SUMMER UNDERGRADUATE RESEARCH SYMPOSIUM

JULY 26-31, 2023

PURDUE UNIVERSITY, WEST LAFAYETTE, INDIANA

SUMMER UNDERGRADUATE RESEARCH SYMPOSIUM

SCHEDULE OF EVENTS

JULY 27, 2023 | GRISSOM HALL

9:00AM-5:00PM Research Talks (500s & 600s)

JULY 27, 2023 | PMU BALLROOMS

10:00AM-11:30AM Morning Poster Session (100s & 200s)

1:00PM-2:30PM Second Poster Session (300s & 400s)

JULY 26-31, 2023 | ONLINE

Virtual presentations (700s)

Virtual presentations are available on the Summer Symposium website.

We encourage those with BoilerKey access to provide feedback to presenters. **To submit feedback, please scan this QR code with your device's camera!**

RESEARCH TALKS

SESSION 1: 9:00AM-10:00AM

ROOM: GRISSOM 118

9:00 To house or to oust: How honey bee workers evaluate male quality
500 *Isabelle Gilchrist†*
Mentor(s): Brock Harpur; Matthew Ginzel; Jonathan Nixon; Alex Pasternak

9:20 Effect of Postmortem Aging on Water-Holding Capacity and Reabsorption Capability of Beef Longissimus
501 Lumborum Muscle
Varisra Upatising†
Mentor(s): Brad Kim; Jin-Kyu Seo; Madison Romanyk; Saud Ur Rehman

9:40 Investigating the role of LETMD1 in mitochondrial protein transport and translocation
502 *Charles Thrift†*
Mentor(s): Shihuan Kuang; Madigan Snyder

ROOM: GRISSOM 125

9:00 Manufacturing and Characterization of Flexible Resistive Tensile Force Sensor with Carbon-Fiber Mesh and
503 Silicone
Harry Lee†
Mentor(s): Garam Kim; Eduardo Barocio

9:20 Bond performance of post-installed GFRP rebars in concrete
504 *Daniel Santamaria†*
Mentor(s): Akanshu Sharma; Deepak Suthar

9:40 Better Safe Than Sorry: Preventing the next pandemic by studying newly emerging coronaviruses
505 *Misa Meadows†*
Mentor(s): Andrew Mesecar; Uttara Jayashankar; Sydney Beechboard; Emma Lendy; Arun Ghosh

ROOM: GRISSOM 126

9:00 The Impact of Print Geometries on Directionality of an Explosive
506 *Jack Martin†*
Mentor(s): Diane Collard; Steven Son; Gabriel Montoya

9:20 Design and synthesis of novel pyridine-based conjugated ligands for 2D perovskite formation and improved
507 solar cell efficiency
Aline Kruger†
Mentor(s): Letian Dou; Jiaonan Sun

9:40 The Effect of the Rotor Screen Gap on Granule and Tablet Properties in a Dry Granulation Line
508 *Jayden Pierce†; Dhruv Mendpara**
Mentor(s): Rex Reklaitis; Yan-Shu Huang; Sunidhi Bachawala

ROOM: GRISSOM 133

9:00 Finding Cybersecurity vulnerabilities in Embedded/IoT systems
509 *Parth Doshi†; Ricardo Andres Calvome Mendez‡; Kyle Robinson‡*
Mentor(s): James Davis; Paschal Amusuo

9:20 Investigation into Alternative Radiation Hardened Photovoltaic Materials for Planetary Missions
510 *Cole Lush†; Ishaan Rao**
Mentor(s): Peter Bermel; Sayan Roy

9:40 Relation of Decentralized Network Architectures to Adversarial Attacks Centrality in Federated Learning
511 *Adam Piaseczny†*
Mentor(s): Christopher Brinton; Rohit Parasnis

ROOM: GRISSOM 134

9:00 Development and Investigation of Load-Based Testing Methodology for HVAC Systems
512 *Seyed Kiarash Mossalaei†*
Mentor(s): Jim Braun; Parveen Dhillion; Do Hyeon Kim; Jie Ma; W. Travis Horton

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

9:20 Air purification technologies for HVAC systems to reduce Indoor bioaerosol concentration
513 *Youyi Zhou†*
Mentor(s): David Warsinger; Sudharshan Anandan

9:40 Predictive Models for Projection Printing of Nanoscale 3D Structures
514 *Rohit Jammula†*
Mentor(s): Xianfan Xu; Jason Johnson

SESSION 2: 10:00AM-11:00AM

ROOM: GRISSOM 118

10:00 Investigating Wetland Methane Emissions: Development and Application of Low-Cost Platforms for Automated
515 Gas Flux Systems
Anya Emerson†
Mentor(s): Jake Hosen; Zaven Arra; Ken Chong

10:20 Bioinformatic analysis of Fumarase and its Role in DNA Stress Response to identify functional pathways
516 *Thomas Sheeley†*
Mentor(s): Ann Kirchmaier; Ronard Kwizera; Harish Kothandaraman; Nadia Atallah Lanman

10:40 Chronic Exposure to Aqueous Film-Forming Foams Leads to Evolutionary Responses in Daphnia magna
517 *Jack Morehouse†; Sarah Pfisterer*; Connor Adamek**
Mentor(s): Jason Hoverman; Devin Jones

ROOM: GRISSOM 125

10:00 Identifying Legionella bacteriophages to create a novel treatment for Legionnaires disease.
518 *Ryan Yin†*
Mentor(s): Zhao-Qing Luo; Kayla Perri

10:20 Changes in Heart Function Associated with Increased Sympathetic Nerve Activity During Autonomic
519 Dysreflexia in Rats with Spinal Cord Injury
Molly Dye†
Mentor(s): Bradley Duerstock; Zada Anderson; Mitch Sanchez; Thomas Everett

10:40 Ultra Sensitive 3D Printed Capacitive Pressure Sensor
520 *Mitesh Mylvaganan†*
Mentor(s): Sunghwan Lee

ROOM: GRISSOM 126

10:00 The Catalytic Performance of Single-Site Indium on Oligomerization and Dehydrogenation Reactions
521 *Matthew C. Gerona†; Emmanuel Ortiz‡*
Mentor(s): Jeffrey Miller; Ted Taewook Kim

10:20 Investigating the Use of Principal Component Analysis as a Tool for Process Monitoring
522 *Adam Georgopoulos†*
Mentor(s): Rex Reklaitis; Rexonni Lagare

10:40 Electrocatalytic Reduction of Nitrate on Copper Single Crystals
523 *Hannah Oberg†*
Mentor(s): Brian Tackett; Joseph Heil

ROOM: GRISSOM 133

10:00 Plug-and-Play ADMM: Natural Image Priors Arena
524 *ILo Chen†*
Mentor(s): Qi Guo

10:20 Development and Application of a Generalized Flapping Wing Vehicle Simulation Package
525 *Darin Tsai†*
Mentor(s): Patrick Hyun; Shijun Zhou

10:40 Coherent Light Optical Haptic Sensor for Robotic Tactile Sensing
526 *Guo Yu†*
Mentor(s): Qi Guo; Charles Brookshire

ROOM: GRISSOM 134

10:00 Personalized Finite Element Model of Tissue Expansion in Breast Reconstruction Patients
527 *Joel Laudo†*
Mentor(s): Adrian Buganza Tepole; Tina Han

10:20 Mechanistic interrogation of the impact of electrode heterogeneities in Lithium-ion batteries for electric vertical take-off and landing aircraft
528 *Alvaro Miguel†*
Mentor(s): Partha Mukherjee; Abhinand Ayyaswamy; Bairav Vishnugopi

10:40 Additive Manufacturing of Fiber Reinforced Ceramic Materials
529 *Ella Richardson†*
Mentor(s): Monique McClain; Josh Anderson

SESSION 3: 11:00AM-12:00PM

ROOM: GRISSOM 118

11:00 Wheat and Sorghum Bran Effects on Structure and Function of Gut Microbiomes
530 *McKenna Stahl†*
Mentor(s): Steve Lindemann; Adam Quinn

11:20 An Immersive Approach to the Expansion of Nuclear Engineering Education
531 *Jonah Lau†; Robert Beatty‡; Shea Ruthe‡; Trent Bloor‡; Zenen Enriquez‡; Julian Triveri‡*
Mentor(s): Stylianos Chatzidakis; George Takahashi; Xin Yi Zhou

11:40 Adaptive Identification of SIS Epidemic Models
532 *William Retnaraj†*
Mentor(s): Philip Paré

ROOM: GRISSOM 125

11:00 Synthesis of atomically precise iron sulfide clusters and their analysis
533 *Dylan Forbes†*
Mentor(s): Xilai Li; Habib Gholipour-Ranjbar; Julia Laskin

11:20 A systematic review of the diverse host-seeking strategies of an understudied tribe of mosquitoes
534 *Sydney Moeller†*
Mentor(s): Ximena Bernal; Shilpi Singh; Richa Singh; Sam Freedlund

11:40 Characteristics of Particles emitted from Croplands
535 *Jeremy Harris†*
Mentor(s): Gouri Prabhakar; Christopher Rapp

ROOM: GRISSOM 126

11:00 Single Photon Emitters in Silicon Nitride: An Automated Study
536 *Alina Stuleanu†; Viet Khoi Pham Khac‡*
Mentor(s): Vladimir Shalaev; Samuel Peana

11:20 Physics Based Synthetic Dataset for Training Neural Network for Diffusion Coefficient Determination
537 *Shayak Chatterjee†*
Mentor(s): Steve Wereley; Pranshul Sardana; Zhengwei Chen

11:40 Microstructural Control of Additively Manufactured Polymer Bonded Explosives
538 *Christina Lumpp†*
Mentor(s): Monique McClain; James Plotzke

ROOM: GRISSOM 133

11:00 Investigation of Diffusion Models with Musical Input
539 *Joshua Kamphuis†; Tim Nadolsky‡; Kevin Kwon*; Tanin Padungkirtsakul*; Sanya Dod*; Kareena Patel*; Rochelle Xue*; Haichang Li**
Mentor(s): Yung-Hsiang Lu; Kristen Yeon-Ji Yun; Purvish Jajal

11:20 Odiff: Differential Testing of ONNX Model Converters
540 *Anusha Sarraf†*
Mentor(s): James Davis; Purvish Jajal

11:40 Characterizing Long-Term Degradation of Plastic Packaging in the Low Earth Environment
541 *Luke Fortner†*
Mentor(s): Muhammad Alam; Md. Asaduz Zaman Mamun

ROOM: GRISSOM 134

11:00 Matrix Addressing of Thermal Actuator Arrays
542 *Justin Rodriguez†; Jalal Ahmad Farooka**
Mentor(s): Alex Chortos; Jue Wang; Mina Lee

11:20 Design and Manufacture of Magnetically Responsive Membranes for Tissue Testing
543 *Seungbin Kwon†*
Mentor(s): Andres F. Arrieta; Katherine S. Riley; Laura Alvarez; Adrian Buganza Tepole; Craig Goergen

11:40 High-Performance Self-Cleaning Radiative Cooling Paint for Reducing Air Conditioning Energy Usage
544 *Katherine Raykova†*
Mentor(s): Xiulin Ruan; Emily Barber

SESSION 4: 12:00PM-1:00PM

ROOM: GRISSOM 126

12:00 Nanoscale Characterization of the Effect of Raloxifene on Human Bone
545 *William Bush†*
Mentor(s): Thomas Siegmund; Elizabeth Montagnino; John Howarter

ROOM: GRISSOM 133

12:00 Investigation of Space Radiation Doses in Satellite Orbits
546 *Ishaan Rao†; Cole Lush**
Mentor(s): Peter Bermel; Sayan Roy

ROOM: GRISSOM 134

12:00 Cognitive State Modeling of Human Machine Interactions in a Level II Driving Simulator
547 *Xipeng Wang†*
Mentor(s): Neera Jain; Sibibalan Jeevanandam; Michael Williamson Tabango

SESSION 5: 1:00PM-2:00PM

ROOM: GRISSOM 118

1:00 Identifying Spatial Patterns Between Agricultural Land Use And Decline In Domestic Honey Production In The
548 United States
Ahnaf Talukder†
Mentor(s): Dharmendra Saraswat

1:20 Estimation of optimal flush times and heat removal rates for sow cooling pads, aluminum vs. stainless steel
549 *Jemima Baributsa†*
Mentor(s): Allan Schinckel; Bob Stwalley

1:40 Is Water Infrastructure Racially Biased? An Investigation into The Presence of Ongoing Tap Water Safety
550 Violations in Communities of Color
John Woodruff†
Mentor(s): Dharmendra Saraswat

ROOM: GRISSOM 125

1:00 Towards a Foundational Self-Supervised Model for Cardiac Magnetic Resonance Segmentation
551 *Sarthak Mangla†*
Mentor(s): Craig Goergen; Conner Earl; Guang Lin

1:20 Performance Evaluation and Thermal Management Solutions for a Sustainable Microsized Hydrogen-Powered
552 Turbo-Shaft Engine
*Nikolai Baranov†; Smit Kapadia**
Mentor(s): Li Qiao; Holman Lau

1:40 Validation of Inter-Scan Variance of Three-Dimensional Ultrashort Echo Time Rosette k-space Trajectory
553 23Na MRI Technique
Nicholas Buffo†
Mentor(s): Deva Chan

ROOM: GRISSOM 126

1:40 Point-of-care imaging device for pathogen detection from color-based nucleic acid amplification
554 *Skyler Campbell†*
Mentor(s): Mohit Verma; Jiangshan Wang; Bibek Raut

ROOM: GRISSOM 133

1:40 Seismic Cracking of Embankments and Earth Dams
555 *Jingqing Liu†*
Mentor(s): Antonio Bobet; Juan Jimenez

ROOM: GRISSOM 134

1:40 Investigating the Effects of Biomaterial Porosity on Muscle Remodeling and Functional Recovery after
556 Volumetric Muscle Injury in Mice
Gabrielle Tanner†
Mentor(s): Taimoor Qazi

SESSION 6: 2:00PM-3:00PM

ROOM: GRISSOM 118

2:00 Organocatalytic Decrosslinking of Formalin-Fixed Proteins
557 *Amanda Marchi†*
Mentor(s): Bryon Drown; Jacob Seay

2:20 Understanding Livability Through Property Condition Surveys in the Hanna Neighborhood
558 *Kevin Potthast†; Jennifer Yang†; Andy Kim**
Mentor(s): Jason Ware

2:40 VP40 Mutants Characterization
559 *Sam Eger†; Anna Kendrick*; Valentina Toro Ramirez*; Manuel Torres**
Mentor(s): Rob Stahelin

ROOM: GRISSOM 125

2:00 3D Printed Assistive Devices for Independent Biomedical Laboratory Work for Individuals with Limited Manual
560 Dexterity and Strength
*David Botana†; Shaiv Mehra**
Mentor(s): Bradley Duerstock; Mitchell Sanchez

2:20 Decoding fNIRS Neural Responses: A Machine Learning Approach
561 *Dalton Aaker†*
Mentor(s): Maureen Shader

2:40 Topological Insulators using DFT and NISQ Simulations
562 *Gustavo Sáez Cruz†; Jessica John Britto†*
Mentor(s): Arnab Banerjee; Varadharajan Muruganandam; Sayan Roy; Bishnu Prasad Belbase; KEERTHI KUMARAN ALAGARSAMY MANIKANDAN

