UROC FALL RESEARCH MIXER

Celebrate, Connect, & Share your research!

Wednesday, December 10, 2025

1:00PM-4:00PM

UC Merced Conference Center Ballroom

Join us for an afternoon of celebration and community

Showcase and celebrate research achievements of undergrads, grad students and postdocs

Network with fellow scholars, mentors, and staff

Enjoy refreshments, conversations and desserts

Poster ID	Poster Title	Poster presenter
Session 1: 1:00 pm - 2:25 pm		
1 A	Drone-Based 3D Visualizations of the Merced Grassland and Vernal Pool Reserve	German De La Luz
2 A	The DNA sensor IFI16β inhibits the AIM2 inflammasome via DNA competition	Joshua Thomas
3 A	Induction and Characterization of Tip-specific Endothelial Cells	Hoda Arab Zadeh
4 A	Effects of Chronic Pyraclostrobin Exposure on Immune Cells in the Spleen	Misha Gerami
5 A	Chemical Synthesis of Norfentanyl for use as Standard in the Analysis of Soil and Biological Matrices	Grace Islas
6 A	Stochastic Modeling of the Deviation of Brownian Particles from the Diffusion Equation	Leonardo Gil Rojo
7 A	Exploring Pyraclostrobin-Induced Effects on the Bone Marrow and Hematopoiesis	Christelle Baria
8 A	Designing Well-Controlled Nanocatalysts for Chemical Transformations	Luis Pinacho-Rios
9 A	Curriculum Learning For Low-Dose CT Reconstruction	Ricardo Ornelas
10 A	Mapping Pedagogical Language in Motion: Developing and Validating a Multimodal Coding System for Classroom Language and Skills	Fernando Negrete Raya
11 A	ANN-Benchmarks Extension for Filtered Search	Abylay Amanbayev
12 A	Coupling the Cyanobacterial KaiABC Clock with DNA Liquid Crystals via RpaA-Mediated Interactions	Ronald Truong
13 A	Synthesizing MoS_2 and Transferring Monolayers onto SnTe to Observe Optoelectronic Properties and Photoluminescence	Rithvik Nandam
14 A	Assembly of a DNA Liquid Crystal for Protein Binding	Areesha Tariq
15 A	FAISS: An Exploration on Similarity Search	Akshaya Natarajan
16 A	Nd Doped MoS_2 for Possible Future Use in Quantum Technology.	Brandon Kwok
17 A	Carbon and Nitrogen Isotope Variation in Managed vs. Unmanaged Grasslands	Megan Kerby
18 A	Engineered TMDC Heterostructures for Deterministic Single Photon Emitters	Julio Salgado

Poster ID	Poster Title	Poster presenter
Session 2: 2:35 pm - 4:00 pm		
1 B	Exploring the Connection Between Dust and Valley Fever Incidence in the Central Valley	Sanya Nath
2 B	Measuring Surface Soil Moisture and Salinity using a Miniaturized Spectrometer	Amy Chan
3 B	Hardware-Aware Neural Networks Using Memristor Conductance Mapping	Adrian Kisieu
4 B	Practical Visualization of Dividing Cells in Response to Injury and Infections	Diana Torres Ortiz
5 B	Pigment Cells Mediate Pathogen Clearance in Planarians	Ashley Liao
6 B	Nutrient-Dependent Transport of Run-and-Tumble Escherichia coli in Micropillar Arrays	Hari Brunda Gopireddy
7 B	Circadian-Linked Hormonal Variation in Human Milk in Relation to Maternal Sleep Patterns	Evan Martin
8 B	The Divergence of Perceived Cognitive Workload and Performance	Zoe Loh
9 B	AI in astronomy: Probing Internal Properties of Unresolved Galaxies	Aurélien Henry
10 B	Structural Variation Prediction in Parent to Child Inheritance	Sara Rehder
11 B	Development of a UVC LED based cold vapor fluorescence detector for field deployable mercury sensing	Oliver Htway
12 B	Differences in Soil Chemical and Physical Properties Between Managed and Unmanaged Agricultural Lands	Emily Solorio
13 B	Measuring conscious contents using EEG complexity	Sergio Ponce de Leon
14 B	Automated recognition and analysis of MLC-Aerosol co-occurrences	Noah Elliott
15 B	Two-Stage Stochastic Portfolio Optimization	Isaic Cruse
16 B	Analyzing The Impact of PACBE: Limitations, Statistical Significance, and Future Directions	Alexandra Lee
17 B	Sleep and Transcriptional Encoding of Ethanol Tolerance Memory-like States in Drosophila	Lina M. Garcia
18 B	Plots of Milky Way-like galaxy GMC	Phoenix Harrison

Title : Drone-Based 3D Visualizations of the Merced Grassland and Vernal Pool Reserve

Author(s) : German De la Luz and Dr. Brandon Stark School of Engineering, University of California, Merced

Abstract :
California has lost over 90% of its native vernal pool habitats, making the Merced Vernal Pools and Grassland Reserve a critical, yet fragile, ecosystem. Physical access to unique features like the Black Rascal Cliff is often restricted by seasonal flooding and the need to protect delicate soil structures. This project addresses these challenges by creating a high-fidelity "digital twin" of the cliff using 3D Gaussian Splatting.
Unlike traditional geometric modeling, Gaussian Splatting utilizes drone-captured aerial imagery to render the landscape as a volumetric cloud of semi-transparent particles. This technique effectively captures the complex, organic textures of the terrain that standard meshes often fail to represent. The resulting model serves a dual purpose: it acts as a permanent scientific archive of the site's current geological state and functions as an immersive educational tool. By digitizing this unique terrain, the project allows users to virtually experience the cliff's vast openness and isolation, fostering a deep emotional connection to the land without compromising its physical integrity.

