savings of the exponential method for problems of this type.

Computational Modeling of Multiple Scattering of Light




Colton J. Bryant, Austin P. Sagan, Michael Siozios, Dustin L. Story,
and Boaz Ilan, PhD; School of Natural Sciences, University of California, Merced

Capturing the effects of absorption and scattering on light passing through a medium has various applications in areas such as biomedical optics, atmospheric sciences, and several other areas of physics. We study these effects, first using the Kubelka-Munk equations, and later using the radiative transfer equation. To find solutions to these equations, we study the associated generalized eigenvalue problems by taking advantage of several inherent symmetries. The symmetries are first established by analyzing the Kubelka-Munk system. Later, we establish these symmetries and apply them to find numerical solutions to the radiative transfer equation using the discrete ordinate method. The solutions to these models lay the ground work for posing and solving related inverse problems. Optimization and root finding techniques are applied to approximate solutions for most inverse problems except in special cases where analytical approximations are available. These solutions are extended to solve similar inverse problems in the field of medical imaging.

Applications in Modern Materials (AiMM)

The Applications in Modern Materials (AiMM) program is a comprehensive and collaborative research experience for undergraduates mentored by physics, chemistry, and engineering faculty at the University of California, Merced. Participants are involved in a wide array of research projects with applications in soft matter, biomaterials, nanomaterials, and/or materials for energy conversion and storage. These undergraduate researchers are involved in a wide array of activities including the synthesis, characterization, and/or modeling of modern materials. Every AiMM project is designed to include the student in cutting- edge research, with the expectation that their work can meaningfully contribute to publications or presentations. Complementing the interdisciplinary nature of the research areas, the program uses a three- pronged design of mentoring, networking, and professional development to support student researchers throughout (and beyond) the program. The participants are closely mentored by faculty and participate in additional networking and professional development activities to connect them with peers, postgraduates, and faculty within AiMM, as well as those associated with other currently funded University of California research programs, in addition to scientific professionals at Lawrence Livermore National Lab and within STEM-related industry.

Polarization Dynamics in Fiber Optical Parametric Oscillator (FOPO)

Elizabeth Avelar Mercado and Jay E. Sharping, PhD;
School of Natural Sciences, University of California, Merced

Optical Parametric Oscillators, OPOs, combined with solid-state lasers are the current state-of-the-art for generating wavelength short-pulsed laser radiation. New efforts are being made to replace optical crystals in OPOs because of the fiber OPOs performance in terms of wavelength tunability and spatial mode profile, as well as the packaging advantages of flexible optical fibers. These features are particularly important for advanced, nonlinear-optical microscopy. One major obstacle is to increase the output power of fiber OPOs to a level suitable for microscopy. Previews experimental results with fiber OPOs indicate that the variation of light's polarization state within the fiber OPO impacts output power. We aim to quantify the impact of variations in polarization within silica (SiO2) microstructure fibers on the nonlinear-optical phase shift in a single pass. We measured spectral broadening due to self-phase modulation (SPM) for fixed average power and for various polarization states, and compared these results with simulation results. We conclude that polarization dynamics have a negligible effect on the nonlinear phase shift, F=?P_peak L, in a single pass.

Arresting Photobleaching of Quantum Dots via Surface Modification for Photovoltaic Applications

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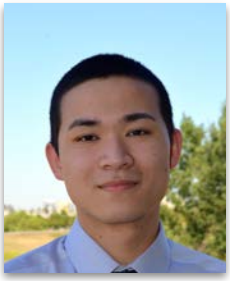
We are investigating the effect of surface modification on the photo-degradation of colloidal quantum dots (QDs). We functionalize the QDs with liquid crystal-like ligands in order to control the energy transfer between the smaller and larger dots in the ensemble. As part of this project, we study the photo-induced spectral changes in self-assembled thin films of CdSe/ZnS core-shell QDs under ambient conditions, and observe a reduction in photoluminescence quenching and a decrease in photo-oxidation. Following up with ultrafast dynamic analysis of QD emission, we observe that the smaller (energy donor) QDs exhibit an increased lifetime, while the larger (energy acceptor) QDs, exhibit a decrease in lifetime. We speculate that as a result of tuning the distance between the particles, the ligand exchange reduces the excitation of dark states via surface passivation or ionization. This ligand exchange allows for a more uniform dispersion of the QDs and may lead to an inexpensive option for improving stability for photovoltaic devices.