ROOM: GRISSOM 126

2:00 Advancing Agricultural Extension & Outreach Through the Development of a Specialized Chatbot
563 *Son Ha†; Jungeun Hwang‡*
Mentor(s): Dharmendra Saraswat; Varun Aggarwal; Aanis Ahmad

2:20 Feasibility of a PTM EV-Based Pipeline for Breast Cancer Subtype Differentiation
564 *Mengting Xu†*
Mentor(s): Andy Tao; Marco Hadisurya

2:40 Effect of Small Arms Fire-like Noise Exposure on the Central Auditory System
565 *Emily Bell†; Andres Navarro‡*
Mentor(s): Ed Bartlett; Meredith Ziliak

ROOM: GRISSOM 133

2:00 **566** Mobility Evolution in the US: Evidence from Electric Vehicle Adoption
Shreejit Poudyal†
Mentor(s): Nadia Gkritza; Prasanna Humagain; Ricardo Chahine

2:20 **567** Deep Learning-based Classification of Trust in Future Construction Sites Using Neuro-Psychophysiological Measurements
Nestor Felipe Gonzalez Garcia†
Mentor(s): Sogand Hasanzadeh; Woei-Chyi Chang

2:40 **568** Biofilm Impact on Absorbed Contaminants on Microplastics and Drinking Water Safety
*Hannah Tharrington†; Catherine Fleming**
Mentor(s): Paula Coelho; Paula Coelho; Caitlin Proctor

ROOM: GRISSOM 134

2:00 **569** The Mechanical Behaviors of a Confining Extracellular Matrix during Cell Division
Matthew Boyd†
Mentor(s): Tae Yoon Kim; Md Foysal Rabbi

2:20 **570** The Impact of Lactation and Early Weaning on Cardiac Physiology
Charlotte Cleary†
Mentor(s): Craig Goergen; Elnaz Ghajar-Rahimi

2:40 **571** Low-dose isoproterenol administration in the murine mdx model unmasks progression of Duchenne-associated cardiomyopathy
Alyssa Richards†
Mentor(s): Craig Goergen; Conner Earl; Steven Welc; Larry Markham; Mark Kowala

SESSION 7: 3:00PM-4:00PM

ROOM: GRISSOM 118

3:00 **572** Numerical Assessment at Equilibrium of the Binding Between One Ligand and Multiple Targeted Proteins: A Web Based Application
Bobby Estrada†
Mentor(s): Wen Jiang; Xiaoqi Zhang

3:20 **573** Expression and Purification of a DAG Biosensor
Soren Spina†
Mentor(s): Angeline Lyon; Ketaki Mahurkar; Elisabeth Garland-Kuntz

3:40 **574** Structural Insight into SHP-1 Inhibition by M029
Amanda Xu†
Mentor(s): Nick Noinaj; Zhong-Yin Zhang; Evan Billings; Zihan Qu

ROOM: GRISSOM 125

3:00 **575** Effect of IRBIT on Insulin Regulation in Vivo
Gabrielle Bailey†
Mentor(s): Greg Hockerman

3:20 **576** Analyzing Lafayette Northend Livability Through Neighborhood Retention
Andy Kim†; Jennifer Yang; Kevin Potthast**
Mentor(s): Jason Ware

3:40 **577** Organizational Goal Conflict Perception and Implications
Ziqi Yao†; Bhavti Shah; Brandon Krivsky**
Mentor(s): Franki Kung; Zhixu (Rick) Yang

ROOM: GRISSOM 126

3:00 **578** Synthesis and Characterization of a Conductive and Solution-Processable Modified Transparent Conducting Polymer
Matthew Schiavone†
Mentor(s): Jianguo Mei; Mustafa Ahmed

3:20 **579** Two-Photon Excited Fluorescence as a Chiral-Specific Surface Spectroscopy Model
Julia Ku†; Camila Strachan‡; Matthew Wilson‡
Mentor(s): Garth Simpson; Kevin Murati; Gwendylan Turner; Caitlin Dunlap

3:40 Enhancing Air Quality Predictions: Integrating Stable Isotopes and Machine Learning in Atmospheric Models
580 *Anusha Waseem†*
Mentor(s): Greg Michalski

ROOM: GRISSOM 133

3:00 Real-Time VOC Measurement Applications in Disaster Relief
581 *Grayson Wittbrod†*
Mentor(s): Brandon Boor; Nusrat Jung; Jinglin Jiang; Xiaosu Ding

3:20 An Origami-inspired Multi-type Locomotive Planetary Exploration Robot
582 *Aditya Arjun Anibha†; Harrison Booker‡; Ansh Mishra*; Sumaira Khan*; Yuto Tanaka**
Mentor(s): Ran Dai

3:40 Manufacturing and Characterization of Alumina/Thermoplastic Polyurethane Composite for the Production of
583 FFF Filament Used in AM Processes
Joseph Meier†
Mentor(s): Tyler Tallman; Julio Hernandez

ROOM: GRISSOM 134

3:00 Design and preliminary evaluation of an engineered polymerizable type I collagen material as a regenerative
584 vascular patch
Jarrett Fowler†
Mentor(s): Rachel Morrison; Sherry Harbin

3:20 Developing Tuneable Granular Hydrogels with High Porosity for Tissue Engineering Applications
585 *Leia Schiltz†*
Mentor(s): Taimoor Qazi

3:40 Examination of Sex Differences Using 4D Ultrasound Analysis in Murine Models of Myocardial Infarction
586 *Amelya Fox†*
Mentor(s): Craig Goergen; Luke Schepers; Conner Earl

SESSION 8: 4:00PM-5:00PM

ROOM: GRISSOM 118

4:00 Structural and Functional Analysis of Enterovirus D68 VP1 F159V
587 *Alejandra Johnson†*
Mentor(s): Richard Kuhn; Thomas Klose; Jacqueline Anderson

4:20 Measuring single molecule membrane penetrating peptide-lipid interactions using in vitro reconstitution
588 *Emmaleigh Shinno†; Andrew Walke‡*
Mentor(s): Shalini Low-Nam; Andrew Walke; Vinay Menon

4:40 Creating Robust Deep Neural Networks through Human Behavior Alignment
589 *Bharath Anand†*
Mentor(s): Sarada Krithivasan; Michael Lee

ROOM: GRISSOM 125

4:00 Canine necropsy cases with unexplained hemorrhaging: investigation of von Willebrand disease type 1 variant
590 *Rebecca Chenoweth†*
Mentor(s): Kari Ekenstedt

4:20 Thermal performance simulations for HL-CMS Inner Tracker detector components
591 *Yuvraj Chauhan†*
Mentor(s): Andreas Jung; Sushrut Karmarkar; Benjamin Denos

4:40 MetaFAIR: An online sensor metadata visualization and exploration tool for FAIR science
592 *Kayla Xu†*
Mentor(s): Ming Qu; Jaewoo Shin; Dikai Xu

ROOM: GRISSOM 126

4:00 Simulating Realistic Patterns: Image Processing for Zebrafish
593 *Kotekar Annapoorna Prabhu†; Caroline Henson**
Mentor(s): Alexandria Volkening

4:20 Mutation of the Ebola Virus VP40 Protein
594 *Manuel Torres Narvaez†; Samuel Wilson*; Valentina Toro**
Mentor(s): Rob Stahelin

4:40 Quantification of intervertebral disc strain from high-resolution ultrasound imaging during dynamic loading
595 *Diya Sakhrani†*
Mentor(s): Craig Goergen; Elnaz Ghajar-Rahimi

ROOM: GRISSOM 133

4:00 Mimicking Sonographer's Expertise: Learning Robotic Ultrasound using Behaviour Cloning
596 *Byung Wook Kim†; Hyunjun Park‡*
Mentor(s): Deepak Raina; Richard Voyles

4:20 Quenching in Cooking Oils? A Search for Environmentally Friendly and Non-Toxic Quench Oils
597 *Sydney Belk†; Yichu Xu*; Jackson Truitt**
Mentor(s): Jeffrey Youngblood; Michael Titus; Rodrigo Orta; David Johnson

4:40 Low-Temperature Solder Alloying
598 *Hevi (Tash) Medde-Witage†*
Mentor(s): Carol Handwerker; John Blendell; Hannah Fowler; Lijia Xie

ROOM: GRISSOM 134

4:00 Hydrolytically Degradable Granular Hydrogels for Tissue Engineering
599 *Nikki Kulkarni†*
Mentor(s): Taimoor Qazi

4:20 Computational Modeling of the Role of Ca2+ Flux Frequency Decoding by Calmodulin and CaMKII Role on
600 Actin Polymerization Dynamics and Dendritic Spine Morphology
Shiv Shukla†
Mentor(s): Tamara Kinzer-Ursem; Barrett Davis

4:40 Spatial Localization of Proteins in Structural Homeostatic Plasticity
601 *Ethan John†*
Mentor(s): Tamara Kinzer-Ursem; Eugene Kim

Research Talk Presentation Abstract Number: 500
Presentation Time: 7/27, GRIS 118 at 9:00am-9:20am

SCARF or MASI

To house or to oust: How honey bee workers evaluate male quality

Author(s):

Isabelle Gilchrist† (Agriculture)

Abstract:

Reproductive division of labor is a key feature of the evolution of eusociality. It results in a workforce of generally non-reproductive individuals that undertake the majority of the labor involved in colony growth, defense, and maintenance. The fitness of these workers is derived indirectly through the reproductive caste. In honey bees, Apis mellifera, the reproductives are known as queens (female) and drones (male). As in other eusocial species, workers are able to assess the reproductive quality of their queen. If she is infected by a pathogen or her reproductive output falters, she is replaced. Much less is known about how workers assess male reproductives. Mating occurs outside the hive, yet incoming drones are accepted into a colony despite their significant drain on resources. How do workers decide which drones to accept and care for and which to evict? Here, I determined how and whether workers gauge the quality of drones introduced into their colony. I reared drones of different age categories and induced an immune response using lipopolysaccharide injection to produce drones of varying quality. Each treatment group was sampled for semen analysis, cuticular hydrocarbon profiling, and acceptance into test colonies. Marked drones were introduced to test colonies where both initial acceptance and retention after 24 hours was recorded. My experiment provides foundational new insights into how non-reproductive members of eusocial colonies are able to assess male reproductive quality and use that information to optimize their own indirect fitness.

Keyword(s):

Nestmate Recognition, Reproductive Quality, Insect Behavior, Honey Bee Drones, Cuticular Hydrocarbons

Mentor(s):

Brock Harpur (Agriculture); Matthew Ginzel (Agriculture); Jonathan Nixon (Agriculture); Alex Pasternak (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 501
Presentation Time: 7/27, GRIS 118 at 9:20am-9:40am

SCARF or MASI

Effect of Postmortem Aging on Water-Holding Capacity and Reabsorption Capability of Beef Longissimus Lumborum Muscle

Author(s):

Varisra Upatising† (Agriculture)

Abstract:

Water-holding capacity (WHC) is the ability of meat to retain moisture and resist water loss from protein denaturation or physical damage. Postmortem aging is a widely adopted post-harvest practice in the meat industry to improve tenderness. While the mechanism by which aging improves tenderness is well-understood, the relationship between WHC and postmortem aging is not fully established. Therefore, the purpose of this study was to investigate the effect of aging on the WHC and reabsorption capability of beef loins.

Strip loins (M. longissimus lumborum; n=60) were collected from both carcass sides from 30 USDA. Top Choice grade beef carcasses at two days postmortem. The loins were divided into four groups, and randomly assigned to different postmortem aging times (2, 7, 14, or 21d). After each assigned aging time, the beef samples underwent compression and centrifugal drip loss to determine WHC. Chemical assays including pH, MFI, and protein solubility were conducted. The statistical analysis was performed by mixed model using SAS software (SAS 9.4, Cary, NC, USA) with a significance level of 0.05.

Compression drip loss and centrifugal drip loss of fresh meat were the highest at 2d (p<0.05), and there was no difference between 7d, 14d, and 21d (p>0.05). Compression and centrifugal drip loss of rehydrated beef samples decreased with aging time (p<0.05). The results of this study showed that postmortem aging could improve the WHC and reabsorption capability of meat. Further trials investigating the underlying mechanisms by which postmortem aging would improve reabsorption capability of muscles will be warranted.

Keyword(s):

Beef, Postmortem Aging, Water-Holding Capacity, Reabsorption Capability

Mentor(s):

Brad Kim (Agriculture); Jin-Kyu Seo (Agriculture); Madison Romanyk (Agriculture); Saud Ur Rehman (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 502
Presentation Time: 7/27, GRIS 118 at 9:40am-10:00am

SCARF or MASI

Investigating the role of LETMD1 in mitochondrial protein transport and translocation

Author(s):

Charles Thrift† (Agriculture)

Abstract:

Within the global population, obesity and metabolic disorders resulting from excess energy are becoming increasingly common. Brown adipose tissue (BAT) mitochondria have the unique ability to conduct non-shivering thermogenesis and dissipate energy as heat, thus promoting energy expenditure. Our research explores the function of LETM1-domain containing 1 (LETMD1), a novel mitochondrial inner membrane protein within BAT. We generated a brown adipocyte-specific (Letmd1UKO) mouse model, which resulted in striking phenotypic differences within Letmd1UKO mice, including whitened BAT, increased lipid droplet accumulation, and loss of normal mitochondria structure and cristae arrangement. To understand how LETMD1 works at the molecular level, we have recently performed TurboID proximity labeling to determine potential interaction partners of LETMD1. This SCARF project aims to validate some of the interactions as well as to further characterize the mutant phenotypes. Determining the role of LETMD1 for BAT thermogenesis, mitochondria structure, and function will increase BAT characterization and potentially lead to therapeutic targets for combatting obesity and metabolic disorders.

Keyword(s):

Brown Adipose Tissue, Knockout, LETMD1, Protein Transport, Protein Transolcation

Mentor(s):

Shihuan Kuang (Agriculture); Madigan Snyder (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 503
Presentation Time: 7/27, GRIS 125 at 9:00am-9:20am

Manufacturing and Characterization of Flexible Resistive Tensile Force Sensor with Carbon-Fiber Mesh and Silicone

Author(s):

Harry Lee† (Engineering, JMHC)

Abstract:

Wearable technologies seamlessly merge the digital and the physical world and have become widely used in industries such as entertainment, sports, military, healthcare, and security. With the growing popularity of wearable devices, flexible sensors play a crucial role in user interaction with technology. In this study flexible tensile force sensors were manufactured by impregnating different long carbon fiber patterns with silicone rubber. The manufacturing method of the sensors adopts the wet layup and vacuum bagging process of thermoset composite manufacturing techniques, resulting in a fast and cost-effective production method. Because carbon fiber is electrically conductive and silicone is not conductive, the stretching of the silicone between the fibers during tensile stretching changed the electrical resistance of the sensors. A Carbon fiber plain weave ply at 45-degree angle and segmented carbon fiber plain weave plies at 45-degree angle were the two patterns impregnated with silicone. The relationships between the tensile load and electrical resistance were characterized for each sensor. Additionally, the ultimate strength, elastic modulus, and fatigue resistance were also determined. The combination of cheaper manufacturing and improved durability due to the strength of carbon fiber will not only fuel the increasing demand of wearable technology, but also broaden the application of flexible sensors for harsher environments.