The DNA sensor IFI16β inhibits the AIM2 inflammasome via DNA competition

Joshua L. Thomas, Sneha Bhat, Eva De Alba, School of Engineering, Bioengineering, University of California, Merced

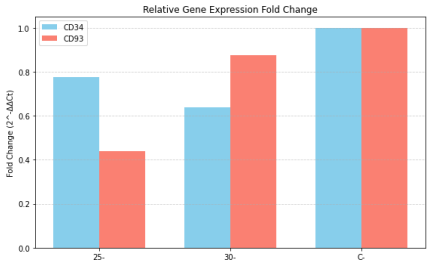
Inflammation is a crucial defense mechanism of the human body. It occurs via recognition by sensor proteins of pathogenic molecules, such as viral or bacterial DNA. The recognition mechanism involves sensor oligomerization, which is a prerequisite for the subsequent recruitment and polymerization of the inflammasome adaptor protein ASC. Self-association is instrumental in inflammasome formation and key to the activation of the effector procaspase-1. The DNA sensors AIM2 and IFI16 are prominent multidomain proteins with DNA-binding domains (HIN) and protein-protein oligomerization domains (PYD) for self-association and ASC recruitment. An isoform of IFI16 named IFI16β, found in humans, has been shown to act as a natural inhibitor of the AIM2 inflammasome. Unlike IFI16, IFI16β lacks the PYD and thus cannot interact with ASC, an essential step in AIM2 inflammasome assembly. In this study, we utilize optical tweezers along with confocal fluorescence microscopy and microfluidics to study the inhibitory properties of IFI16β. We performed DNA competition experiments on a single dsDNA molecule using mixtures of AIM2 and IFI16β at different concentrations. Our data shows that IFI16β and AIM2 bind to dsDNA stochastically, with a drastic decrease in AIM2 binding at equimolar concentration; form complexes before and after binding to dsDNA; comigrate on the dsDNA, impacting AIM2 binding dynamics. Overall, our data indicate that inhibition is primarily driven by dsDNA competition, which depends on the relative concentrations of IFI16β and AIM2. Additionally, AIM2 shows a higher dissociation rate when IFI16β is present, demonstrating that IFI16β alters AIM2's binding dynamics. In addition, IFI16β–AIM2 complex formation and comigration may impede ASC recruitment and inflammasome assembly.

Induction and Characterization of Tip-specific Endothelial Cells for Promoting Angiogenesis

Hoda A. Zadeh[1,2], Kara E. McCloskey[1]

[1]School of Engineering, University of California, Merced
[2]Materials and Biomaterials Science and Engineering, University of California, Merced

Peripheral arterial disease is caused by blockages in blood flow to the lower extremities and can lead to critical limb ischemia, limb amputation, and mortality. Promoting the growth of new blood vessels and angiogenesis in ischemic limbs is a promising treatment strategy. This could be accomplished by either 1) activating microvascular endothelial cells (ECs) to convert into sprouting ECs, called tip-specific ECs, or 2) delivering tip-specific ECs directly into the ischemic limb. However, tip-specific ECs have only been recently recognized as distinct cells with upregulation in specific genes, including DLL4, CD34, and CD93 expression. Here, we examined the effects of vascular endothelial growth factor (VEGF), basic fibroblast growth factor (bFGF), Placental growth factor (PlGF), and γ-secretase inhibitor (DAPT) to induce human umbilical vein endothelial cells (HUVECs) into a tip-specific subphenotype and measured the designated genes expression with Flow cytometry followed by qPCR. Results indicate that 25 ng/mL VEGF induces 15-24% of untreated ECs to express $DLL4^+$ and 100 ng/mL bFGF upregulates DLL4 expression between 14-16%. Neither 10 uM DAPT nor 50 ng/mL PlGF treatment generated $DLL4^+$ cells. Moreover, co-staining of DLL4 and CD34 did not show a co-positive ($DLL4^+/CD34^+$) population in flow cytometry. qPCR of $DLL4^-$ cells shows downregulation of CD34 and CD93 compared to untreated control. The results suggest that VEGF induces tip-specific EC phenotype in human ECs by upregulation of DLL4 expression but not CD34 proportionally. This study shows the importance of targeted approaches in developing therapies based on relative gene expression for angiogenesis-associated disease. Further research in tip-specific EC conversion mechanisms will advance the understanding of gene relative expression in therapeutic angiogenesis treatment in patients with ischemic conditions.



Effects of Chronic Pyraclostrobin Exposure on Immune Cells in the Spleen

Misha Gerami [1], Jennifer O. Manilay[1], PhD, School of Natural Sciences, University of California, Merced

Long term exposure of agriculturally used fungicide, pyraclostrobin, has revealed long-lasting mitochondrial dysfunction. Mitochondria function is crucial for hematopoietic stem cell differentiation and homeostasis, which begins in the bone marrow. Bone marrow failure (BMF) is a disorder that causes dysfunction of blood cell formation such as erythrocytes, leukocytes, and platelets. This disorder can lead to impaired functioning of the spleen, which is responsible for removing damaged blood cells and storing platelets. Our objective is to investigate the effects of prolonged chronic pesticide exposure, specifically pyraclostrobin on BMF and the spleen's hematopoietic responses. To accomplish this, eight- to twelve-week-old C57BL/6 mice were exposed to pyraclostrobin via intraperitoneal injections for thirty days, with weekly health checks. Our control group administered corn oil (vehicle only) injections, whereas the experimental group received a mixture of pyraclostrobin dissolved in corn oil at a dosage of 10 mg/kg body weight. The mice were then dissected to process splenocytes for flow cytometric analysis. Our pilot studies suggest that pesticide-induced modifications in the spleen will result in an increase in the total number of CD4+ T-cells but a decrease in CD8+ T-cells percentage among female mice. Studies are currently underway. This study is relevant as pesticide exposure is heavily impacting Central Valley farmers, with broader implications calling for analysis of sex-specific issues and other health concerns in those exposed.