Travel Distance of Kinesin-Based Transport on Various Roadblocks

Ho L. Chan and Jing Xu, PhD, School of Natural Sciences, University of California, Merced

Microtubule-associated proteins (MAPs) are known to inhibit kinesin-based transport, which lead to various neurodegenerative diseases such as Alzheimer's disease. Recent experiments, however, have shown that multiple kinesins transport can in fact overcome MAPs at low concentrations. Little is known about the performance of multiple kinesins in different concentrations of MAPs due to the difficulty in controlling the exact number of kinesin motors in vitro. We employ the Monte Carlo method to numerically simulate the travel distance of kinesin motors in the presence of MAPs based on experimentally measured parameters. Here we present the threshold spacing between MAPs in which kinesin-based transport loses 50 percent of its original performance and find that kinesin-based transport follows Michaelis-Menten kinetics. For all number of motors we tested, the mean travel distance reduces to half maximum at a MAP spacing of (400±100) nm. Our results indicate that all types of MAPs have the same effect on kinesin-based transport regardless of the number of motors present. Our results imply that there are some intrinsic relations between kinesin and MAPs, but the nature of those relations requires further study.

Silk Fibroin Based Materials for Time Release Drug Delivery of HIV Entry Inhibitors

Megan C. Halkett, Li Zhang, PhD, and Patricia J. LiWang, PhD; School of Natural Sciences, University of California, Merced

HIV infects more than 2 million people each year, so prevention of this virus is very important to human health. The goal of this project is to formulate HIV inhibitors into silk materials that can be used to prevent the sexual spread of HIV. Several proteins have been found to be very potent at inhibiting HIV entry into human cells. However, in order for these proteins to be effective, they require a delivery material that will slowly release a constant dose of the medication over the course of treatment. Silk fibroin, a natural and biocompatible protein, has the potential to form the ideal drug delivery material as its manipulable secondary structure allows researchers to optimize the material's physical properties to fit their purpose. We report the formulation of HIV inhibitors in silk materials that have been processed by water vapor annealing to be insoluble in solution that mimics human body fluids and to allow the slow, constant release of our inhibitor over the period of a week. Various water annealing conditions, silk concentrations and silk to inhibitor ratios were tested to optimize the time release profile of our silk fibroin delivery materials. Enzyme-linked immunosorbent assays (ELISA) were performed to quantify the amount of inhibitor released each day.

Strain Induced Photoluminescence Shift in Quantum Dot Molecules

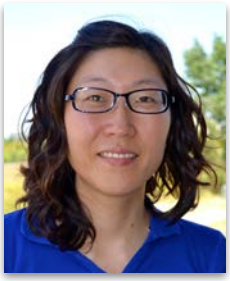
Peter Meisenheimer, Joshua Casara, Andrew Jacobs, Michael Scheibner, PhD; School of Natural Sciences, University of California, Merced

Although quantum mechanics has been around for nearly a century, we have only just begun to utilize it as a tool for building useful devices. The goal of our project is to utilize these properties like discrete energies and spin in a quantum mechanical device to measure something on the human scale with what we are calling the Gravity Spin Probe system (GraSP). The purpose of GraSP is to use the gravity field produced by heavy materials to act on a mechanical resonator, producing a measurable signal; the field will pull on a test mass deforming the system, effectively weighing the sample even without touching it. Quantum Dot Molecules (QDMs); solid state coupled quantum dot systems, are highly sensitive to strain and could be used to measure this extremely small deformation. Because of their size, QDMs show discrete energy states that are highly dependent on crystal properties, including lattice composition, geometry, strain, etc. Using an excitation laser, we can probe these energy states to detect changes in these properties. Our goal in this stage of the project is the fabrication of an atomic force microscope to introduce highly localized strain into QDM samples. We then use photoluminescence spectroscopy to measure the changes in the energy states caused by this deformation. If successful, this technology would enable not only quantum-enhanced motion sensing via the device proposed, but would pave the way for the use of coherent spin and phonon measurements to quantum-enhance other technologies ranging from medical diagnostics to geosurveying.

Employing Alkene Cross-Metathesis Reactions for the Synthesis of Organosilane-Functionalized Silica Surfaces

Jocelyn Ochoa and Benjamin J. Stokes, PhD; School of Natural Sciences, University of California, Merced

Hydrophobin proteins, which are produced by fungi, have unique surface-attractive properties, including an affinity for hydrophobic surfaces. These properties could make them useful in drug delivery systems, but their absorption to hydrophobic surfaces is not well understood. In order to advance in this area, the synthesis of a variety of model hydrophobic surfaces is necessary. As such, we have synthesized monounsaturated organosilane-functionalized silica surfaces via cross metathesis of terminal alkenes. We have applied cross-metathesis reactions to surface functionalization in two complementary ways. Initially, we focused on metathesizing a terminal alkene hydrocarbon and an alkene-terminated trichlorosilane prior to surface immobilization. Later, we cross-metathesized terminal alkene hydrocarbons directly onto an alkene-terminated surface. We have characterized the functionalized surfaces by measuring the surface tension of water droplets in contact with them. These surfaces will be used to study their interactions with hydrophobin proteins.