Keyword(s):

Advanced Composites, Soft Robotics, Sensors, Carbon Fiber, Elastomer

Mentor(s):

Garam Kim (Polytechnic Institute); Eduardo Barocio (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 504
Presentation Time: 7/27, GRIS 125 at 9:20am-9:40am

Colombian Research Scholars Program

Bond performance of post-installed GFRP rebars in concrete

Author(s):

Daniel Santamaria† (Graduate)

Abstract:

Post-installed connections play a vital role in securely fastening various elements to existing concrete structural elements, such as columns, beams, walls, and other load-bearing components. In the past, various types of fastening systems such as post-installed reinforcing steel bars, bonded anchors, or expansion anchors have been investigated. Another system that has drawn attention is the use of Glass Fiber Reinforced Polymer (GFRP). Advantageous properties like non-corrosive nature, high tensile strength, and lightweight properties favor the use of GFRP.

Most studies so far investigated the capacity of post-installed GFRP bars located away from the edge. However, in real life application, the edge distance can be relatively small. This research work aims to obtain more insight into the behavior of post-installed GFRP bars in concrete with the focus on the edge distance of the bar.

This presentation shows the experimental results of a test on the behavior of post-installed GFRP bars in concrete subjected to tension. The GFRP bars were post-installed into the concrete using high-strength epoxy mortar after standardized cleaning of the borehole. This study focused on the influence of the edge distance on the pull-out capacity of the bar, which failed either due to pull-out or splitting of concrete.

The results show that the edge distance significantly affects both capacity and failure mode of the GFRP bar. While a pull-out failure was observed in cases where the GFRP was located away from the edge, premature concrete splitting occurred with relatively small edge distance.

Keyword(s):

Anchorages, Reinforcement, Concrete, GFRP

Mentor(s):

Akanshu Sharma (Engineering); Deepak Suthar (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 505
Presentation Time: 7/27, GRIS 125 at 9:40am-10:00am

Biochemistry REU

Better Safe Than Sorry: Preventing the next pandemic by studying newly emerging coronaviruses

Author(s):

Misa Meadows† (Belhaven University)

Abstract:

The effects of the Covid-19 global pandemic caused by the betacoronavirus, SARS-CoV-2, has emphasized the importance of studying newly emerging coronaviruses that could potentially cause further pandemics. The recent emergence of CCoV-HuPn-2018 (CCoV), a human-infecting canine coronavirus, was detected in patients with pneumonia in Malaysia, identifying CCoV as a zoonotic virus. Upon sequencing, the novel CCoV was classified as an alphacoronavirus, similar to other animal-infecting coronaviruses such as the feline infectious peritonitis virus (FIPV), which infects cats.

Coronaviruses are single-stranded positive RNA viruses that translate their genome into two large polypeptides, pp1a and pp1ab. The 3-Chymotrypsin-like protease (3CLpro) is responsible for cleaving these polypeptides at eleven sites to form smaller, non-structural proteins that are essential for viral replication. The importance of the 3CLpro and its conservation amongst various coronaviral genera make it an attractive drug target.

The objective of our study is to repurpose small molecule inhibitors designed against SARS-CoV-2 in efforts to establish broad-spectrum inhibition against alphacoronaviruses CCoV and FIPV. In this study, we use a fluorescent-based peptidomimetic substrate to characterize and compare the 3CLpro enzymatic properties. We further performed Structure Activity Relationship (SAR) studies to identify characteristics of the inhibitors contributing to broad-spectrum efficacy. To understand how the identified inhibitors affect the stability of the protein, the melting temperatures of the 3CLpros bound to these inhibitors were quantified using Differential Scanning Fluorimetry (DSF). Together, this study provides valuable information for the future development of broad spectrum inhibitors against various coronaviral genera.

Keyword(s):

Coronavirus, CCoV-HuPn-2018, Small Molecule Inhibitors, Structure Activity Relationship, 3 Chymotrypsin-Like Protease

Mentor(s):

Andrew Mesecar (Agriculture); Uttara Jayashankar (Science); Sydney Beechboard (Agriculture); Emma Lendy (Agriculture); Arun Ghosh (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 506
Presentation Time: 7/27, GRIS 126 at 9:00am-9:20am

SURF

The Impact of Print Geometries on Directionality of an Explosive

Author(s):

Jack Martin† (Engineering, JMHC)

Abstract:

With the use of Vibration Assisted Printing (VAP), printing can be done at much higher speeds in more complex geometries that could enhance the range of tailorability among high solids loading materials. This project studied different inline and offset print geometries at two infill percentages to understand the impact on detonation shock front velocity using an RDX-based explosive. Four different print orientations—0° inline, 0° offset, 45° inline, and 45° crosshatch —were analyzed. Detonation testing was performed on all the samples and the tests were imaged with ultra highspeed imaging to determine the effects of printing on detonation propagation. The test results showed jetting behavior of the shock front specifically along channels (inline) in between RDX explosive print beads that inhibited detonation propagation. This jetting was not observed in cross-grain samples. Gaps in material (low print infill) combined with the orientation of the print led to more polarizing detonation velocity.

Keyword(s):

Additive Manufacturing, Detonation, Shock Physics

Mentor(s):

Diane Collard (Engineering); Steven Son (Engineering); Gabriel Montoya (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 507
Presentation Time: 7/27, GRIS 126 at 9:20am-9:40am

SURF

Design and synthesis of novel pyridine-based conjugated ligands for 2D perovskite formation and improved solar cell efficiency

Author(s):

Aline Kruger† (Drew University)

Abstract:

Perovskites are structures composed of a general ABX3 lattice, in which the A and B sites are traditionally metal cations, while the X is an anion. Lead halide perovskite materials, however, incorporate an organic ligand at their A site, creating a new class of hybrid organic-inorganic perovskites that are known for their ability to harvest sunlight into electricity. Hence, they have recently become promising candidates for solar cell applications. One major area of research focuses on the substitution of different A-site organic ligands to optimize perovskite power conversion efficiency (PCE) while also probing other challenges, such as susceptibility to environmental degradation and prolonged moisture exposure that limit hybrid perovskite application in real-world solar cell panels. In this research, a series of novel pyridine-based ligands was synthesized to address these issues. Thin films were also prepared and characterized by X-ray diffraction, UV-Vis, and photoluminescence spectra. The UV-Vis absorption spectra display new excitonic peaks, indicating that 2D hybrid perovskites were formed with pyridine-based ligands, which is in agreement with the X-ray diffraction patterns and photoluminescence spectra obtained. In addition, solar cell devices were built and their PCEs fall between 15 - 20.2 per cent. These results indicate that the pyridine-based ligands are tolerated in the lattice and that formation of desired hybrid 2D perovskites is observed. These new derivatives contribute to the expansion of the ligand library available for 2D perovskites and to the search for the best efficiency of solar cell devices employing this new organic-inorganic class of materials.

Keyword(s):

2D Perovskites, Thin Films, Ligand Design, Semiconductors

Mentor(s):

Letian Dou (Engineering); Jiaonan Sun (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 508
Presentation Time: 7/27, GRIS 126 at 9:40am-10:00am

SURF

The Effect of the Rotor Screen Gap on Granule and Tablet Properties in a Dry Granulation Line

Author(s):

Jayden Pierce† (Engineering, Liberal Arts); Dhruv Mendpara* (Engineering)

Abstract:

Dry granulation is a common method used in the pharmaceutical industry to create granules from powders to improve flowability and content uniformity. The powders are first fed into the roller compactor (RC) to produce granules, which are further compressed in the tablet press (TP) to form tablets. The effects of several RC control variables (CV) such as roll pressure on granule properties, tableting critical process parameters (CPPs) and tablet critical quality attributes (CQAs) are well documented. However, the effects of other RC CVs are not well understood. This paper investigates the relationship between a novel CV in the RC, the rotor screen gap (RSG), on granule properties and several tablet CQAs such as tablet density and tensile strength. Two KTron feeders are separately charged with pure acetaminophen (APAP) and microcrystalline cellulose (MCC PH-102) PH-102 with feedrates of 1 kg/hr and 9 kg/hr respectively to create a 10% APAP 90% MCC PH-102 blend. The KTron feeders feed the powders into a continuous blender and then into the RC. The RSG is varied at 6 different gaps, each at 30-bar and 60-bar hydraulic pressure. The granules produced by the RC are fed into the TP to create tablets. Granule properties are characterized using the Canty SolidSizer and tablet CQAs using the Sotax AT4. Preliminary results reveal that the RSG appears to affect bulk density and granule size distribution, but the trend is unclear. Additionally, experiments must be performed to understand the relationship between the RSG and tablet CQAs.

Keyword(s):

Continuous Manufacturing, Dry Granulation, Rotor Screen Gap, Tensile Strength, Granule Size Distribution

Mentor(s):

Rex Reklaitis (Engineering); Yan-Shu Huang (Engineering); Sunidhi Bachawala (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 509
Presentation Time: 7/27, GRIS 133 at 9:00am-9:20am

SURF

Finding Cybersecurity vulnerabilities in Embedded/IoT systems

Author(s):

Parth Doshi† (Engineering); Ricardo Andres Calvome Mendez‡ (Engineering); Kyle Robinson‡ (Engineering)

Abstract:

Embedded Network Stacks (ENS) enable interaction between software and physical devices. They enable seamless communication and ensure reliable data transmission. Several flaws found in ENS can pose high-severity cybersecurity risks. These are remotely triggerable and can impact the physical world, highlighting the significance of testing ENS to detect and address these vulnerabilities. Although previous research has provided insights into the characteristics of defects in various types of software systems, there is a gap in the literature regarding the properties of known defects specifically in ENS, and an easy method of integrating more ENS to be tested. This paper highlights a systematic testing framework and a portability layer that facilitates an easier integration of other ENS – Zephyr, Linux, to be tested and analyzed. The development of a portability layer facilitates testing of a larger number of ENS enabling identification of vulnerabilities across diverse ENS systems. Most of these defects, primarily concentrated in two specific layers of the network stack, can be triggered by modifying just one or two fields within a single packet to produce testing scripts. To verify the effectiveness of the scripts we generated, a unit testing approach was developed that evaluated each functionality individually. Our results concluded 90% line coverage evaluating the effectiveness of the unit testing approach. Additionally, the portability layer was examined by integrating two additional Network Stacks and verifying the correctness of its functionality. Implementation of this layer reduced source code for the system call functions by 150 lines on an average per ENS.

Keyword(s):

Cybersecurity, Embedded Network Stacks, Vulnerabilities, Portability Layer, Unit Testing

Mentor(s):

James Davis (Engineering); Paschal Amusuo (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 510
Presentation Time: 7/27, GRIS 133 at 9:20am-9:40am

SCALE,SURF

Investigation into Alternative Radiation Hardened Photovoltaic Materials for Planetary Missions

Author(s):

Cole Lush† (Engineering, JMHC); Ishaan Rao* (Engineering, JMHC)

Abstract:

In outer space, the survivability of photovoltaic cells critically impacts the success of long-term missions, by ensuring that enough power is always available to run computations, operate equipment, and collect data. Ionizing radiation is a key factor that can degrade the performance of space photovoltaics, but different environments can have variable effects on different photovoltaic cells, making a predictive understanding of performance in targeted environments highly complex yet consequential. Conventional photovoltaic systems rely on production methods and materials which have been in use for decades, but also can prove insufficient in terms of their efficiency and adequate resistance to the space radiation environment. Furthermore, including radiation shielding can make the launch cost prohibitive. Thus, a preferred approach is to identify materials with greater inherent radiation tolerance. To address this need, this study aims to identify lightweight, cost-effective, radiation-hardened alternatives to currently operating photovoltaic systems. Focusing on the nonionizing energy loss of different materials, the SR-NIEL 7 tool was used to simulate different materials and their reactions to different particles and doses. This data was then used in the OMERE 5.6 tool to effectively simulate a mission in geosynchronous orbit (GEO) as a reference and better understand the structural defects produced via displacement damage. The results describe which photovoltaic materials are projected to perform well in certain particle environments. This information could provide potential insight into which materials could be further considered for study, specifically focusing on the feasibility of implementing such materials into actual space systems.

Keyword(s):

Displacement Damage Modeling, Nonionizing Energy Loss, Photovoltaics, Radiation Hardened Nanoelectronics, Radiation Resistance

Mentor(s):

Peter Bermel (Engineering); Sayan Roy (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 511
Presentation Time: 7/27, GRIS 133 at 9:40am-10:00am

SURF

Relation of Decentralized Network Architectures to Adversarial Attacks Centrality in Federated Learning

Author(s):

Adam Piaseczny† (Engineering)

Abstract:

As the popularity of federated learning grows, new frameworks for decentralized settings are becoming widespread. By leveraging the advantages of environments without centralized coordinators they allow for fast and energy-efficient inter-client communication. However, these advancements also pose new security challenges, particularly in settings where malicious agents may interfere with the learning process. This paper investigates these security implications. We examine how different node centralities affect the potency of attacks in fully decentralized settings over various real-world and synthetic random directed graphs. Using established decentralized aggregation frameworks, we explore the relationship between the decrease in testing accuracy, optimality gap, convergence rate and attacks on the top-k most central nodes based on different centrality measures. We then look at how the adversarial distortion spread, and convergence rates are affected by various malicious agent eigenvector centralities. The results of this investigation will provide valuable insights into the spread of model alteration in distributed learning environments, a critical aspect of mitigating the impact of malicious interference in Federated Learning. The results also lay the groundwork for potential future work in the detection and identification of malicious interference, which would contribute to the development of more secure federated Learning frameworks.

Keyword(s):

Machine Learning, Federated Learning, Networks, Adversarial, Centrality

Mentor(s):

Christopher Brinton (Engineering); Rohit Parasnis (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 512
Presentation Time: 7/27, GRIS 134 at 9:00am-9:20am

SURF

Development and Investigation of Load-Based Testing Methodology for HVAC Systems

Author(s):

Seyed Kiarash Mossalaei† (Engineering)

Abstract:

In the United States, 40% of the total energy is consumed by commercial and residential buildings, of which cooling and heating account for a significant portion. Improving heating, ventilation, and air conditioning (HVAC) systems' energy efficiency is imperative for sustainability and decarbonization. The current HVAC systems testing methodologies, e.g., AHRI 210/240, lacks procedures to account for various components of modern equipment such as economizer, variability of fan speeds, and the manufacturer's native controls in the performance rating. Developing an improved testing methodology measuring the overall performance of equipment is key in improving HVAC systems performance, as it motivates manufacturers to develop energy-efficient products. The load-based testing methodology aims to achieve this goal by assessing the overall performance of HVAC systems with their integrated controls using a virtual building model. For a rooftop unit (RTU), the load-based methodology uses two psychrometric chambers allowing the integrated controls to naturally react to the dynamic changes of temperature and moisture emulated by a virtual building model. A closed-looped apparatus (CLA) is being developed for testing residential units mimicking the function of the psychometric room for the indoor unit while the outdoor unit is set up in a psychrometric chamber. The CLA will allow testing of multiple units simultaneously, reducing the overall testing time. A thermostat environment emulator (TEE) was constructed to improve the reproducibility of the methodology at different labs by providing a controlled environment for the thermostat. This study investigates load-based testing methodology for residential and commercial equipment for further assessment and improvement.