Title: Chemical Synthesis of Norfentanyl for use as Standard in the Analysis of Soil and Biological Matrices.

Author(s): Grace M. Islas, Salustra S. Urbin, Lisa R. Larabee and Carlos A. Valdez

Abstract:

The synthetic opioid class of compounds collectively known as fentanyls have become the focal point of several efforts around the globe centered on determining ways to neutralize their toxic biological effectsl1], With the realization of this global pandemic event, drug enforcement agencies globally have started programs aimed at the development of more efficient ways for the detection of the opioid by various analytical methods, mostly involving gas chromatography-mass spectrometry (GC-MS) and liquid chromatography-mass spectrometry (LC-MS).

Fentanyl, when produced in clandestine laboratories, makes its way to the soils in the surroundings where it can remain for years due to its limited degradation, Chemical processes within the soil convert the fentanyl into Norfentanyl, which can be used as an indicative marker of the past presence of the opioid and thus, a clandestine center of production for it, Therefore, Norfentanyl synthesis is critical as a positive control for developing and validating reliable detection methods for soil and biological matrices. As our studies will involve the use of GC-MS in the future, we will employ the synthesized Norfentanyl in derivatization studies to create analogs that provide analysts with additional ways to detect this important fentanyl marker.

Stochastic Modeling of the Deviation of Brownian Particles from the Diffusion Equation

Leonardo Gil Rojo, Changho Kim. PhD
School of Natural Sciences, University of California Merced

The diffusion equation is a differential equation used to model various natural phenomena in the macroscopic world that emerge from the motions of discrete microscopic particles. However, the discrete nature of the particles means there will be some deviation from the diffusion equation. Here, we aim to quantify this deviation through stochastic analysis and computer modeling of a system of particles undergoing Brownian motion. The mathematical analysis of our system, with subsequent verification through simulations, shows that the Brownian particles do follow the diffusion equation on average, however the deviation from the model increases when the number of particles overall is reduced or when the length scale is reduced. We find that the diffusion equation model breaks down at the microscopic scales with a small amount of particles.

Exploring the Pyraclostrobin-Induced Effects on the Bone Marrow and Hematopoiesis

Christelle A. Baria,[1] and Jennifer O. Manilay, PhD[1] , School of Natural Sciences, University of California, Merced

Pesticide use is widespread in agricultural regions like California's Central Valley, yet there is limited knowledge of its direct impacts on immune health, particularly bone marrow failure (BMF) and the mechanisms by which pesticide-induced toxicity may impair hematopoiesis. Pyraclostrobin (Pyra) is a strobilurin fungicide used to control crop diseases but can induce oxidative stress by inhibiting mitochondrial cytochrome-bc1 complex, which is important for cellular respiration. This study aims to investigate how Pyra affects hematopoiesis, innate immune cells, and lymphocytes in bone marrow (BM) to understand its potential link to BMF using mouse models. The BM is the main site for hematopoiesis, containing the microenvironment that provides niches that support self-renewal and differentiation of hematopoietic stem cells. We exposed 10-18 week-old C57BL/6 mice to a 10 mg/kg body weight dose of Pyra in corn oil (treatment) and the control was exposed to corn oil alone, both administered via intraperitoneal (IP) injections for thirty days. BM from tibias and femurs were extracted and analyzed by flow cytometry. Our prior 30-day mixed-sex experiment showed statistically significant differences in the percentage of BM B cell and $CD19^{-}$ $CD3^{-}$ populations between male and female groups exposed to Pyra. In addition, Pyra-treated female mice displayed significantly lower average T-cell percentages than the vehicle group. The findings of this study have the potential to inform pesticide safety regulations for inhabitants of agricultural regions like Merced.

Title: Designing Well-Controlled Nanocatalysts for Chemical Transformations

Author(s): Luis N. Pinacho-Rios, Montserrat Mendoza, Jennifer D. Lee, PhD, Department of Chemistry and Biochemistry, University of California, Merced

Abstract:
Catalysts are materials that enable chemical transformations and are essential for advancing the energy efficiency of chemical processes. Precise synthetic control over material compositions and structure at the atomic scale has demonstrated great potential in designing efficient catalysts. Currently, catalysts prepared by conventional synthetic methods often exhibit low reactivity and stability during chemical reactions due to uncontrolled particle compositions and nonuniform particle morphologies. Recent advances in colloid chemistry have led to the development of new design strategies to prepare catalysts with well-controlled particle sizes, shapes, and compositions, enabling improved stability and catalytic performance during reactions. To demonstrate the tunability of the colloidal synthesis method, we report the design of two bimetallic nanoparticle systems, one with a core-shell structure and the other with a randomly alloyed structure. In particular, core-shell ruthenium-copper (RuCu) nanoparticles with varying Ru compositions and platinum-nickel (PtNi) alloy nanoparticles are synthesized by the colloidal method. The particle morphologies and size distributions of the as-prepared samples are characterized by transmission electron microscopy. Additionally, the metal compositions and distributions in both bimetallic systems are probed by scanning transmission electron microscopy coupled with energy dispersive X-ray spectroscopy. These techniques reveal well-controlled nanoparticles in both systems, enabling their use as viable catalysts for broader catalysis applications.

Title: Curriculum Learning For Low-Dose CT Reconstruction

Authors: Ricardo Ornelas and Roummel Marcia

Abstract: Low-dose computed tomography (CT) reconstruction is highly sensitive to noise and artifacts due to limited photon counts. We introduce a curriculum learning framework that progressively trains a neural network from clean to increasingly noisy sinograms, enabling gradual adaptation to challenging noise conditions. This staged learning strategy enhances both stability and generalization compared to conventional direct training on noisy data. Additionally, we leverage hybrid loss functions that combine mean squared error (MSE), structural similarity (SSIM), and learned perceptual image patch similarity (LPIPS) to improve perceptual fidelity and preserve fine anatomical details. Extensive experiments on the LoDoPaB-CT dataset demonstrate that our approach outperforms baseline methods across MSE, SSIM, peak signal to noise ratio (PSNR), and LPIPS metrics, producing sharper and more anatomically accurate reconstructions under extreme low-dose conditions.