Temporal Stability of Lipid Bilayers on Poly(dimethyl)siloxane (PDMS) Surfaces

June S. Park and Anand Bala Subramaniam, PhD; School of Engineering, University of California, Merced

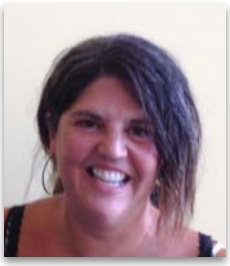
Poly(dimethyl)siloxane (PDMS) is an elastomeric polymer used in microfluidic and biomedical applications due to properties such as optical transparency, deformability, and ability to be molded into micro patterns through soft lithography. Systems that mimic cell membranes are designed by depositing lipid bilayers on plasma oxidized PDMS surfaces. The temporal stability of lipid bilayers on hydrophilic PDMS surfaces however, has not been investigated. Previous researchers showed that plasma treated PDMS stored in ambient air remained hydrophilic for 24 hours. This lab examined the temporal stability of lipid bilayers deposited on plasma oxidized PDMS, (hydroxyethyl)methacrylate coated PDMS, and carboxymethylcellulose (CMC) coated PDMS through small unilamellar vesicle fusion. The stability of the bilayer was quantified by monitoring the average fluorescence intensity of the lipid bilayer, which contained the fluorescent lipid rhodamine-DPPE (or 1,2-dioleoyl-sn-glycero-3-phosphoethanolamine-N-(lissamine rhodamine B sulfonyl) ammonium salt), and the fluidity of the lipid bilayer using fluorescence recovery after photobleaching (FRAP). Experimental results were compared with concurrent measurements of static water contact angles on the same PDMS surfaces without lipid bilayers. This study correlated water contact angles, which measure surface hydrophilicity, with lipid bilayer stability. Our findings showed that lipid bilayers are stable on treated PDMS surfaces for multiple days, with CMC coated PDMS supporting lipid bilayers for five days. These results provide a benchmark for the suitability of conducting long-term studies of lipid membrane biophysics on oxidized PDMS surfaces.

Investigation of Metamorphic Circadian Clock Protein

Phillip J. Smith, Andy LiWang, PhD, and Archana Chavan PhD; School of Natural Sciences, University of California, Merced

Organisms are believed to have developed an internal clock system through evolutionary adaptations to routine environmental cycles. Elucidation of the precise mechanism of the internal biological clock is of interest as it may have significant implications in understanding and treatment of sleep disorders and jet lag. Due to the complexity of the human system, our research focuses on a simplistic, model system found in the cyanobacterium Thermosynechococcus elongatus. This oscillating system consists of three proteins, KaiA, KaiB and KaiC, and is responsible for maintenance of the ~24-hour circadian rhythm. KaiA promotes KaiC autophosphorylation (daytime) and KaiB promotes KaiC autodephosphorylation (nighttime) in an oscillatory fashion, which regulates global gene expression in cyanobacteria. It is currently understood that wild-type KaiB exists in equilibrium: tetramer-dimer-monomer, and that the monomer possesses the ability to contribute to a temporal delay to maintain rhythmicity by fold-switching. To better understand this fold-switching mechanism, we have engineered a nine amino acid truncation in the N-terminal domain of KaiB (KaiB?N9) by using polymerase chain reaction. An 15N-enriched KaiB?N9 was expressed in E. coli then purified by affinity and gel filtration chromatography for subsequent structural characterization by nuclear magnetic resonance (NMR) spectroscopy. Structural characterization of this mutant will allow us to explore the role of KaiB fold-switching in the clock's rhythm.

The following students are registered participants of the 2015 University of California, Merced Undergraduate Summer Research Symposium:



Interviewing the Homeless: Their Experiences with Healthcare and Stress Management

Julie A. Von Berckefeldt, Anne B. Andaya, Stephen L. Maxey, and Matthew J. Zawadzki, PhD; School of Social Sciences, Humanities and Arts, University of California, Merced

Healthcare access and proactive stress management are vital components to living a healthy lifestyle. For a homeless person it is challenging to acquire these components due to a lack of resources. Research has found that many homeless individuals experience more emotional distress and have worse health than the general population. However, many aspects of homelessness remain unanswered due to the dearth of research on this vulnerable population. A clearer understanding of the stressors experienced by the homeless and how and when they access healthcare systems are unknown. The purpose of this study is to gain a greater understanding of how the homeless perceive their personal circumstances in relation to healthcare and stress management. The research completed thus far has been developing a semi-structured interview. This interview blends descriptive and structural open-ended questions to assess everyday stressful experiences, the availability and desired resources to cope with stressors, how the homeless treat health issues and are perceived by healthcare professionals. Interviews will be conducted with 20 homeless individuals to understand their experiences with stress and healthcare access and utilization to provide a deeper awareness of their daily lives. Such knowledge will be an invaluable resource for researchers, city officials, and nonprofit organizations to inform future health interventions and improve the quality of life of the homeless.