Keyword(s):

Load-Based Methodology, Thermostat Environment Emulator, Closed-Looped Apparatus, Testing and Rating Methodology

Mentor(s):

Jim Braun (Engineering); Parveen Dhillion (Engineering); Do Hyeon Kim (Engineering); Jie Ma (Engineering); W. Travis Horton (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 513
Presentation Time: 7/27, GRIS 134 at 9:20am-9:40am

SURF

Air purification technologies for HVAC systems to reduce Indoor bioaerosol concentration

Author(s):

Youyi Zhou† (Engineering, JMHC)

Abstract:

Indoor air quality because of the presence of bioaerosols has long been a concern, which has been further heightened by the Covid-19 pandemic. Improving indoor air quality requires novel purification technologies to remove these bioaerosols. This study focuses on investigating photocatalytic oxidation and acoustic technologies to reduce bioaerosol concentration by combining them with heating, ventilation, and air conditioning systems (HVAC). The deposition of bioaerosols is critical for both technologies, and the particle diameter in the range of 100nm to 300 nm is the most difficult to capture. Bioaerosol diameters and airflow conditions govern the deposition of aerosols on surfaces within HVAC ducts. In this work, both simulations and experiments are performed to investigate deposition for particle sizes ranging from 100nm to 300nm. Lagrangian particle track code is developed to analyze the deposition efficiency in a duct-based geometry. Particle size distribution measurements of aerosolized 200 nm polystyrene latex particles performed inside a HVAC duct. The results showed that aerosolized polystyrene latex particles had a geometric mean of 115.16 nm and a geometric stand deviation of 2.12. This result is important to understand the deposition behavior experimentally.

Keyword(s):

Air Purification, HVAC, Photocatalysis, Indoor Air Quality, Photocatalytic Oxidation

Mentor(s):

David Warsinger (Engineering); Sudharshan Anandan (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 514
Presentation Time: 7/27, GRIS 134 at 9:40am-10:00am

SURF

Predictive Models for Projection Printing of Nanoscale 3D Structures

Author(s):

Rohit Jammula† (Engineering)

Abstract:

The ability to 3D-print nanoscale objects has lead to innovations in fields as diverse as microfluidics, electronics, and medicine. A particularly scalable process involves projection printing with two-photon polymerization. By using a digital micro-mirror device to focus specified patterns of light through a polymer, one can induce chemical reactions in a sheet of highly localized volumes to rapidly print the desired layer. Precise, nanoscale 3D structures result from altering the pattern at each layer and vertically adjusting the printing stage. Unfortunately, owing to extraneous physical factors, the resultant print often deviates from the intended pattern described by the incident light. Thus, we attempt to build predictive models relating the input light pattern and output structure, investigating both partial and complete pattern representations. Small-scale models such as Gaussian Random Processes are computationally efficient for partial parametrizations, though their inability to capture all facets of a pattern necessitates an accurate understanding of print deformation effects. On the other hand, convolutional neural networks are more computationally intensive but can capture the more robust spatial information inherent in multimodal, full-image representations.

Keyword(s):

Two-Photon Polymerization, Projection Printing, Gaussian Random Process, Convolutional Neural Network

Mentor(s):

Xianfan Xu (Engineering); Jason Johnson (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 515
Presentation Time: 7/27, GRIS 118 at 10:00am-10:20am

SCARF or MASI

Investigating Wetland Methane Emissions: Development and Application of Low-Cost Platforms for Automated Gas Flux Systems

Author(s):

Anya Emerson† (Engineering)

Abstract:

Wetlands provide benefits including nutrient retention and removal. Yet, one negative impact of wetlands is the production of methane (a greenhouse gas). The primary drivers of wetland methane release (flux) to the atmosphere are still being determined because of variability across systems and a lack of sufficient volumes of high-quality data. Current methods of recording methane fluxes from aquatic systems have a limited range of collection time due to short battery life and supervision of expensive equipment.

Accurate, low-cost sensor measurement systems exist; however, the assembly and programming in field-based studies requires considerable technical knowledge. Further, completely automated gas flux monitoring devices are not available using low-cost platforms.

This project aimed to develop, test, and utilize an environmental monitoring system emulating other methane flux chambers that maintain their low-cost and accuracy, while additionally requiring minimal technical skills. We utilized our monitoring system to collect methane data of a depressional wetland with high spatial and temporal resolution.

Our system uses open-source hardware and software developed with the nonprofit organization River Restoration Intelligence and Verification (RRIV). The flux chambers consist of an inverted 5 gallon bucket and rechargeable D-cell batteries. Data was collected using Figaro NGM2611-E13 methane sensors and AHT20 humidity and temperature sensors, for calibration.

Our data show a high degree of replicability across devices, indicating that gas fluxes are being captured accurately. We collected methane gas flux estimates across a depressional wetland at the Purdue Wildlife Area. We found that methane fluxes varied time of day, temperature, and water depth.

Keyword(s):

Methane, Open-Source, Wetlands, Gas Flux, Sensors

Mentor(s):

Jake Hosen (Agriculture); Zaven Arra (River Restoration Intelligence and Verification Organization (RRIV)); Ken Chong (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 516
Presentation Time: 7/27, GRIS 118 at 10:20am-10:40am

SCARF or MASI

Bioinformatic analysis of Fumarase and its Role in DNA Stress Response to identify functional pathways

Author(s):

Thomas Sheeley† (Agriculture)

Abstract:

Redacted.

Keyword(s):

Fumarase, DNA Repair, DNA Replication, Stall Forks

Mentor(s):

Ann Kirchmaier (Agriculture); Ronard Kwizera (Agriculture); Harish Kothandaraman (Purdue University); Nadia Atallah Lanman (Veterinary Medicine)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 517
Presentation Time: 7/27, GRIS 118 at 10:40am-11:00am

Chronic Exposure to Aqueous Film-Forming Foams Leads to Evolutionary Responses in Daphnia magna

Author(s):

Jack Morehouse† (Science); Sarah Pfisterer* (Agriculture); Connor Adamek* (Agriculture)

Abstract:

Researchers have developed numerous per- and polyfluoroalkyl substances (PFAS)-free aqueous film-forming foam (AFFF) formulations to replace PFAS-containing AFFF for use in fire suppression. Recent research has demonstrated that these replacement formulations are more acutely toxic than the traditional PFAS-containing AFFF. Given their relatively high toxicity, frequent exposure to the formulations could lead to evolutionary responses (i.e. evolved tolerance) in exposed populations. In this study, we examined the effects of chronic exposure to seven AFFF formulations (6 PFAS-free and 1 PFAS-containing) on the evolution of tolerance in Daphnia magna. Following an 84-day exposure to six concentrations of each formulation, we used a series of laboratory lethal concentration (LC50) tests on a subset of zooplankton populations to examine the potential change in tolerance. We found chronic exposure to three AFFF formulations led to a change in tolerance in exposed populations as compared to those with no previous exposure; whereas chronic exposure to AFFF increased the tolerance in two zooplankton populations, exposure resulted in increased sensitivity in a third population. This work is the first to examine evolved responses to AFFF formulations. Furthermore, these results highlight the myriad ecological and evolutionary effects of chronic AFFF exposure, particularly on keystone species in aquatic ecosystems.

Keyword(s):

Zooplankton, Evolved Tolerance, Trophic Cascade, Sublethal Effects, Non-Monotonic Response

Mentor(s):

Jason Hoverman (Agriculture); Devin Jones (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 518
Presentation Time: 7/27, GRIS 125 at 10:00am-10:20am

Identifying Legionella bacteriophages to create a novel treatment for Legionnaires disease.

Author(s):

Ryan Yin†

Abstract:

Chlorine-tolerant and biofilm-related pathogens, an emergent type of waterborne disease, have become a growing issue for the American healthcare system. The C.D.C. estimates about 7.2 million individuals get sick annually, and financial strain totals over 3 billion dollars in direct healthcare costs. Of these new types of diseases, the most immediately concerning are diseases with the highest mortality rates. My research at the Luo Lab focuses on Legionnaires disease, which accounts for about 15% of deaths in this emergent class of pathogen but only consists of less than 1% of reported cases at emergency departments.

Our research aims to discover a phage-related treatment for Legionnaires disease. The methodology in our approach is simple and robust: isolation, exposure, and analysis. Our first goal is to isolate to find a phage that might kill the legionella bacterium. We have searched the places most likely to have the perfect conditions for bacterial propagation: warm and stagnant waters. Once we isolate the phages, we then expose the phages to a prepared bacterium solution. To analyze whether any change has happened, we first quantitatively analyze the appearance of the bacterial solution. If the solution expresses a visual change, we will further analyze the phage contents inside. Although we do not have any conclusive results, a wider socially contracted approach in gathering samples can help us widen our reach and provide more samples to test for anti-legionella phages.

Keyword(s):

Legionnaires Disease, Legionella, Phage, Pathogen

Mentor(s):

Zhao-Qing Luo (Science); Kayla Perri (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 519
Presentation Time: 7/27, GRIS 125 at 10:20am-10:40am

Changes in Heart Function Associated with Increased Sympathetic Nerve Activity During Autonomic Dysreflexia in Rats with Spinal Cord Injury

Author(s):

Molly Dye† (Engineering)

Abstract:

Autonomic dysreflexia (AD) is a condition which may arise after spinal cord injury (SCI) which involves the dysregulation of the autonomic nervous system, leading to episodic hypertension. A noxious stimulus, usually urological, may result in the overreaction of the sympathetic nervous system, raising blood pressure until the stimulus is removed. Skin sympathetic nerve activity (SKNA) is a method used to measure sympathetic nerve activity. SKNA bursting refers to segments in SKNA data which correspond to increased sympathetic nerve activity. We found there is an increase in P wave height, decrease in QRS width and increase in SKNA bursting during AD. The purpose of this study is to test the hypothesis that increased P wave height and decreased QRS width are also associated with increased SKNA bursting. To mimic the onset of AD in humans, Sprague Dawley rats underwent T2/3 high thoracic spinal cord injury surgery to make rodent models susceptible to AD. Radio telemetry devices were implanted in rats to record blood pressure, heart rate, and electrocardiogram (ECG) parameters. Colorectal distension (CRD) was performed to elicit AD, causing at least a 15 mmHg increase in systolic blood pressure. Non-invasive surface electrodes were used to measure SKNA. Integrated SKNA data will be analyzed with a dual threshold algorithm to mark bursting. An unpaired t-test will be used to compare ECG data during SKNA bursting and non-bursting segments.

Keyword(s):

Autonomic Dysreflexia (AD), Spinal Cord Injury (SCI), Sympathetic Nervous System, Skin Sympathetic Nerve Activity (SKNA), Electrocardiogram (ECG)

Mentor(s):

Bradley Duerstock (Engineering); Zada Anderson (Engineering); Mitch Sanchez (Engineering); Thomas Everett (Indiana University)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 520
Presentation Time: 7/27, GRIS 125 at 10:40am-11:00am

Ultra Sensitive 3D Printed Capacitive Pressure Sensor

Author(s):

Mitesh Mylvaganan† (Polytechnic Institute)

Abstract:

In this work, we showcase a highly sensitive capacitive pressure sensors using the hybrid structure of a 3D printed substrate and conducting polymer. The sensor will be small at dimensions of 10mmx10mmx3mm. Capacitive pressure sensors measure changes in electrical capacitance caused by applied pressure. The previous methods of fabricating capacitive pressure sensors currently include mold-based slow or expensive micropatterning methods such as injection molding or Si-based photolithography. In comparison to micropatterning, 3D printing is advantageous in terms of process simplification and efficiency since it excludes the complicated mold-based manufacturing process. The Liquid Crystal Display (LCD)-based vat photopolymerization (VPP) was leveraged to manufacture the pressure sensor's substrate with a high-resolution (x-y resolution of 28.5 um) multiscale pattern. In addition, a nanoscale poly(3,4-ethylenedioxythiophene) (PEDOT) layer is coated on the 3D-printed microstructure pattern using Oxidative chemical vapor deposition(oCVD). OCVD PEDOT was used because of its excellent step coverages, mechanical flexibility, and tunable conductivity. To investigate the effect of dimensional parameters on the sensing performance, porosity of the dielectric layer was controlled from 0.4 to 0.9. The figure of merit performance of pressure sensor such as sensitivity, response time, limit of detection, and linearity range was measured with varying porosity. We hope to produce a fully functional sensor that can be mass manufactured quickly and inexpensively. Sensors of this size and sensitivity have applications in smart watches and medical applications.

Keyword(s):

3D Print, Pressure Sensor, Microstructures

Mentor(s):

Sunghwan Lee (Polytechnic Institute)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 521
Presentation Time: 7/27, GRIS 126 at 10:00am-10:20am

CISTAR,SURF

The Catalytic Performance of Single-Site Indium on Oligomerization and Dehydrogenation Reactions

Author(s):

Matthew C. Gerona† (Rose-Hulman Institute of Technology); Emmanuel Ortiz‡ (University of Delaware)

Abstract:

U.S. shale natural gas reserves are now easily accessible due to the advancement of fracking. These reserves contain significant amounts of natural gas liquids. Due to its intrinsic property of containing lesser impurities compared to other fossil fuels, natural gas has potential to serve as a transition fuel for sustainable energy. The objective is to find new heterogeneous catalyst technology that can convert light olefins to transportation fuels such as gasoline and diesel fuel. It has previously been shown that gallium, zinc, and alumina convert ethylene and propylene to higher molecular weight hydrocarbons through a Lewis acid mechanism. It is hypothesized that other Lewis acid transition and post-transition metals would also be active. In this study, it is shown that single-site indium ions supported on alumina convert olefins to fuel range hydrocarbons. The catalysts were prepared by incipient wetness impregnation and evaluated for the conversion of olefins to higher molecular weight hydrocarbons. Compared to alumina, single-site indium on alumina has a much higher rate of reaction and makes different products. As the percent of indium in the catalyst increases, propylene conversion increases. The results confirm that single-site indium on alumina is catalytic for conversion of olefins to higher molecular weight. The performance of the catalyst will be evaluated to determine reaction kinetics and products under a variety of process conditions of varying temperature and pressure. In addition, the catalyst will be fully characterized to determine if it is a Lewis acid site.

Keyword(s):

Catalysis, Oligomerization, Dehydrogenation, Lewis Acid Catalyst, Indium

Mentor(s):

Jeffrey Miller (Engineering); Ted Taewook Kim (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 522
Presentation Time: 7/27, GRIS 126 at 10:20am-10:40am

SURF

Investigating the Use of Principal Component Analysis as a Tool for Process Monitoring

Author(s):

Adam Georgopoulos† (Engineering)

Abstract:

Continuous manufacturing of pharmaceutical tablets offers more economic and scalable production with improved quality control over traditional batch processes, but this requires adequate process monitoring techniques. Principal component analysis (PCA), a multivariate statistical method, is more commonly used in process monitoring than the simpler univariate statistical process monitoring approach for its robustness and ability to reduce data on a large amount of process variables to only 2 or 3, allowing easier visualization of relationships between them. However, it has not been widely implemented in a pharmaceutical manufacturing setting. This project investigates the use of principal component analysis (PCA) as a means of process monitoring in a dry granulation process, a key step in tablet manufacturing. Dry granulation process data from 15 experiments investigating ribbon splitting in a roller compactor were used to construct plots of all process variables over time. PCA plots for each experiment were also made, accompanied by diagnostics plots showing details of the underlying variable relationships and the PCA model’s goodness of fit. Each experiment required >10 univariate plots to display the data, showing relationships between at most 2 variables at a time. Preliminary PCA plots of each experiment were concise yet captured the variable relationships; a PCA plot of all 15 experiments highlighted discrepancies in process behavior between different experiments, while the univariate method did not. More investigation is being done into how PCA captures differences between startup, steady-state, and shutdown conditions, and the causes behind the distinct regions on the plots of all 15 datasets.