Title; Mapping Pedagogical Language in Motion: Developing and Validating a Multimodal Coding System for Classroom Language and Skills

Author: Fernando Negrete Raya

Abstract: This work-in-progress presents the development, refinement, and reliability testing of a comprehensive Language Content and Skills Coding System designed to capture how teachers' linguistic and instructional behaviors shape student learning opportunities in bilingual and disciplinary classrooms. Drawing on frameworks from systemic functional linguistics and gesture research, the coding system organizes observable teaching behaviors into theoretically grounded categories, including *Explanation/Description, Questioning, Summarizing, Communicating Objectives, Feedback,* and *Scaffolding.* These are complemented by codes for language modality (English/Spanish), gesture type, and classroom configuration, enabling an integrated analysis of language use and pedagogical interaction.

Undergraduate coders (n = 6) were trained through iterative calibration sessions using authentic classroom video data. Inter-rater reliability was calculated using Cohen's kappa and percent agreement across major language and skills dimensions. Preliminary results indicate adequate reliability for across the dimensions($\kappa \approx .70$). Coding discrepancies informed further clarification of inclusion/exclusion criteria and the development of exemplar video segments to enhance future coder consistency.

By systematizing how linguistic and pedagogical moves are represented, the coding scheme offers a scalable framework for analyzing classroom discourse across bilingual STEM contexts. The presentation will invite feedback on refinement strategies and on integrating multimodal (gesture-speech) indicators into subsequent phases of reliability testing and automated annotation.

ANN-Benchmarks Extension for Filtered Search

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December 2025

Abstract

Retrieval-Augmented Generation (RAG) applications increasingly rely on Approximate Nearest Neighbor Search (ANNS) over text embeddings, often combined with metadata filtering to exclude irrelevant results. Although ANNS has been extensively studied, there is little work analyzing workloads with filters, and limited datasets with metadata attributes and vectors based on text embeddings. To this end, we extend ANN-Benchmarks to support queries with metadata filters, analyzing effects of filter selectivity and search parameters on query performance. We also introduce datasets derived from movie synopses (over 500,000 vectors) and user reviews (over 2 million vectors) on IMDb, enriched with over 5 metadata attributes per vector, and corresponding query workloads. Extensive experiments across three open-source vector search systems – Milvus, pgvector, and FAISS – reveal some intriguing initial results. Additionally, we implement support for predicate evaluation in the HNSW index in FAISS, ensuring comparable performance evaluation with other systems.

Circadian rhythms in cyanobacteria are regulated by the KaiABC oscillator, a post-translational timing system whose activity is influenced by associated transcription factors such as RpaA. In this project, we aim to investigate how RpaA interacts with DNA liquid crystals and whether these interactions can be coupled to the KaiABC oscillator to modulate optical properties. We expressed and purified the RpaA D53E mutant, previously reported to enhance DNA binding. Parallel to protein purification, we designed and prepared a DNA liquid crystal system. Our initial annealing produced inconsistently folded DNA, as confirmed by NMR; therefore, we performed a second annealing using a larger reaction volume. Circular dichroism (CD) spectroscopy was used to compare melting temperatures and structural stability between the two DNA preparations. Our next steps include binding D53E RpaA to the DNA liquid crystal and integrating this complex into the KaiABC oscillator. Ultimately, we aim to determine whether the oscillator's dynamic phosphorylation cycle can disrupt or shift the optical behavior of the DNA liquid crystal. This work may provide insight into coupling biomolecular timing mechanisms with emergent DNA-based materials.

Title: Strain-Engineered Optoelectronic Behavior in CVD-Grown MoS2, Transferred onto SnTe

Author: Rithvik N, Bamidele O, Hui C, School of Natural Sciences, Physics, University of California, Merced

Abstract: Strain engineering is a powerful approach for tuning the electronic and optical properties of two-dimensional semiconductors. In this work, we investigate strain effects in monolayer and few layer MoS_2 transferred onto single-crystal SnTe using spatially resolved Raman and photoluminescence (PL) spectroscopy. The lattice mismatch, surface morphology, and mechanical compliance of SnTe introduce nonuniform local strain in the MoS_2 overlayer, producing measurable shifts in the E′ and A_1' Raman modes relative to SiO_2-supported references. Raman mapping reveals distinct strain domains correlated with transfer-induced interfacial features and SnTe's intrinsic step structure. Corresponding PL measurements show exciton energy shifts and linewidth variations that track the local strain landscape, demonstrating strain-driven modulation of optical transitions rather than predominantly charge-transfer effects. These results establish MoS_2/SnTe heterostructures as a controllable platform for strain engineering and highlight Raman/PL spectroscopy as an effective tool for resolving nanoscale strain patterns in layered systems.

Title: FAISS: An Exploration on AI Similarity Search

Author(s): Richard Camacho, Akshaya Natarajan, Ailisha Shukla, School of Engineering, Computer Science and Engineering, University of California, Merced

Abstract:
As we shift to an "AI" focused future, querying continues to play a critical role in most aspects of modern computing. However, modern search systems struggle to efficiently retrieve relevant results from large-scale, high-dimensional vector datasets. Exploring FAISS (Facebook AI Similarity Search), we can implement a faster and more accurate search system for a wide range of applications. Our approach includes constructing multiple FAISS index types (IVF, HNSW, and CAGRA), selectivity, evaluating them on CPU and GPU hardware, measuring recall, query latency, and runtime. These findings show that FAISS provides accurate and high-speed search performance, making it suitable for semantic data retrieval. The evaluated methods were integrated using a SQLite database, GTE embeddings, and a Streamlit interface to demonstrate how vector database research can be translated into a practical and intuitive user-facing system.