The First in Situ Tree Roots from the Upper Mehrten Formation (~5 Ma), Turlock Lake, Stanislaus County, California

Michael George and Luke Castle, Julia T. Sankey, PhD; Geology Program, California State University, Stanislaus, Turlock, CA

Early Pliocene (~5 Ma) sedimentary rocks are exposed in and around Turlock Lake (Stanislaus County), California. The deposits formed in floodplain, river, and lake environments, and are composed of material from andesitic eruptions from western Nevada, prior to uplift of the Sierra Nevada Mountains. Numerous vertebrate and plant fossils were collected from these deposits in the 1970s, including many mammals; a 6-9 foot long, tusk-toothed salmon; and a Galapagos-sized tortoise. No complete, articulated fossils have been found; all were transported prior to burial. However, the taphonomy (death and burial) of these sites and the landscapes during this time are not well understood. Previous work referred to a paleosol (fossil soil) from the upper Mehrten, but was not described or documented. A paleosol would indicate that parts of the landscape were exposed for long enough periods of time (100s to 1000s of years) for plants to grow and for soil to develop. Evidence for paleosols include many features, including the presence of plant roots and root casts. I examined upper Mehrten deposits at three areas around Turlock Lake. I found numerous root casts of various sizes in all areas, clear evidence that paleosols are present. Most importantly, we found a site with large, in situ tree roots. This is the first discovery of root casts and in situ tree root casts from the upper Mehrten, and documents that landscapes were subaerially exposed for lengthy periods of time during which time soils formed and large trees grew.

Steam generation with a Novel Copper Minichannel Solar

Paulo Jeremias, Keith Saechao, Van Duong, and Gerardo Diaz, PhD;
School of Engineering, University of California, Merced

Steam generation devices have traditionally been powered by fossil fuels, however, there is a trend to move to a renewable and sustainable way of generate useful energy. Solar water heaters are being disseminated all around the world as a new option for local generation of energy. Many researchers have developed systems to increase the efficiency and temperature of their solar water heater. Some of them developed evacuated tubes to reduce the convection and conduction losses; others used mirrors to concentrate the radiation in a specific point of interest. However for many years the design of flat plate collectors has not changed, causing a slow increase of their thermal efficiency. Using a novel design developed at UC Merced, a copper water heater based on minichannel tubes is able to generate steam using no vacuum or concentration. By a thermodynamic and experimental approach the present study characterizes the performance of steam generation from a minichannel-based solar collector using copper tubes. Covering topics as design, steam generation, and thermosiphon effect, this study provides a complete overview of this system.

Investigation of the Fold Switching Mechanism of the Biological Clock Protein KaiB

Michael I. Montoya, Joel Heisler, and Andy LiWang, PhD; School of Natural Sciences, University of California, Merced

The predictable changes in temperature and light brought about by the rotation of the Earth are anticipated by the biological clock in nearly all organisms. The most simplistic model used for studying biological rhythm is composed of the KaiA, KaiB, and KaiC three-protein system within cyanobacteria. Although KaiB exists mainly as a tetramer, recent literature has shown that elimination of nine N-terminal residues shifted equilibrium toward the monomeric state. KaiB in its monomeric state has been found to switch between two three-dimensional folds. Utilization of PCR-mediated site-directed mutagenesis yielded a DNA sequence that encoded for a truncated KaiB9-108. Much like the behavior of the recently reported KaiB10-108, the protein obtained is expected to exhibit similar tetrameric depolymerization to the monomeric state. The success in obtaining the truncated protein would pave the way for the characterization of equilibrium and determination of the fold of each state, through biophysical techniques such as gel filtration and NMR.

Improving Zero-Finding Algorithm For Optimization Methods in Image Reconstruction

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With the advent of improved technology, digital images have become commonplace in today's society. In addition to personal use, digital images have become prevalent in both academia and industry in fields such as astronomy, security, and medicine. Often times in iSmage processing applications, high quality images must be generated from incomplete or noisy data, which requires solving large scale optimization problems. An essential part of solving these optimization problems is root-finding algorithms. Such numerical methods begin with an initial guess and iteratively improve upon the approximation converging towards a limit, the root. In applications, the rate at which an algorithm converges to the root is often important. The objective of this research is to develop and implement faster root-finding algorithms for optimization methods in image reconstruction.

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