Keyword(s):

Pharmaceutical Tablets, Continuous Manufacturing, Dry Granulation, Principal Component Analysis, Process Monitoring

Mentor(s):

Rex Reklaitis (Engineering); Rexonni Lagare (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 523
Presentation Time: 7/27, GRIS 126 at 10:40am-11:00am

SURF

Electrocatalytic Reduction of Nitrate on Copper Single Crystals

Author(s):

Hannah Oberg† (Engineering)

Abstract:

Large-scale overfertilization of crops elicits major ecological consequences, as runoff ammonia reacts with ground water, poisoning water sources with nitrate, leading to algal blooms that create aquatic dead-zones. Electrocatalytic nitrate reduction has been of specific interest because of its ability to transform nitrate into nitrogen gas. Specifically, this reduction on copper electrodes has drawn special attention due to copper's abundance and low cost regarding its relative activity, however the specific mechanism is not well-understood, preventing commercial use. Polycrystalline copper, Cu(100), Cu(110), and Cu(111) electrodes were studied to understand their respective selectivities and activities. Mass spectrometry data was collected using an in situ Electrochemical Mass Spectrometer (EC-MS) to measure gaseous products. A potential program was used to characterize at which potentials certain products formed, comparing this with charge balances to determine reaction mechanisms. Examining these data sets gives insights into possible non-gaseous products formed and non-faradaic reactions occurring. Inductively coupled plasma optical emissions spectroscopy (ICP-OES) was used to qualitatively determine copper dissolution and relative stability of each copper electrode. Key observations include the formation of gaseous NO on all facets at open circuit potential and significant amounts of N2O formed on Cu(110). Overall, these findings suggest that each facet has specific activities, selectivities, and stabilities at varying potentials. These results have major implications on how metallic configurations yield diverse results; depending on preferred product, the electrode with highest efficiency could be selected. Additionally, this can be applied to nanostructured catalysts when determining size and shape to design efficient nitrate remediation systems.

Keyword(s):

Nitrate Reduction, Copper Single Crystals, Selectivity, Activity

Mentor(s):

Brian Tackett (Engineering); Joseph Heil (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 524
Presentation Time: 7/27, GRIS 133 at 10:00am-10:20am

SURF

Plug-and-Play ADMM: Natural Image Priors Arena

Author(s):

ILo Chen† (Engineering)

Abstract:

It is easy to get bad-quality pictures in everyday life. For example, nonsufficient time of exposure or shaking hands will cause the image to be noisy or blurry. As a result, there have been many different image restoration algorithms using computer vision and have been broadly applied in the camera industries. One well-known study in this area is the Plug-and-Play Alternating Direction Method of Multiplier framework (PnP ADMM) that can restore an imperfect image regardless of the restoration tasks. This PnP ADMM is an iterative method based on an objective function comprising of two terms, image reformation model and natural image prior, that need to be determined. Image reformation model is determined based on the restoration task, and natural image prior can be determined based on personal preferences. There have been multiple natural image priors proposed from hand-crafted to learning-based, but limited studies were done on the pros and cons of them, which makes choosing which prior to use a difficult decision. We compare the computational cost, convergence, accuracy, and robustness for image deblurring task between different natural images priors in our research and provide guidelines on how to select the most efficient natural image prior to PnP ADMM for future applications.

Keyword(s):

Machine Learning, Image Restoration, Deblurring, Unsupervised Learning, Deep Image Prior

Mentor(s):

Qi Guo (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 525
Presentation Time: 7/27, GRIS 133 at 10:20am-10:40am

SURF

Development and Application of a Generalized Flapping Wing Vehicle Simulation Package

Author(s):

Darin Tsai† (Engineering, Science)

Abstract:

In aerial robotics, propeller drones rose to popularity for their simplicity in dynamics and ease of control. However, its capabilities fall short to flapping wing vehicles (FWV) in areas of flight safety, maneuverability, and better adaptability to unknown environments. In contrast to propeller drones' wide range of support software, the complicated dynamics of FWVs often hinder the development of fundamental packages that serve as a baseline for critical features such as automated control and trajectory optimization. This inherent engineering challenge incentivized this study's creation of open-sourced Generalized Robo-Aerial Simulation Setup (GRASS), an open-source package platform for underactuated FWV systems, which have fewer control inputs than their degrees-of-freedom. GRASS lowers the difficulties of entrance into this field by assisting researchers in developing and testing FWVs with minimal resources required. It's an all-encompassing software that integrates complex 3D models, tuneable flapping aerodynamics, and control, enabling researchers to leverage the ever-decreasing computational cost to their advantage. GRASS is written in C++ and Python with a workflow that allows user import of 3D models for simulation in Gazebo, a 3D dynamic simulator. Additionally, bidirectional communication between Gazebo and ROS2, a robot software toolkit, is implemented to isolate control, data collection, and analysis, while simultaneously enabling robot hardware testing. Incorporating the blade element method into GRASS, a 10-degree-of-freedom FWV with simple control and real-time data streaming is simulated with the goal of achieving autonomous hovering. GRASS serves as a comprehensive strategy for the fusion of multi-disciplinary subteams, streamlining the continuous integration and development of FWV.

Keyword(s):

Aerial Robotics, Flapping Wing Vehicles, Simulation Platform, Underactuated Systems, ROS2 Ignition Gazebo

Mentor(s):

Patrick Hyun (Engineering); Shijun Zhou (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 526
Presentation Time: 7/27, GRIS 133 at 10:40am-11:00am

SURF

Coherent Light Optical Haptic Sensor for Robotic Tactile Sensing

Author(s):

Guo Yu† (Engineering)

Abstract:

One major challenge robots face is their lack of tactile perception. This limitation increases the risk of breaking fragile objects and makes it difficult for robots to detect slipping movements and adjust their gripping force. To alleviate this limitation, this research aims to develop a vision-based haptic sensor that can provide robots with valuable information about the objects they hold. The initial phase of research is simulating the interaction between a coherent light source and the surface deformation of a box. The shape of the deformation was parameterized using sinusoidal basis functions, and the intensity difference opposite of the light source was collected. This data was used to train a machine learning (ML) model to predict the basis parameterization given an intensity change. Simulation results indicate that it is feasible to extract the shape information from the intensity change. A physical prototype was designed to mimic the simulated system. Laser light was reflected within a sensing cavity and the intensity pattern was captured as an image using a standard CMOS camera. The sensing cavity is composed of a deformable gel (elastomer) surrounded by a reflective film. Utilizing photometric stereo, training samples for various surface deformations can be collected, and a ML algorithm can be trained to predict the surface shape based on change in intensity pattern. This research tackles the challenge of tactile sensing in robotics by designing a vision-based haptic sensor. Further improvements include making the sensor small enough to be mounted on the fingertip of a robot.

Keyword(s):

Robotics, Machine Learning, Sensors & Microsystems

Mentor(s):

Qi Guo (Engineering); Charles Brookshire (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 527
Presentation Time: 7/27, GRIS 134 at 10:00am-10:20am

SURF

Personalized Finite Element Model of Tissue Expansion in Breast Reconstruction Patients

Author(s):

Joel Laudo† (Engineering)

Abstract:

Tissue expansion is a common medical procedure that induces new skin growth to repair skin defects, assist in breast reconstruction, or produce new skin in situ for harvest and use elsewhere on the body. The process involves inserting an inflatable balloon under the skin and filling it with saline at regular intervals over a period of weeks to apply pressure to the surface of the skin, prompting the skin to grow. Tissue expansion is the most common method to create space for a breast implant in patients who are in the initial stages of breast reconstruction. However, the variability and unpredictability of the procedure can lead to complications and imprecise results. A recently developed computational model has made it possible to accurately predict the spatial and temporal variations of skin growth, with significant potential to reduce complications and standardize the procedure. In this work, we demonstrate a method to validate this model using data from a breast reconstruction patient undergoing tissue expansion. Using patient-specific geometry and protocol information, we built a personalized finite element model in the finite element software ABAQUS, simulated the expansion protocol over time in high fidelity using a custom PID controller implemented in user amplitude function (UAMP), applied our computational skin growth model through a user material subroutine (UMAT), and then compared the predicted growth to the growth observed directly in the patient. Our work establishes a basis for the future use of personalized finite element models as a predictive tool for clinical tissue expansion.

Keyword(s):

Skin Growth, Tissue Expansion, Finite Element Modeling, Breast Reconstruction, Biomechanics

Mentor(s):

Adrian Buganza Tepole (Engineering); Tina Han (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 528
Presentation Time: 7/27, GRIS 134 at 10:20am-10:40am

SURF

Mechanistic interrogation of the impact of electrode heterogeneities in Lithium-ion batteries for electric vertical take-off and landing aircraft

Author(s):

Alvaro Miguel† (Engineering)

Abstract:

Electric vertical takeoff and landing (eVTOL) aircraft are gaining considerable interest due to their potential to improve urban mobility and eliminating the use of carbon-based fuels. Studies show that short-term flights can be up to 50% more inefficient than long-term flights, indicating that eVTOLs provide a viable option for improved business models and more sustainable transportation. Providing sufficient energy density to eVTOLs has been a major challenge because of extreme high-power demand. Non-equilibrium operation of the battery, coupled with electrode heterogeneities, can cause non-uniform heat generation and non-linear electrochemical performance. This study aims to understand the impact of electrode heterogeneities from manufacturing variability on eVTOL performance and safety. The role of heterogeneities in a lithium-ion battery is evaluated by modeling the thermo-electrochemical performance of three different eVTOL architectures targeting short- and long-range missions. The model allowed for visualization of the spatio-temporal evolution of potential fields and transport descriptors along the electrode, providing insight on locations of maximum heat generation, thermal stress and regions of high and low intercalation capacity. This reveals mission phase changes than cause non-linear performance, which can be used to mitigate variability in electrode manufacturing and minimize performance loss. The work demonstrates that mission-specific design of eVTOL batteries, along with an understanding of electrode heterogeneity under high power conditions, is extremely important for performance, safety and manufacturability of eVTOLs. Therefore, analysis of heterogeneities on eVTOLs can help create a feedback loop, providing valuable insights to electrode manufacturing towards enhanced performance and utility of eVTOLs for various applications.

Keyword(s):

Electrode Heterogeneity, Li-Ion Batteries, eVTOL, Capacity Loss, Thermal Safety

Mentor(s):

Partha Mukherjee (Engineering); Abhinand Ayyaswamy (Engineering); Bairav Vishnugopi (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 529
Presentation Time: 7/27, GRIS 134 at 10:40am-11:00am

SURF

Additive Manufacturing of Fiber Reinforced Ceramic Materials

Author(s):

Ella Richardson† (Engineering, JMHC)

Abstract:

Thermal protection systems (TPS), rocket nozzles, and other high temperature aerospace components are often made of ceramic matrix composites (CMCs). CMCs can be manufactured using methods including silicon infiltration, chemical vapor deposition, and polymer pyrolysis, but these first two processes are costly and time consuming. Additive manufacturing techniques have shown promise to produce CMCs via polymer pyrolysis because they could reduce the manufacturing time and allow for a more tailored design of the part. This project aims to study how 3D printing affects the microstructure of fiber filled ceramics and their resulting mechanical and erosion rate properties. To do this, a mixture of photocurable preceramic polymer resin was created and filled with milled fiber reinforcements from 20-40 wt. %. These filled mixtures were photocured, and their cure depths were measured with calipers. The cure depth was found to be more dependent on solids loading than cure time. The maximum cure depth was 1.01 mm at 30 wt. % fiber after 2 minutes of drying and 5 minutes of curing, which provides a potential layer height for printing. The cure depth slightly increased with higher solids loading before it reached 30 wt. % where it then decreased again. The selected mixture was extruded, photo-cured, and pyrolyzed into test specimens for thermal ablation and flexural tests. Additive manufacturing was used to rapidly print photocurable fiber reinforced ceramic resins to produce CMCs for aerospace applications, such as components on rocket nozzles and TPS.

Keyword(s):

Additive Manufacturing, Ceramic Matrix Composites, Thermal Protection Systems, Photocure, Polymers

Mentor(s):

Monique McClain (Engineering); Josh Anderson (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 530
Presentation Time: 7/27, GRIS 118 at 11:00am-11:20am

Wheat and Sorghum Bran Effects on Structure and Function of Gut Microbiomes

Author(s):

McKenna Stahl† (HHS)

Abstract:

Human gut bacterial communities are important for digestive health, ultimately impacting overall health. While various factors can impact gut microbiomes, fiber consumption is a key manipulated factor that impacts gut health. Gut microbiota utilize dietary fiber for energy and produce short-chain fatty acids (SCFAs), like butyrate. While fecal in vitro fermentations have shown dependence on fiber type and structure, in vivo effects are not as well characterized. Regular consumption of specific bran types may increase utilization by microbiota while having limited utilization effects for other bran types. This study investigated effects of dietary intervention of sorghum (SB) and wheat brans (WB) on human gut microbiota composition and functionality.

Participants (n=3) completed a cross-over study consuming either WB or SB in the form of muffins (20g/day) for two weeks, followed by a two-week washout, before consuming the alternate bran for another two-weeks. Fecal samples were collected before and after each treatment period and used to ferment both bran types and their extracted arabinoxylans (AX) in vitro. Gas, pH, and SCFA production measured fermentation rate. Contrary to the initial hypothesis, consumption of a specific bran type did not always increase general fermentations of bran in vitro, however donor and bran types showed strong effects throughout all in vitro tests. All participants had increased butyrate production in WB fermented samples post-intervention with WB; this trend was only observed with donor 2 when measuring SB fermentation. Though results are complex, bran type displayed specific effects in in vivo and in vitro systems.

Keyword(s):

Gut Microbiome, Wheat Bran, Sorghum Bran, Digestive Health, Microbiota

Mentor(s):

Steve Lindemann (Agriculture); Adam Quinn (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 531
Presentation Time: 7/27, GRIS 118 at 11:20am-11:40am

An Immersive Approach to the Expansion of Nuclear Engineering Education

Author(s):

Jonah Lau† (Engineering); Robert Beatty‡ (Engineering); Shea Ruthe‡ (Engineering); Trent Bloor‡ (Engineering, JMHC); Zenen Enriquez‡ (Engineering); Julian Triveri‡ (Polytechnic Institute)

Abstract:

The nuclear industry has struggled to bridge the generational gap in technological fluency, an issue illuminated by the 2019 “NSUF University Research Reactor Fitness Study Report” which saw a 60% decrease in research reactors nationwide. This problem threatens the industry's contribution to global decarbonization efforts amidst climate change as research reactors contribute to the bulk development and operation of advanced nuclear technology. Addressing the challenge, this research group has been working on a research project that leverages immersion with the use of contextualized spaces to create Virtual Laboratories (Virtual Labs) for nuclear engineering education, basing this approach on the concepts of Bloom's Affective Domain and Kolb's Experiential Learning Loop. Having developed Matlab scripts that model the physics behind Nuclear engineering Undergraduate Laboratories such as the Geiger Counter, Neutron Detector, and Nuclear Reactor labs, these scripts were then translated to C# and then built into the Unity game engine which powers the Virtual Labs' framework. The Neutron Detection Virtual Lab offers customizable procedures for nuclear electronics and constructing a radiation detection setup, with additional modularity planned. The Geiger counter lab simulates radiation detection using a handheld detector(Geiger Counter), with a move to 3D augmented reality representation in the works. The Virtual Reactor Lab simulates Purdue University's PUR-1 light water open pool reactor, benchmarked with available reactor data. The promise for advancements in technological fluency brought about by these Virtual Labs within the Nuclear Industry could aid in the industry's decarbonization and training efforts as a whole, propelling the sector forward.