Quantum computing opens new solutions to problems that were previously inefficient to solve with classical computing, such as those requiring high precision. However, larger scale use is still limited by many factors, including the requirement of extremely low temperatures to reduce thermal disruption as well as highly specialized operating knowledge. Quantum computing is also limited by manufacturing costs associated with semiconductor quantum dots.

Provided rare Earth metals can be used similarly to quantum dots in quantum systems, we can address a large amount of the previous problems in quantum technology. Metals such as neodymium already have room temperature use with laser pointers, neodymium itself and any necessary equipment is far less complex as well as being far cheaper to access than those of current quantum computers.

In this work we will investigate the optical properties of Nd-doped MoS_2 for possible usage in quantum technology. Early data focuses on photoluminescence data from energy and temperature dependence. Presence of similar data to both MoS_2 and Nd suggests the MoS_2, which has promising applications in quantum computing, gains some properties of the Nd.

Title: Carbon and Nitrogen Isotope Variation in Managed vs. Unmanaged Grasslands

Author: Megan S. Kerby, School of Natural Sciences, University of California, Merced

Abstract:

We perform a comparative analysis of the physical and chemical soil properties between two adjacent landscapes: the managed Experimental Smart Farm (ESF) and the unmanaged Experimental Research Area (ERA). Soil samples were evaluated for physical properties and carbon (C) and nitrogen (N) properties. Using gas isotope analysis, unmanaged soils had higher nitrogen to carbon ratios than managed soils, revealing improved carbon capture in untilled soil through lower levels of carbon release.

Title: Engineered TMDC Heterostructures for Deterministic Single Photon Emitters

Author: Julio Salgado, School of Engineering, University of California, Merced

Abstract:
Monolayer transition metal dichalcogenides (TMDCs) have attracted interest as hosts for quantum light sources due to their strong excitonic effects and direct bandgaps at the monolayer limit. Monolayer tungsten disulfide (WS_2), a member of the transition metal dichalcogenide (TMDC) family, exhibits a direct bandgap of approximately 2.0 eV (~620 nm), strong spin–orbit coupling, and valley-dependent selection rules that make it a candidate for quantum photonic devices. Under the right confinement conditions the properties of thin layer WS_2 enable WS_2 to host single photon emitters.
Vertical and lateral TMDC heterostructures offer a versatile approach for engineering localized excitonic states capable of acting as single-photon emitters (SPEs). Using interlayer coupling and strain engineering, these heterostructures enable spatial and spectral control over quantum emitters with purity, high brightness, and stability. Recent developments have demonstrated that TMDC-based heterostructures can host SPEs localized at domain boundaries, defects, or interlayer potentials, offering new routes to scalable and integrable quantum light sources.

Title: Exploring the Connection Between Dust and Valley Fever Incidence in the Central Valley

Author(s): Sanya Nath, Precious Ebiendele,
Adeyemi Adebiyi, Ph.D, Aerosol-Climate Group, Department of Life and Environmental Sciences, School of Natural Sciences, University of California – Merced

Abstract:

Valley Fever is a fungal respiratory disease caused by inhaling spores transported from dry, disturbed soils, making dust events a plausible but still weakly quantified driver of this exposure in California's Central Valley. Here, my poster examines the relationship between dust and valley Fever incidence in the Central Valley by combining daily particulate matter (PM10) measurements from Environmental Protection Agency (EPA) monitors, valley fever incidence counts per county from the California Department of Public Health (CDPH), and dust-derived satellite imagery. First, to examine this connection, we focused on a widespread dust event that swept across the central valley on October 11, 2021. Our study indicated that PM10 levels during this dust event, mainly in Fresno, were higher than on previous days with non-dust conditions and entered unhealthy air quality index (AQI) categories, potentially heightening the risk of inhaling fungal spores. We use this case study to develop a preliminary framework for linking dust events to short-term, unhealthy air-quality spikes and potential Valley Fever risk. We believe our findings could inform evidence-based strategies to protect community health and address the health impacts of air pollution in the Central Valley.

Measuring Surface Soil Moisture and Salinity using a Miniaturized Spectrometer

Amy W. Chan, Rafal Krzysiak, YangQuan Chen, Department of Mechanical Engineering, University of California Merced

Surface soil moisture and soil salinity play crucial roles in agricultural applications such as irrigation and precision agriculture. The developments to sense surface soil moisture and salinity are important to improve sustainability and efficiency of food production. Previous studies utilized hyper-spectral and multispectral sensors to capture images and extract data through pixels, however these procedures are expensive and have low accuracy due to requiring indirect data extraction. Therefore, there is a need to develop methods to sense surface soil moisture that are inexpensive and highly accurate. In this study, we propose a point sensing system utilizing a miniaturized spectrometer to sense surface soil moisture and salinity. A polarized filter was added to the spectrometer to remove surface reflections from the surface soil moisture. This system was validated by conducting real-world experiments to establish a relationship between surface soil moisture and spectrum response. The results obtained from the spectrometer indicated that surface soil moisture and absorption magnitude are significantly correlated to sensing surface soil moisture. Notably, the results obtained from this method allowed for proximal sensing and the spectrum absorption magnitude to be revealed at the specific band directly.

Title: Hardware-Aware Neural Networks Using Memristor Conductance Mapping

Authors: Adrian Kisieu, Changho Kim University of California, Merced

Abstract:
This project tests whether a forward-pass deep neural network trained in PyTorch on the MNIST handwritten-digit dataset can be transferred onto real memristor hardware without losing significant accuracy. The main challenge is that original weights are continuous numbers, while physical memristors can only store specific conductance levels defined by the device's measured Conductance Conversion Curve (CCC). After training the model with standard stochastic gradient descent, each weight is converted through this curve and quantized to a conductance the device can actually hold. The goal is to make the network physically implementable on memristor hardware while keeping the accuracy drop as small as possible.