Keyword(s):

Technological Fluency Gap, Educational-Based Reactor Digital Twins, Virtual / Augmented Reality, Nuclear Physics, Global Decarbonization Efforts

Mentor(s):

Stylianos Chatzidakis (Engineering); George Takahashi (Research Computing); Xin Yi Zhou (Research Computing)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 532
Presentation Time: 7/27, GRIS 118 at 11:40am-12:00pm

Adaptive Identification of SIS Epidemic Models

Author(s):

William Retnaraj† (Indian Institute of Technology Kharagpur)

Abstract:

Containment strategies for spreading processes, such as epidemics, require a good estimate of key parameters that govern their dynamics. However, accurately identifying these underlying parameters from data is often a challenging task. In this work, we address the problem of parameter identification in epidemiological spreading processes, which is frequently complicated by numerical ill-conditioning inherent to the model structure and the lack of persistence of excitation necessary for the convergence of adaptive learning schemes. To overcome these challenges, we propose leveraging a relaxed property called initial excitation, combined with a recursive least squares algorithm, to design an online adaptive identifier. This identifier learns the parameters of the susceptible-infected-susceptible (SIS) epidemic model from the available knowledge of its states. We provide a proof that the iterates generated by our proposed algorithm minimize a relevant auxiliary weighted least squares cost function. To validate our approach, we conduct numerical case studies encompassing both aggregate-population SIS models and networked SIS models. Through these studies, we demonstrate the convergence of the error in the estimated epidemic parameters and compare our results with those obtained using conventional identification approaches. Specifically, we showcase the successful recovery of parameters and contact network structure for aggregate-population SIS models and networked SIS models, respectively.

Keyword(s):

System Identification, Adaptive Systems, Epidemics

Mentor(s):

Philip Paré (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 533
Presentation Time: 7/27, GRIS 125 at 11:00am-11:20am

Synthesis of atomically precise iron sulfide clusters and their analysis

Author(s):

Dylan Forbes† (Science, JMHC)

Abstract:

Nanoclusters consist of a core of atoms that are usually protected with surface ligands, intermediate in size between single atoms and nanoparticles. Their high surface to volume ratio, unique electronic structure, and tunability makes them a great candidate as a model system for fundamental studies and application in catalysis, energy storage, and molecular electronics. In this study, we designed nanoclusters using atom-by-atom substitution to replace one of the Fe atoms in the core of $[Fe_6S_8L_6]^{+/2+}$ cluster with other transition metals. Because the core determines the overall properties of the nanocluster, this is an effective method for tuning the electronic and magnetic properties of the cluster. We synthesized nanoclusters based on the iron sulfide and nickel sulfide cluster protected with triethylphosphine ligand (PEt_3) and analyzed them using high resolution mass spectrometry. Mass spectrometric analysis showed that when $FeCl_2$ is used as a metal precursor in the synthesis singly and doubly charged cationic species are formed $[Fe_6S_8L_6]^{+/2+}$($L=PEt_3$). Meanwhile, using $NiCl_2$ as a metal precursor generates singly charged $[Ni_3S_3HL_5]^+$ cluster with the same synthetic procedure. We examined the substitution of Ni atom to the core of $[Fe_6S_8L_6]^{+/2+}$ clusters by using 1:50 molar ratio of $NiCl_2$ and $FeCl_2$. Mass spectrometric analysis revealed signals corresponding to $[Fe_5NiS_8L_6]^+$, $[Fe_4Ni_2S_8L_6]^+$, $[Fe_5NiS_8L_5]^{2+}$, and $[Fe_4Ni_2S_8L_5]^{2+}$ species indicating that $[Fe_6S_8L_6]^{+/2+}$ cluster undergoes atom-by-atom substitution. The core of the $[Ni_3S_3HL_5]^+$ cluster does not undergo substitution with Fe atoms. This work increases the range of atomically precise alloy nanoclusters that have potential applications in molecular electronics, spintronics, quantum computing, and energy storage.

Keyword(s):

Nanoclusters, High Resolution Mass Spectrometry, Atom-By-Atom Substitution

Mentor(s):

Xilai Li (Science); Habib Gholipour-Ranjbar (Science); Julia Laskin (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 534
Presentation Time: 7/27, GRIS 125 at 11:20am-11:40am

A systematic review of the diverse host-seeking strategies of an understudied tribe of mosquitoes

Author(s):

Sydney Moeller† (Science)

Abstract:

Blood-sucking insects use different strategies to detect, locate and feed on their hosts. Among mosquitoes, host-seeking behavior and specificity ultimately modulate disease dynamics and have relevant ecological and evolutionary implications. We synthesize current knowledge on the diversity of host-seeking strategies and host interactions in an understudied tribe of mosquitoes, Uranotaeniini (Diptera: Culicidae). We performed a systematic review which revealed that mosquitoes from this clade have a broad host range including both invertebrates and vertebrates. To detect and localize their host, these mosquitoes use diverse host-emitted cues. In addition, several species harbor pathogens and thus act as disease vectors. Overall, interest in this group continues to grow and expand to include new geographic areas and approaches. These studies, however, are disconnected and spread over a wide range of specialized journals. By consolidating the information on Uranotaeniini, we provide valuable insights into the feeding strategies used by mosquitoes and identify fertile gaps for future research.

Keyword(s):

Uranotaeniini, Host-Seeking Behavior, Mosquito-Borne Diseases, Host Preferences, Mosquito Sensory Adaptations

Mentor(s):

Ximena Bernal (Science); Shilpi Singh (Science); Richa Singh (Science); Sam Freedlund (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 535
Presentation Time: 7/27, GRIS 125 at 11:40am-12:00pm

DUIRI or DURI

Characteristics of Particles emitted from Croplands

Author(s):

Jeremy Harris† (Science)

Abstract:

From tilling to spraying of pesticides to harvesting, agricultural activities emit a variety of aerosols into the atmosphere. These aerosols under the right conditions can act as cloud condensation nuclei (CCN), forming water droplets that make fog and clouds. How easily the water droplets are formed on the types of aerosols. The purpose of this project is to explore the role of agricultural emissions as CCNs. To gauge how well these emissions form into water droplets, an instrument called the Dual-Column Cloud Condensation Nuclei Counter (CCNC) was stationed at Purdue University's Agronomy Center for Research & Education (ACRE). The CCNC data along with weather data from the on-site weather station were analyzed to study the differences in atmospheric aerosols from fungicide spray and crop harvest.

Keyword(s):

Cloud Condensation Nuclei, Croplands, Aerosols, Emissions, Atmospheric Science

Mentor(s):

Gouri Prabhakar (Science); Christopher Rapp (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 536
Presentation Time: 7/27, GRIS 126 at 11:00am-11:20am

SURF

Single Photon Emitters in Silicon Nitride: An Automated Study

Author(s):

Alina Stuleanu† (Engineering); Viet Khoi Pham Khac‡ (Engineering)

Abstract:

Single-photon emitters (SPEs) are crucial to the development of novel quantum information technologies. Although SPEs are vital to many quantum science applications, the development of an ideal source of SPEs is in a nascent stage. Silicon nitride (SiN) has recently been discovered to host SPEs. This is highly advantageous for integration with quantum photonic circuitry as SiN is a well-developed and leading industrial platform for integrated photonics. The goal of our work is to comprehensively understand and optimize a recently discovered method of large-scale site-controlled fabrication of SiN SPEs. Site control is critical as it allows SiN photonic circuitry to be fabricated with precisely placed SPEs. To accomplish this, localized emitters will be induced in SiN on silicon dioxide nanopillars using rapid thermal annealing. To facilitate the large-scale measurements of crucial SPE characteristics such as lifetime, brightness, indistinguishability, and stability, we are building a time-correlated single photon counting confocal microscopy setup with a focus on automation. This approach is based on the modular software framework Qudi, which allows for maximum flexibility in hardware and algorithm design. The statistical results of this analysis will determine whether this fabrication method is effective for industrial production of SPEs to be used in quantum technologies. Studying the impact of different parameters on SPE behavior will give us a better understanding of emitter formation mechanisms and performance. This will enable us to optimize and develop SPEs for integration with quantum photonic circuitry, as well as further our knowledge of SiN's intrinsic single photon emitters.

Keyword(s):

Single Photon Emitters, Qudi Python Framework, Automation, Optics, Quantum Photonics

Mentor(s):

Vladimir Shalaev (Engineering); Samuel Peana (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 537
Presentation Time: 7/27, GRIS 126 at 11:20am-11:40am

SURF

Physics Based Synthetic Dataset for Training Neural Network for Diffusion Coefficient Determination

Author(s):

Shayak Chatterjee† (Engineering)

Abstract:

Particle diffusometry (PD) has emerged as a useful method of finding the diffusion coefficient of a particle in a microfluidic setup with utilities in pathogen detection, pharmaceuticals and fuel cells. Conventional methods used to identify diffusion coefficient are single particle tracing and correlation based methods. Studies have been conducted to investigate application of neural networks for PD and results show that neural networks perform better than the aforementioned conventional methods. However, the current training approach relies on simulated data which utilizes a random walk model without considering essential physics, such as particle-particle and particle-fluid interactions. Our objective is to enhance the training dataset by incorporating improved physics. We have used computer simulations with particle fluid interactions to generate the physics-based dataset. Initial benchmarking involves comparing the physics-based dataset with the original random walk dataset (non-physics). Evaluation metrics include the mean absolute displacement of particles between timesteps and their positions at t = 0s. Furthermore, we will assess the performance (metrics such as mean absolute distance covered by particles and R^2 value) of the neural network trained on the physics-based dataset compared to the non-physics-trained network and conventional techniques mentioned before. This study aims to improve the physics fidelity of the training dataset and enhance the accuracy of the neural network in determining diffusion coefficients.

Keyword(s):

Microfluidics, Machine Learning, Computer Simulations, Particle Diffusometry, Fluid Mechanics

Mentor(s):

Steve Wereley (Engineering); Pranshul Sardana (Engineering); Zhengwei Chen (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 538
Presentation Time: 7/27, GRIS 126 at 11:40am-12:00pm

SURF

Microstructural Control of Additively Manufactured Polymer Bonded Explosives

Author(s):

Christina Lumpp† (Engineering)

Abstract:

Polymer Bonded Explosives (PBXs) are commonly used for explosive components that cannot be easily melted and cast due to their high energy density and insensitivity to accidental detonation. Traditional steel-die compaction of molding powder does not allow for the precise placement of particles and polymer within a PBX, producing unpredictable defects that can lead to hot spot formation during impact, heating, or vibration. Vibratory powder dispensing methods have been used to deposit powders for other applications, so using them to deposit particles into precise patterns prior to compaction could reduce the production of unpredictable defects. This project investigates how powder and polymer deposition prior to compaction can enable repeatable microstructural control of PBXs to improve the predictability of hot spot formation. The mass flow rate of the mock powder, with particle sizes ranging from 13-212 microns, was measured over time to determine the consistency. The precision with which the powder dispensing could start and stop was also examined. Samples of hydroxyl-terminated polybutadiene (HTPB) binder and sugar were partially cured before being pressed in a steel-die. The required curing time was measured as well as the final sample density. A digital microscope was used to observe the adhesion between binder and powder particles and to understand microstructural variations due to manufacturing methods. The results of this study will inform the community on how polymer and particle interactions influence the microstructure of PBXs.

Keyword(s):

Additive Manufacturing, Energetic Materials

Mentor(s):

Monique McClain (Engineering); James Plotzke (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 539
Presentation Time: 7/27, GRIS 133 at 11:00am-11:20am

SURF

Investigation of Diffusion Models with Musical Input

Author(s):

Joshua Kamphuis† (Engineering); Tim Nadolsky‡ (Science); Kevin Kwon* (Engineering); Tanin Padungkirtsakul* (Engineering); Sanya Dod* (Engineering); Kareena Patel* (Liberal Arts); Rochelle Xue* (Engineering); Haichang Li* (Engineering)

Abstract:

Recent years have seen rapid development in artificial intelligence, and an increasingly broad scope of AI as a tool in industries outside of technology. With tools like Stable Diffusion, a text-to-image generative model, AI has entered cultural, artistic spaces. We investigate the use of this diffusion model to visualize music in real-time. We record raw music data and convert it into musical instrument digital interface (MIDI) and Mel-Spectrogram audio formats to extract features that vary between pieces and develop as a piece progresses. These features are used to predict the genre of a piece and the emotions it conveys using a neural network and support vector machine, deep learning models trained on large datasets of samples from classical music songs. The outputs from these models are used to generate prompts that Stable Diffusion translates into images, which are generated multiple times per second and strung together into video. The accuracies of the deep learning algorithms will be evaluated on training data. For real-time implementation, we evaluate Stable Diffusion's various available pipelines and modifiable parameters to balance quality and speed and investigate frame interpolation to make video smoother. These metrics will provide conclusions and recommendations on impactful audio features for music emotion recognition (MER) and efficient use of Stable Diffusion.

Keyword(s):

Machine Learning, Big Data, Music Emotion Recognition, Music Information Retrieval, Stable Diffusion

Mentor(s):

Yung-Hsiang Lu (Engineering); Kristen Yeon-Ji Yun (Liberal Arts); Purvish Jajal (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 540
Presentation Time: 7/27, GRIS 133 at 11:20am-11:40am

SURF

Odiff: Differential Testing of ONNX Model Converters

Author(s):

Anusha Sarraf† (Science)

Abstract:

Practically implementing a Machine Learning (ML) model involve developing, deploying, using, and reusing models. Deep Learning (DL) model converters facilitate the use of models by moving them from frameworks to runtime environments. The conversion process is however often accompanied by errors which results in degraded model quality and disruption of deployment. Previous work attempts to analyze failures in model conversion to ONNX: Open Neural Network Exchange representation. The location, symptoms, causes, and trends over time of failures are studied but expanding on the causes remains essential. This project mainly focuses on finding bugs responsible for those errors when converting models to ONNX. We have collected data from Stack Overflow and GitHub to analyze the popularity of different conversion representations and investigated the type of issues that happen specifically with the most popular one: ONNX. Our further work involves building a framework for testing ONNX converters that we can use to find bugs. We intend on testing torch.onnx and tf2onnx converters using our framework. When the framework is completed, we plan on using NN-Smith to generate artificial ML models, convert them to ONNX representation, and then compare the outputs of the original and converted models. In cases of discrepancies, we plan to inspect the converted model layer by layer to find bugs. We expect the bugs we find to be noticed and addressed by software developers. We also hope that the framework we built is utilized by other ONNX users to find and report bugs.

Keyword(s):

Machine Learning: Deep Learning, ONNX, Software Testing, Troubleshooting, Deep Learning Interoperability

Mentor(s):

James Davis (Engineering); Purvish Jajal (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 541
Presentation Time: 7/27, GRIS 133 at 11:40am-12:00pm

SCALE,SURF

Characterizing Long-Term Degradation of Plastic Packaging in the Low Earth Environment

Author(s):

Luke Fortner† (Engineering)

Abstract:

The nanosatellite, a class of satellites that weighs under 10kg, has experienced a large increase in demand over the past decade. Historically constructed with expensive ceramic packaging, a need for lower weight and cost has led to the elevated use of a commercial off-the-shelf (COTS) alternative, plastic encapsulated microelectronics (PEMs). Unfortunately, these components are not manufactured to withstand the harsh environment of space, as extremely high temperature (T) cycling and radiation exposure causes degradation of PEM packaging. In this study, the epoxy mold compound (EMC), a typical material used in PEMs, is treated as a dielectric in order to characterize this degradation. The SPENVIS software and the AP-8 radiation belt model were used initially to obtain an accurate representation of the low Earth environment. These parameters were then applied as the EMC was subject to T cycling and proton bombardment for varying time intervals. Analysis between control and irradiated results will allow us to determine the degradation of the EMC. These results will be implemented in radiation-hardening software tools to further the design and qualification of PEMS for space and military applications.

Keyword(s):

Radiation Hardening, Total Ionizing Dose, Satellite Constellations, Plastic Encapsulation

Mentor(s):

Muhammad Alam (Engineering); Md. Asaduz Zaman Mamun (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 542
Presentation Time: 7/27, GRIS 134 at 11:00am-11:20am

SURF

Matrix Addressing of Thermal Actuator Arrays

Author(s):

Justin Rodriguez† (Engineering); Jalal Ahmad Farooka* (Engineering)

Abstract:

In In the natural world, entities morph their shape to facilitate their function, such as capturing sunlight or avoiding danger or damage. Recreating this shape-morphing capability in technological systems creates opportunities for advanced clothing and adaptable optical and acoustic devices. The primary objective of this work is to develop a paper-thin large-scale array of thermal actuators, which are among the most powerful and reliable actuators. The key challenge is enabling selective and independent control of a large number of actuating pixels while minimizing the complexity of the control system. To address this, we propose implementing matrix addressing techniques to control the actuator arrays. Matrix addressing of thermal actuators requires the local generation of thermal energy by the conduction of electricity in a high-resistance material. Constructing a thermal array involves three key materials: electrodes with high electrical conductivity and current-carrying capacity, a resistive layer with significantly higher resistance to minimize electrical crosstalk and an active component with large thermally induced strains. The actuating composite consists of a polymer for structural integrity and paraffin wax, a low-cost material that expands when heated. The array's performance, including heat generation and response time, is evaluated through experimental measurements. The implementation of matrix addressing techniques enables precise control and coordination of individual pixels within the array. This proposed work presents new opportunities for thermal actuator arrays, offering low-profile, cost-effective, and scalable devices. By leveraging the thermal array's capabilities and the actuator material's expansive properties, targeted and efficient actuation can be achieved, improving acoustic devices.

Keyword(s):

Thermal Technology, Composite Materials, Actuators, Matrix Addressing

Mentor(s):

Alex Chortos (Engineering); Jue Wang (Engineering); Mina Lee (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 543
Presentation Time: 7/27, GRIS 134 at 11:20am-11:40am

SURF

Design and Manufacture of Magnetically Responsive Membranes for Tissue Testing

Author(s):

Seungbin Kwon† (Engineering)

Abstract:

Understanding the mechanical characteristics of tissue is critical to advance diagnostic methods and medical treatment. However, most mechanical testing methods for tissue are performed ex-vivo. This disregards the natural environment of tissue and hinders the preservation of homeostasis and properties of tissue. A different approach is to use magnetically responsive membranes. Previous studies used magnetically aligned platelets to create synthetic materials with biologically inspired microstructures and elastomer composites that generate magnetic torques. We project to develop a remotely actuated polymer membrane containing magnetically responsive particles which will be adhered to biological tissue in vivo and stimulated by magnetic fields. In this study, we develop a manufacturing method for casting a Polydimethylsiloxane (PDMS) and Nickel composite membrane and perform mechanical characterization and adhesion tests. This approach preserves the mechanical properties of tissue, addressing the common complication of ex-vivo testing. PDMS-nickel membranes are cast in specifically designed 3D printed molds with microscope slides. The nickel platelets are magnetically aligned by a rotating permanent magnet during curing process. We mechanically test the manufactured PDMS-nickel membranes and perform preliminary adhesion tests with biological tissue. Equibiaxial testing is performed with the PDMS-nickel membranes to find the range of moduli of elasticity and numerous adhesives were assessed in adhering the membranes to mouse skin. Based on our investigation of the material properties and magnetic response of cured PDMS-nickel membranes, this study offers new insights for alternative approaches to ex-vivo research of tissue.

Keyword(s):

Fabrication, Multifunctional Composites, Structural Materials, Biomedical Sensing

Mentor(s):

Andres F. Arrieta (Engineering); Katherine S. Riley (Engineering); Laura Alvarez (Engineering); Adrian Buganza Tepole (Engineering); Craig Goergen (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 544
Presentation Time: 7/27, GRIS 134 at 11:40am-12:00pm

SURF

High-Performance Self-Cleaning Radiative Cooling Paint for Reducing Air Conditioning Energy Usage

Author(s):

Katherine Raykova† (Engineering, Liberal Arts)

Abstract:

According to the US Department of Energy, air conditioners consume 6% of the electricity produced in the United States and release 117 million metric tons of CO¬¬2 annually. Radiative cooling paints have the potential to reduce this energy consumption and CO¬¬2 emission by offering a possible passive cooling method for buildings. However, natural weathering and soiling have been shown to diminish the paint's effectiveness and energy savings over time. This study analyzes the performance of a proposed self-cleaning hydrophobic binder, as an alternative to existing commercial binders like acrylic. UV-Vis spectroscopy and a preliminary UV weathering test were conducted on three paint samples formulated with the proposed binder and the pigment hBN, which has previously been able to achieve full daytime sub-ambient cooling in an acrylic-based formulation. FT-IR spectroscopy was then conducted on three additional hBN paint samples to study the binder's performance in the infrared range. Paints formulated with this binder achieved ultra-high reflectance of up to 97.5% in the solar spectral range and show promise in maintaining this optical performance after long term exposure to solar irradiation. The FT-IR results on the paint show high emissivity, which is favorable in the radiative cooling mechanism of emitting heat to deep space (through the sky window). Ongoing and future work includes outdoor, extended weathering, and abrasion testing to provide a comprehensive examination of the proposed binder's durability and sub-ambient cooling capabilities.

Keyword(s):

Energy & Environment, Radiative Cooling, Passive Cooling

Mentor(s):

Xiulin Ruan (Engineering); Emily Barber (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 545
Presentation Time: 7/27, GRIS 126 at 12:00pm-12:20pm

SURF

Nanoscale Characterization of the Effect of Raloxifene on Human Bone

Author(s):

William Bush† (Engineering)

Abstract:

Raloxifene, an FDA approved selective estrogen receptor modulator, has been proven to reduce fracture risk in women experiencing postmenopausal osteoporosis. Raloxifene was shown to increase bone mineralization and bone mass through its interaction with the cell mediated bone generation-reabsorption cycle. The drug, however, reduced clinical fracture events, further than can be explained by the level of increased bone density. Few studies have shown that raloxifene has cell-independent mechanisms to increase fracture strength. Therefore, this project aims to investigate the nanoscale non-cell mediated impact of the drug on the structure-property relationship of and interface between the two base components of bone, the organic collagen matrix and mineralized crystals. Raloxifene has been shown to increase loosely bound water in bone, and the resultant structure-property effects were sought through small and wide-angle x-ray scattering and in-situ tensile testing after bone samples were soaked in raloxifene and control solutions. The effects of raloxifene on the nanoscale structure of bone will further the investigation on cell independent strengthening mechanisms.

Keyword(s):

Bone, Small-Angle Scattering, Wide-Angle Scattering, Raloxifene, Toughness

Mentor(s):

Thomas Siegmund (Engineering); Elizabeth Montagnino (Engineering); John Howarter (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 546
Presentation Time: 7/27, GRIS 133 at 12:00pm-12:20pm

SCALE,SURF

Investigation of Space Radiation Doses in Satellite Orbits

Author(s):

Ishaan Rao† (Engineering, JMHC); Cole Lush* (Engineering, JMHC)

Abstract:

The radiation environment in Earth orbit is generally harmful to satellite electronics. To maximize satellite durability in the radiation environment, an accurate estimate of the radiation dose received in any given orbit is required. While prior work has characterized low earth orbit and geosynchronous orbits, relatively few studies have looked between geosynchronous orbit and lunar orbit. This paper investigates the radiation environment in cislunar space to determine the expected radiation dose for common orbits. For a representative sample of the regions of Earth orbits, circular orbits are studied at altitudes 200km, 2500km, 4500km, 25,000km, and 35,790km, as well as in a near-lunar orbit of about 600,000km. Using a tool developed by the European Space Agency known as SPENVIS, the trapped proton and electron doses, as well as the Galactic Cosmic Ray doses for Hydrogen, Helium, Carbon, and Iron ions, over a one-year period in each orbit are found. The total absorbed radiation dose per unit time is measured in units of rads; this allows for comparisons to determine safe and unsafe regions of cislunar space for various electronics. Having more accurate radiation dose information allows satellite designs to optimize their intended orbits, balancing radiation shielding with mass requirements. Having a detailed understanding of the distribution of radiation particles also allows for electronic equipment to be designed for durability against particular types of radiation.

Keyword(s):

Environmental Characterization, Space Radiation, High Energy Particles

Mentor(s):

Peter Bermel (Engineering); Sayan Roy (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 547
Presentation Time: 7/27, GRIS 134 at 12:00pm-12:20pm

SURF

Cognitive State Modeling of Human Machine Interactions in a Level II Driving Simulator

Author(s):

Xipeng Wang† (Science, Polytechnic Institute)

Abstract:

The development of safer and more efficient driving systems has gained attention in the fields of automation and importantly, human-automation interaction. It is widely held that autonomous vehicles with embedded models of human cognition may be better able to interact with human passengers or drivers and improve overall safety and comfort. Therefore, this research aims to understand how humans interact with autonomous vehicles, with a particular emphasis on modeling how humans' trust, mental workload, risk perception, and self-confidence change in response to different stimuli. The goal is to develop an SAE Level II autonomous vehicle simulator which will serve as a testbed for human subjects' experiments. The backbone of the high-fidelity 3D simulator is developed using Unreal Engine 5 and encompasses an expansive open world map set in a dynamic city environment. The simulator includes intricately designed traffic systems that mimic real-life scenarios and gives experimenters complete control over independent variables such as automation transparency, task complexity, recommended control mode, and system reliability. Various optimization techniques are applied to ensure optimal performance of the software and hardware. Pilot studies will be conducted to evaluate the ecological validity of the developed scenarios and to inform any required modifications. Future work involves data collection through experimental trials and using the collected data for gray-box system identification and validation.

Keyword(s):

Human-Automation Interaction, Driving Simulator, Unreal Engine, Control-Oriented Modeling

Mentor(s):

Neera Jain (Engineering); Sibibalan Jeevanandam (Engineering); Michael Williamson Tabango (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 548
Presentation Time: 7/27, GRIS 118 at 1:00pm-1:20pm

Digital Ag REEU

Identifying Spatial Patterns Between Agricultural Land Use And Decline In Domestic Honey Production In The United States

Author(s):

Ahnaf Talukder† (George Mason University)

Abstract:

The purpose of this study was to identify spatial patterns between agricultural land use and domestic honey production in the United States using USDA survey data from beekeepers. Survey data on the historical production of honey in pounds, production of honey in dollars, and total count of honeybee colonies from 1987 to 2022 were sourced from the USDA's NASS database. After cleaning and wrangling the data using Python, linear regression analysis was conducted to identify trends. Initial findings show that domestic production of honey is decreasing by 2.6 million pounds each year and honey productivity per colony is decreasing by 0.63 pounds each year. By mapping honey productivity per colony across different states using ArcGIS Pro, spatial patterns were identified that show greater loss in colony productivity in states with more cropland, which can be attributed to the use of various pesticides in agriculture that are harmful to honeybees and other pollinators alike. Exacerbated by colony collapse disorder and climate change, these results raise huge concerns for the future of the domestic beekeeping industry and everyone who depends on it for honey and pollination services.

Keyword(s):

Honey, Production, Disease, Trends, Honeybees

Mentor(s):

Dharmendra Saraswat (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 549
Presentation Time: 7/27, GRIS 118 at 1:20pm-1:40pm

Digital Ag REEU

Estimation of optimal flush times and heat removal rates for sow cooling pads, aluminum vs stainless steel

Author(s):

Jemima Baributsa† (Agriculture)

Abstract:

Purdue University's departments of Animal Science and Agricultural and Biological Engineering developed a prototype electronic cooling pad (ECP) and an artificial sow (AS), simulating the implementation of the ECP as a combatant to heat stress (HS) for a real sow in a farm. The study objective was to model the impacts of AS skin temperature and ECP flush water temperature on heat removal and ECP flush rates. Collected data will be used to model patterns of the temperature data collected from the AS on the ECP. Patterns from collected data will then be compared with real sows using an ECP. To perform objective measurements, three AS skin temperature configurations (35, 39, and 43C) will be tested. The temperature range for the AS was reflective of that in real sows experiencing mild to severe HS. The AS temperature will be recorded from the bottom of its rubber surface with an infrared temperature gun as it was lifted on and off the ECP in 10-minute intervals for 3 repetitions. The ECP will be configured to flush at three cool water temperatures (15, 18, and 21C). The ECP will be set to automatically flush when the ECP thermocouples reaches 26C. Data collected for each of the nine combinations will be analyzed for any concrete results.

Keyword(s):

Heat Stress, Electronic Cooling Pad, Artificial Sow

Mentor(s):

Allan Schinckel (Agriculture); Bob Stwalley (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 550
Presentation Time: 7/27, GRIS 118 at 1:40pm-2:00pm

Digital Ag REEU

Is Water Infrastructure Racially Biased? An Investigation into The Presence of Ongoing Tap Water Safety Violations in Communities of Color

Author(s):

John Woodruff† (Agriculture, Engineering, JMHC)

Abstract:

The purpose of this study was to demonstrate a statistical relationship between ongoing tap water safety violations and the ethnic makeup of the communities they occur in, focused on counties in Indiana. Methodology was designed to validate and reproduce the results of Watered Down Justice, a study conducted for the nonprofit environmental organization Natural Resource Defense Council by Kristi P. Fedinick, et al. This study, which concluded that there is a significant statistical relationship between ongoing unfixed water quality violations and higher than average non-white populations in counties across the United States, laid out a detailed set of criteria for evaluation of ongoing safety violations which were adapted for use in Indiana by this study. Data analysis and visualization was achieved via mixed use of Microsoft Excel and ArcGIS. Data were obtained from publicly available US Census Bureau and Environmental Protection Agency databases.

Keyword(s):

Water Resources, Infrastructure, Demographics, Racial Bias, Water Quality

Mentor(s):

Dharmendra Saraswat (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 551
Presentation Time: 7/27, GRIS 125 at 1:00pm-1:20pm

DUIRI or DURI

Towards a Foundational Self-Supervised Model for Cardiac Magnetic Resonance Segmentation

Author(s):

Sarthak Mangla† (Science)

Abstract:

Deep Learning techniques are now widely utilized to automate various segmentation and classification tasks in medical imaging. Specifically, performing semantic segmentation on cardiac magnetic resonance (CMR) has proved to save time and effort in the long run. In addition, pretraining models with self-supervision learning methods have been widely successful in bolstering performance. We aim to combine these two methodologies in a novel framework to improve general CMR segmentation accuracy. Our approach involves leveraging a convolutional U-net to construct a general foundational model built on top of a large collection of CMR datasets. We utilize self-supervision learning techniques like contrastive learning via Barlow Twins, image inpainting, and rotation prediction to acquire robust semantic representations of CMR images for the foundation model. This model will then serve as a starting point for subsequent fine-tuning on specific cardiac analysis tasks in diseases like Duchenne muscular dystrophy (DMD). Our previous work specifically focused on automating the segmentation of MRI images for DMD strain calculations. With no pretraining, the DMD images had a test-set Mean Squared Error (MSE) of 0.19 ± 0.11 (cm2; mean ± SD) and a test-set mean Dice score of 0.89 ± 0.08 for the endocardial boundary and a 0.93 ± 0.05 for the epicardial boundary. While the foundational model is still being incorporated, it has demonstrated promise in initial tests. We hope to make this foundational model open-source as a baseline for CMR understanding, enabling further contributions from the community.