Title: Practical Visualization of Dividing Cells in Response to Injury and Infections

Authors: Diana Torres Ortiz, Beryl N. Arinda, Peter Karabinis, and Nestor J. Oviedo, School of Natural Sciences, Biology, University of California, Merced

Abstract:

In most multicellular organisms, mitotic activity rises after injury or infection. This cellular response is unavoidable, but questions still exist about the spatiotemporal dynamics of cell proliferation. To gain insights about cellular dynamics in response to injury and infection, we use whole-mount immunostaining to detect proteins of interest. These can later be quantified to establish the expression in a specific cell, tissue, or organism. Our lab uses *Schmidtea mediterranea*, a planarian flatworm, as a model organism to study stem cell regulation, cancer, and host-pathogen interactions. Our interest in planarians stems from their remarkable regenerative capabilities, driven by their stem cells (neoblasts). Planarians are capable of overcoming infections and repairing tissue after injury. One of the main reasons for overcoming injury and infections is the increase in actively dividing cells. We performed immunohistochemistry to detect phosphorylated histone-3, a marker of actively dividing cells, which can be observed and quantified by fluorescent microscopy. In planarians, we found that 6 hours after injury or infection, there is a noticeable increase in mitotic cells throughout the organism. Remarkably, we observed a differential rise in mitoses at 48 hours, whereas in response to infections, it occurs within 24 hours. Future work will address the molecular mechanisms underlying differential cellular dynamics during cell division to design strategies for future clinical interventions.

Title: Pigment Cells Mediate Pathogen Clearance in Planarians

Authors: Ashley Liao, Beryl N. Arinda, and Néstor J. Oviedo; School of Natural Sciences, University of California, Merced

Abstract:

Candida albicans is one of the most prevalent human fungal pathogens, leading to infections including oral thrush and yeast infections. However, current fungal infection models have major limitations. They do not allow us to visualize epithelial infection progression in a whole organism paired with non-invasive infection system. The planarian flatworm *Schmidtea mediterranea* serves as a powerful *in vivo* infection model for studying host-pathogen interactions due to non-invasive infection methods and effective innate immune responses. These allow planarians to quickly eliminate and recover from *C. albicans* infections in 10-12 days, through unknown mechanisms. Melanocytes (pigment cells) are known to have immune functions including pathogen recognition, phagocytosis, and antigen processing and presentation. During infection, non-uniform pigment was observed on the planarian epithelial surface. Here, we investigated the role of pigment cells in planarian antifungal immune response. To remove pigment cells, we continuously exposed planarians to white light. We reduced ≥80% of pigment cells from the planarian's body area in 7-15 days using this strategy. To confirm pigment loss, planarians were imaged and pigment changes were quantified using PlanaraChrome, a program that quantifies relative pigment levels. Depigmented planarians were infected with *C. albicans* for 3 days, following an updated planarian infection protocol via soaking. Depigmented planarians were highly susceptible to fungal infections and succumbed within 72 hours. This suggests that pigment cells play a critical role in host recovery and survival. Planarians display remarkable evolutionary conservation, making them a suitable model for studying antifungal innate immune mechanisms. Determining the mechanisms underlying pathogen clearance will shed light on infection responses in other organisms.

Title: Nutrient-Dependent Transport of Run-and-Tumble *Escherichia coli* in Micropillar Arrays

Authors: Mariam Dalqamouni*, **Hari Brunda Gopireddy**, Parveen Kumar, Bin Liu and Pooja Chopra

*California State University Bakersfield
School of Natural Sciences, University of California, Merced

Abstract: The ability of motile bacteria to navigate structured environments is central to processes ranging from colonization to infection. In this study, we investigate how run-and-tumble *Escherichia coli* move through arrays of micron-scale pillars when suspended in two chemically distinct nutrient-rich fluids: Motility Buffer (MB) and Tryptone Broth (TB). Using high-resolution 4D (3D + time) tracking microscopy, we reconstruct full bacterial trajectories within the structured domain. Surprisingly, the micropillar lattice enhances bacterial dispersal rather than hindering it. This enhancement is medium-dependent: in MB, where cells exhibit longer runs and fewer tumbles, transport becomes more persistent and super-diffusive; in TB, cells show more frequent directional changes and slower spreading. Spatial variations in swimming behavior suggest that hydrodynamic interactions with pillar surfaces and local run-tumble dynamics jointly shape escape rates and long-term transport. Our findings highlight how nutrient conditions and geometric confinement together modulate bacterial motility, with implications for microbiome engineering, antifouling strategies, and the design of structured microbial habitats

Title: Circadian-Linked Hormonal Variation in Human Milk in Relation to Maternal Sleep Patterns

Authors: Evan K. Martin, Kavya Swaminathan, MA, Jennifer Hahn-Holbrook, PhD

Research abstract:
Cortisol, a glucocorticoid hormone involved in regulating stress responses and maintaining circadian clocks throughout the body, is being studied for its potential daily rhythm in human milk, with a focus on understanding how levels may vary between elevated mornings and reduced evenings. Quality sleep in mothers is expected to support this robust circadian cortisol cycle in milk, providing strong time-of-day cues to infants that help to entrain infant circadian rhythms and promote infant health. Conversely, poor or disrupted maternal sleep may attenuate circadian rhythms in human milk. The purpose of this study is to investigate the relationship between maternal sleep patterns and circadian rhythms of cortisol in human breast milk, examining how variations in sleep quality may influence cortisol's daily fluctuations, which are crucial for infant circadian development. To test these associations, 105 breastfeeding mothers will collect 24-hour milk samples while wearing Actiwatch Spectrum Plus watches to capture objective sleep patterns over one week. Anticipated results from this research suggest that better maternal sleep quality will be associated with more pronounced and consistent cortisol variation in breast milk, while disrupted sleep may dampen or desynchronize this rhythm. By uncovering these associations, this study aims to inform potential interventions, such as maternal sleep optimization programs and targeted breastfeeding schedules, to support infant circadian health and enhance maternal well-being.

Title: The Divergence of Perceived Cognitive Workload and Performance

Authors: Zoe Loh, Spencer C. Castro, School of Engineering, University of California, Merced

As task demands increase, fewer limited cognitive resources remain for not only executing the task but monitoring one's own performance. This study investigates the point at which performance and self-assessment begin to diverge under increasing cognitive workload. Participants completed a dynamic visual tracking task in which they monitored target dots moving among distractors on a screen. Task difficulty was manipulated by varying the number of target dots from two to four. Participants were prompted to estimate their performance prior to receiving feedback. Following each trial, they also completed the Paas scale to assess perceived cognitive workload. Participants accurately assessed their performance overall (b = 0.58, SE = 0.11, z = 4.50, p < .001). However, they became less accurate when the difficulty increased to 3 targets (b = -0.44, SE =0.14, z = -3.29, p = .001) and 4 targets (b= -0.75, SE = 0.15, z = -4.91, p < .001). Participants were able to accurately detect changes in workload in general (b = -0.68, SE = 0.10, z = -6.63, p < .001). However, they became less accurate when the difficulty increased to 3 targets (b = 0.39, SE = 0.13, z = 3.06, p = .002) and 4 targets (b = 0.61, SE = 0.16, z = 3.86, p < .001). Participants accurately assessed the quality of their performance and detected changes in workload. They were less accurate in their judgements at higher difficulty levels. As task demands increase, individual ability to monitor task performance is reduced.

Title: AI in astronomy: Probing Internal Properties of Unresolved Galaxies

Author(s):
- Aurélien Henry and Gillian Wilson, School of Natural Sciences, Department of Physics, University of California Merced
- Gregory Rudnick and Craig Brooks, Department of Physics and Astronomy, The University of Kansas, Lawrence
- Pascale Jablonka and Utsav Akhaury, Laboratory of Astrophysics, Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland

Abstract: (219 words)
One of the main technological limitations in modern astronomy is linked to the spatial resolution of telescopes. Indeed, to achieve a better spatial resolution and resolve distant galaxies to study their internal properties, we need telescopes with larger and larger mirrors, making the telescopes more and more expensive. One solution is to build foldable mirrors onboard space telescopes, like what was achieved on the James Webb Space Telescope (JWST). Another solution is to improve our softwares and image processing by using (supervised) artificial intelligence. In this project, we trained a model specialized in deconvolving images of galaxies in optical and near-infrared light. We showed that, by using our model on real data, we were able to break the resolution barrier and access information that was previously impossible to get to. We were able to measure gradients of colors, which are used to probe differences in star-formation efficiency, dust attenuation, stellar ages or metallicity within the galaxies. By comparing galaxies in dense environments (clusters) and galaxies in the field, we successfully demonstrated how the environment can favor a particular quenching mechanism at redshift 1 (roughly 8 billions years ago). This pilot study demonstrates that AI could revolutionize astronomy by helping us get a deeper understanding of the evolution of galaxies through cosmic time without requiring any new images or telescopes.

Structural Variation Prediction in Parent to Child Inheritance

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Abstract

Children inherit genetic traits from prospective parents, those traits are made up of an individual's Deoxyribonucleic Acid (DNA). DNA is a double stranded structure held together through chemical bonds, known as nucleotide bases; nucleotide bases form alleles to make up inherited traits of the child received equally from their parents. When DNA is repaired, or replicated, an allele can be altered from the originally inherited allele, this altered allele is then classified as a Structural Variant (SV). SVs in turn can influence the expression of an individual's genetic makeup which can present as complex diseases. The research proposal aims to elucidate the genomic specificity of inherited SVs of a child from their parents through SV type and under the principles of Mendelian inheritance. Current procedures in place plan to predict SVs in children from parent inheritance based on a computational framework of a likelihood approach. Constraints will be written to include a mathematical gradient encompassing the type of SV and prediction of inheritance accordingly. Anticipated results of research will yield a further understanding of the genetic framework between SVs and heritability within familial constraints.

Title: Development of a UV C LED based cold vapor fluorescence detector for field deployable mercury sensing

Authors: Oliver Htway, Yangquan Chen, School of Engineering, University of California, Merced

Abstract: Atmospheric mercury is a persistent neurotoxin, yet high sensitivity field measurements still rely on bulky and power intensive cold vapor fluorescence analyzers that are difficult to deploy outside laboratory environments. This project addresses the need for a compact, low power mercury detector whose behavior is characterized well enough to support safe, linear, and reliable operation.

We are developing a UV C LED based cold vapor fluorescence system in which a 254 nm LED illuminates a mercury bearing flow cell through a light pipe and baffle assembly, and the resulting fluorescence is measured with a photomultiplier tube and low noise analog front end. To understand the coupled optical and electronic dynamics without relying solely on first principles modeling, we apply data driven system identification in MATLAB. Step and swept sine experiments provide input output data for fitting low order models that estimate gain, bandwidth, dominant time constants, and the onset of saturation. Early ARX and OE fits show weak validation and non white residuals, suggesting that the detector response is influenced by unmodeled delay, multiphase flow behavior, and timing offsets that require refined preprocessing and improved excitation.

Preliminary results include a literature survey on UV C LED driven mercury fluorescence, definition of the optical layout, and first pass schematics for the LED driver and PMT readout. These components establish feasible operating ranges and identify key noise sources. Integrating system identification with hardware development supports the goal of creating a portable mercury analyzer suitable for environmental sensing and future field deployment.

Title: Differences in Soil Chemical and Physical Properties Between Managed and Unmanaged Agricultural Lands

Author: Emily Solorio, School of Natural Sciences, University of California, Merced

Abstract:
Agricultural management can influence both the chemical and physical properties of soil. In this study, soils from the managed Experimental Smart Farm (ESF) were compared to soils from the unmanaged Experimental Research Area. Soil samples from both sites were collected during Spring 2025 and analyzed for pH, electrical conductivity (EC), bulk density, and soil color. Because soils support both food production and surrounding natural ecosystems, understanding how farming practices might alter soil chemical and physical properties is critical for developing sustainable strategies. Overall, managed ESF soils showed higher chemical differences, like pH while physical properties like color and bulk density remained similar between sites.

Perturbational complexity index (PCI) is a measure of consciousness that was motivated by integrated information theory's (IIT) claim that consciousness is phenomenologically integrated and differentiated. PCI quantifies the brain's spatiotemporal response to a TMS-evoked potential using EEG. The original formulation (PCIlz) uses source localization and Lempel-Ziv complexity (LZc); the latest formulation (PCIst) uses principal component decomposition and state-transition quantification. Although both versions of PCI have been shown to discriminate conscious level, and previous work with PCIlz and related measures of neural differentiation have been shown to discriminate meaningful and non-meaningful visual stimuli, results for LZc have been inconsistent, and comparable work hasn't been done with PCIst. To investigate these questions, we analyzed three EEG datasets where 40 participants performed an active face perception task, an active visual oddball task, and a passive auditory oddball task. We computed PCIst and LZc for every trial and analyzed the results using Bayesian mixed-effects models. We found that i) PCIst was higher for meaningful visual stimuli but that LZc could be higher or lower; ii) PCIst was higher for rare visual stimuli but LZc was lower; and iii) PCIst was higher for rare auditory stimuli but LZc did not discriminate rare vs. frequent auditory stimuli. These findings indicate that PCIst discriminates visual and auditory stimuli more reliably and more consistently than LZc. We suggest that these differences can be explained by differences in how PCIst and LZc are operationalized, and we conclude with a discussion of limitations and opportunities for future work.

Title: Automated recognition and analysis of MLC-aerosol co-occurrences

Author(s): Noah Elliott, Satyendra Pandey, Adeyemi Adebiyi, School of Natural Sciences, University of California, Merced

Abstract:

Understanding how aerosols impact low level cloud formation is important for understanding our climate as a whole and by extension improving long-term climate change projections and short-term weather prediction. Prior work has shown that mid-level clouds can affect the formation of low-level clouds co-occurring with aerosols.

To gain a better understanding of the role mid-level clouds have in this relationship, we can assess environmental conditions where mid-level clouds and aerosols co-occur above the southeast Atlantic. Specifically in this study, comparing conditions between three different categories of co-occurrences, where mid-level clouds form above / beside / below aerosols. To facilitate this comparison and see if automation is possible, a python program was developed to download and analyze Calypso LIDAR data for the recognition and categorization of co-occurrences.

Additionally, the program downloads and analyzes relevant Aqua MODIS imagery, and Aqua AIRS vertical profiles for all of the previously detected co-occurrences; providing a categorized list of all co-occurrences for a specified date range, their coordinates, the altitudes of the components, and vertical profiles for temperature and humidity at the location and time of the co-occurrence as well as many other variables used both internally to validate detected co-occurrences, and provided in the final CSV file output, ready for analysis by any spreadsheet program.

Here, we use Google sheets to assess the produced data. Which shows that, between co-occurrence types and against random vertical profiles within the study area, there are notable differences in average temperature and humidity at the 14 VP altitude levels.

Title: Two-Stage Stochastic Portfolio Optimization

Authors: Isaic Cruse and Roummel Marcia, School of Natural Sciences, University of California, Merced

Abstract:
The main goal of portfolio optimization is to maximize returns while minimizing loss. While the Markowitz's Mean-Variance model serves as the standard framework for constructing portfolios, it relies on the assumption that future market parameters (mean and variance) are known with certainty. In reality future market information is inherently uncertain. Consequently, the deterministic model fails to account for estimation errors and real-world constraints. To address these limitations, we propose a Two-Stage Stochastic Approach. This model minimizes risk by incorporating real-world trading constraints and scenario based asset return distributions derived from real market data.

Title: Analyzing the Impact of PACBE Lifestyle Interventions: Limitations, Statistical Significance, and Future Directions

Authors: Edward Vang, Alexandra Lee

Collaborators: Laura Sainz Merin (BS), Marisela Yepez (BA), Micaela Velasco Sandoval (BA), Patricia Navarro (BA), Rosa Manzo (PhD)

Abstract Body:

Asthma is prevalent in Latinx communities in the San JoaquinValley due to poor air quality and underserved healthcare access. Promotoras and Community-Based Education (PACBE) project (2021-2022) aimed to evaluate the impact of a Promotora-led virtual home visitation program on asthma outcomes among 67 Latinx patients in Madera and Fresno. One-third of adults within the area are diagnosed with asthma, with 70% of their children also affected with asthma. The study also examined the Promotora model's influence on participant trust, engagement, and retention in a virtual setting. Promotora are community health workers that help underserved communities by promoting health education and assisting them through the healthcare system.

The PACBE project is built on three core foundations. The Asthma Management and Education Foundation, which aims to educate community members in asthma management, Promotoras in the Public Health Workforce, which involves Promotora in planning and leading the delivery of asthma interventions, and the Community-Based Health Professional Training Opportunities, which allow medical students to assist Promotoras in delivering asthma interventions.

Participants completed pre-test surveys, knowledge assessments, and CDC home assessments at the start and after 4–6 months. Statistical models, including logistic regression and correlation analyses, assessed the results.

Results showed an average nine-point increase in the Asthma Knowledge Test and a 9.1% rise in participants reporting better asthma control. Results also indicated a significant association between knowledge improvement and decreased vacuuming frequency, showing that an increase in knowledge doesn't always correlate to improvement in behaviors. Feedback from focus groups and interviews highlighted improved asthma trigger awareness, better inhaler usage, and a preference for in-person program delivery. Future studies with larger samples may better measure knowledge and behavior changes.