Keyword(s):

Deep Learning, Self-Supervision, Cardiac Magnetic Resonance, Semantic Segmentation, Duchenne Muscular Dystrophy

Mentor(s):

Craig Goergen (Engineering); Conner Earl (Engineering); Guang Lin (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 552
Presentation Time: 7/27, GRIS 125 at 1:20pm-1:40pm

DUIRI or DURI

Performance Evaluation and Thermal Management Solutions for a Sustainable Microsized Hydrogen-Powered Turbo-Shaft Engine

Author(s):

Nikolai Baranov† (Engineering); Smit Kapadia* (Engineering)

Abstract:

Analyzing the aerospace and automotive industries, there is a transition to sustainable energy generation. Aiming to bridge industrial emissions with the worldwide net zero goal by 2050, one widely considered solution for long-range drones and small aircraft is compact turbo-shaft engines combusting clean hydrogen gas to produce shaft work. The small size and energy-dense fuel allow for a universal powerplant with high specific power output that fits a wide variety of existing solutions. One such micro-sized turboshaft internal combustion engine was created to test the potential power output, thermal management, and combustor optimization of the existing stainless steel assembly. The computational models predicted a potential power output of 72 kW from the turbine assembly, with the compressor dissipating 70.5 kW, indicating a usable 1.5 kW from the overall engine. During standard operation at a rotational speed of 98,000 RPM, the models predicted thermal failure of the rear combustor wall after reaching the operational time mark of 2 minutes, which was later physically verified. During data collection, several thermocouples and strain sensors indicated heat concentration and compression near the corners of the rectangular combustor. Additional ventilation was created, allowing cooler air to circulate the outgoing exhaust gases faster with a relative loss of combustor performance due to additional turbulence. Overall, the project has proven that micro gas turbines can be utilized for clean power generation on larger drones. Future developments may prompt the use of higher-grade materials and thermal insulation to help boost the thermodynamic performance of this promising potential solution.

Keyword(s):

Micro Gas Turbine, Hydrogen Powered, Thermal Management, UAVs, Sustainability

Mentor(s):

Li Qiao (Engineering); Holman Lau (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 553
Presentation Time: 7/27, GRIS 125 at 1:40pm-2:00pm

Validation of Inter-Scan Variance of Three-Dimensional Ultrashort Echo Time Rosette k-space Trajectory 23Na MRI Technique

Author(s):

Nicholas Buffo† (Engineering)

Abstract:

Articular cartilage is a connective tissue that lines the surfaces of bones and provide a smooth and lubricated surface to handle high joint loads and reduce friction. Osteoarthritis, a degenerative whole joint disease, including the degeneration of articular cartilage has affected millions of people worldwide. Early indications and detection of osteoarthritis are still being developed, but new imaging techniques have promising results. Specifically, sodium (23Na) MRI, through analysis of sodium standards and signal from the scan, can provide quantitative data about tissue content through its relationship to glycosaminoglycans (GAG) and fixed charged density. GAGs are highly negatively charged sidechains covalently linked to a protein backbone – this complex constitutes a proteoglycan. 23Na is responsible for maintaining the charge and osmotic balance against the highly negatively charged GAGs. Thus, 23Na density tracking can give rise to detection of cartilage degeneration through diminished sodium signal. Currently, 23Na MRI's translation is hindered by long scan times and poor image quality (e.g., low signal to noise ratio (SNR) and spatial resolution). Our dual-echo ultra-short echo time 3D-rosette k-space trajectory aims to improve SNR and spatial resolution in comparison to an industry-standard 23Na MRI technique using radial k-space acquisition. This research will explore the validation of inter-scan variance in a 6–12-month period of the 23Na MRI analysis of industry-standard radial acquisition techniques compared to our dual-echo UTE 3D-rosette k-space trajectory. Examining the inter- and intrascan variance with our novel rosette UTE sequence will ensure that this sequence is repeatable for further studies and may be utilized in the analysis of these studies.

Keyword(s):

Magnetic Resonance Imaging, Cartilage Degeneration, Bioimaging, Osteoarthritis

Mentor(s):

Deva Chan (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 554
Presentation Time: 7/27, GRIS 126 at 1:40pm-2:00pm

SURF

Point-of-care imaging device for pathogen detection from color-based nucleic acid amplification

Author(s):

Skyler Campbell† (Duke University)

Abstract:

We sought to develop a point-of-care (POC) diagnostic device for pathogen detection within 60 minutes in a non-laboratory setting. In recent years, researchers have utilized DNA amplification techniques that leverage color-based indicators to quickly identify pathogens from just a few copies of genetic material. These tests allow an easy visual way to read results; if the color of the sample changes, the pathogen is present. However, if a user wants to know the precise quantity of pathogen present, image analysis must be conducted on the samples. We aimed to conduct this thorough quantitative analysis within the POC setting and have successfully developed a device that consolidates the entire detection process into a portable, user-friendly package. The device's components cover the two key parts of achieving data-informed results: collection and analysis. The samples are placed in the device and are heated up to 65°C, which is the temperature needed for the amplification reaction. A camera captures time-lapse images to track color change as the reaction progresses. A Raspberry Pi single-board computer contained in the device then allows it to automatically run image processing code on the collected snapshots. We aim to test the device for proof-of-concept such that an untrained user can receive automated quantitative results from our device within 60 minutes. We would like to continue developing the device for application across different point-of-care settings. The device offers an appealing opportunity to have both precision and user-friendliness in portable tests, without having to sacrifice either benefit.

Keyword(s):

Image Analysis, Point-Of-Care Testing, Portable Computing Device, Pathogen Detection, 3D Printing

Mentor(s):

Mohit Verma (Agriculture); Jiangshan Wang (Engineering); Bibek Raut (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 555
Presentation Time: 7/27, GRIS 133 at 1:40pm-2:00pm

SURF

Seismic Cracking of Embankments and Earth Dams

Author(s):

Jingqing Liu† (Engineering)

Abstract:

When embankments and earth dams are subjected to seismic loadings, lateral and longitudinal deformations, crest settlement, transverse and longitudinal cracking, and liquefaction may occur. Earthquake-induced cracks are considered one of the most hazardous consequences of seismic damage because they can lead to increased seepage through the dam and internal erosion, which may result in failure of the dam and catastrophic release of the water in the reservoir. The consequences can be devastating, as seen with the failure of the Nova Kakhovka dam in southern Ukraine. This research project aims to improve the seismic design of embankments and earth dams by creating a new, updated database of earthquake-induced deformations of earth dams, which will provide a tool for practitioners to predict the extent and depth of seismic cracking. Data on earthquakes, dams, and seismically-induced damages from the period of 2000 to 2023 was gathered from the technical literature, which included conference publications, journal papers and technical reports. My contribution to the research focused on the reports of damage to over 250 dams in China during the 2008 Wenchuan earthquake. The modernized database, containing several hundred dam cases, will be used to develop new empirical methods for evaluating earthquake-induced cracking. Creation of such database will be crucial to the safety of embankments and earth dams since it will provide high-quality data to estimate seismically-induced cracks in dams and to improve the seismic resilience of embankments and dams.

Keyword(s):

Earthquake-Induced Cracking, Seismic Damages, Embankments & Dams, Material Modeling & Simulation

Mentor(s):

Antonio Bobet (Engineering); Juan Jimenez (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 556
Presentation Time: 7/27, GRIS 134 at 1:40pm-2:00pm

SURF

Investigating the Effects of Biomaterial Porosity on Muscle Remodeling and Functional Recovery after Volumetric Muscle Injury in Mice

Author(s):

Gabrielle Tanner† (Engineering, JMHC)

Abstract:

Volumetric muscle loss (VML) is a condition marked by excessive scar tissue deposition and functional disability following severe muscle trauma wherein the volume of tissue lost exceeds the body's regenerative capacity. There is currently no effective treatment for VML, but bioengineering interventions such as biomaterials that fill the VML defect to support tissue repair are a promising strategy. However, traditional biomaterials used for this purpose are either non-porous or have rigid form, making them challenging to implant. In the present study, we tested the effects of granular hydrogels — an emerging class of injectable and porous biomaterials — on muscle repair, hypothesizing that their porosity will support native cell invasion and their flowability will permit conformable defect filling, leading to effective muscle repair. We prepared granular hydrogels by fragmenting bulk crosslinked hyaluronic acid hydrogels, then created a bilateral VML injury in the tibialis anterior (TA) muscles of 12-14 week old mice and implanted either granular or bulk (control) hydrogels. Muscle forces were quantified at baseline and after 4 weeks. Muscles were then histologically processed and stained to evaluate cell and vessel invasion, scar deposition, and new muscle fiber formation. Invasion of non-myogenic (Hoechst) and myogenic (Pax7+ satellite cells), and embryonic myosin heavy chain (new fibers) into the defect region were found to be significantly greater in granular hydrogel groups than in bulk groups, providing the first evidence of the efficacy of granular hydrogels in the effective treatment of VML injuries.

Keyword(s):

Granular Hydrogels, Volumetric Muscle Loss, Immunohistochemistry, Fibrosis, Biomechanics

Mentor(s):

Taimoor Qazi (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 557
Presentation Time: 7/27, GRIS 118 at 2:00pm-2:20pm

Analyze This! Analytical Chemistry REU

Organocatalytic Decrosslinking of Formalin-Fixed Proteins

Author(s):

Amanda Marchi† (Science)

Abstract:

Formalin-fixed paraffin-embedded (FFPE) tissue samples from surgical procedures and biopsies are often preserved in a formaldehyde solution to impede degradation of biopolymers. An estimated 520 million FFPE samples are currently biobanked in the United States. Nucleic acids and proteins react with formaldehyde to form hemi-aminal and aminal adduct crosslinks. Although an effective method for the preservation of biospecimen, most methods that characterize nucleic acids or proteins (e.g. sequence or mass spectrometry-based proteomics) require liberation of the biopolymers from crosslinks before analysis. Typically employed methods to remove adducts involve lengthy exposure to high temperatures and extreme pH which can erase labile chemical modifications. Our central hypothesis is that bifunctional aryl catalysts will expedite the removal of formaldehyde adducts through reduced temperatures which will ameliorate the recovery of proteins and their post-translational modifications in proteomics applications. FFPE tissue samples were simulated by culturing HeLa cells and fixing them with formaldehyde. Cell lysates were subjected to specific organocatalysts and temperatures for decrosslinking. The effectiveness of decrosslinking was evaluated by a combination of bottom-up and top-down protein mass spectrometry measurements. Figures of merit include the number of identified proteins, number of identified (modified) peptides, and sequence coverage.

Keyword(s):

Proteomics, Mass Spectrometry, Organocatalysts, Formalin-Fixed Paraffin-Embedded (FFPE), Biopolymers

Mentor(s):

Bryon Drown (Science); Jacob Seay (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 558
Presentation Time: 7/27, GRIS 118 at 2:20pm-2:40pm

Understanding Livability Through Property Condition Surveys in the Hanna Neighborhood

Author(s):

Kevin Potthast† (Engineering); Jennifer Yang† (Engineering, JMHC); Andy Kim* (DSB, JMHC)

Abstract:

Amongst the ongoing economic decline of the Northend of Lafayette, Indiana, the community has faced many challenges: neighborhood retention, housing deterioration, and safety concerns. These issues pose a threat to the community well-being, as well as the livability factor – referring to the “environmental chances” of life (Veenhoven, 1999). This can be tied to the housing conditions in said environment. To evaluate the extent to which living conditions affect the quality-of-life in the Northend, the team conducted property condition surveys recording the housing conditions of the Hanna neighborhood – one of the many neighborhoods in the Northend. In this assessment, randomly-selected residential buildings in the neighborhood were examined based on criteria covering both the structural and property conditions, judged on a qualitative grading scale. Additionally, the team graded each street within the neighborhood on the quality of its public right-of-way. The thirteen criteria used here are also measured on a similar qualitative scale as the residential buildings. The data collected in this survey on the Hanna neighborhood will be analyzed to determine how the factors of livability regarding housing conditions affect the community well-being of the Hanna neighborhood. Furthermore, the data found in this study can be compared to similar livability studies previously conducted in other Northend neighborhoods. The combined results will allow the team to better understand the well-being of the entire Lafayette Northend community and provide community partners – the City of Lafayette and the Faith Community Development Corporation – further insights to make data-driven decisions regarding their neighborhood revitalization efforts.

Keyword(s):

Community Well-Being, Quality of Life, Livability, Neighborhood Revitalization, Property Condition

Mentor(s):

Jason Ware (JMHC)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 559
Presentation Time: 7/27, GRIS 118 at 2:40pm-3:00pm

REU in Structural and Computational Biology & Biophysics

VP40 Mutants Characterization

Author(s):

Sam Eger† (Science, JMHC); Anna Kendrick* (Pharmacy); Valentina Toro Ramirez* (Pharmacy); Manuel Torres* (Pharmacy)

Abstract:

Abstract:

Ebola Virus' structure contains 7 proteins, including the matrix protein, VP40, which is sufficient for virus-like particle (VLP) formation. VP40 localizes at the host's plasma membrane inner leaflet in a phosphatidylserine (PS)-dependent manner via key positively charged residues in its basic patch. Further recruitment of VP40 then forms a hexamer, and eventually a filament. Mutations in the VP40 basic patch region have been discovered in a recent virus outbreak in the Democratic Republic of Congo which include G226R, S228N, S228G, and H269R, however, little is known about their effect on infectivity of the virus. The goal of this study is to characterize these mutants for their stability and binding affinity to PS containing membranes. It is hypothesized that the G226R and H269R will increase viral egress, as they mutate to more positively charged residues in the basic patch. S228N and S228G will likely decrease viral egress however, as both mutate a H-bonding serine in the basic patch. Plasmids harboring these mutants were transformed into DH5α competent cells to be midi prepped for eventual protein expression. These mutants were then transformed into BL21 competent cells, expressing VP40 via an IPTG induction mechanism, then purified. SEC profiles for S228N showed only Dimer formation while S228G showed dimer and octamer formation, similar to the Wild Type. Stability and binding affinity for PS will also eventually be tested via DSF and SPR, respectively. This will elucidate potentially dangerous mutants, which could lead to procuring specific antibodies to prevent further spread of concerning mutants.

Keyword(s):

VP40, Virus Like Particle (VLP), Phospatidylserine (PS), VP40 Basic Patch

Mentor(s):

Rob Stahelin (Pharmacy)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 560
Presentation Time: 7/27, GRIS 125 at 2:00pm-2:20pm

3D Printed Assistive Devices for Independent Biomedical Laboratory Work for Individuals with Limited Manual Dexterity and Strength

Author(s):

David Botana† (Northwestern University); Shaiv Mehra* (Engineering)

Abstract:

This study aimed to develop assistive devices to assist individuals with decreased manual dexterity and strength to engage independently in wet lab work across various lab settings. Individuals with disabilities frequently utilize assistive technology and accommodations to achieve equity in higher education while maintaining autonomy. However, a lack of accessible devices in labs may force them to depend on peers for assistance, which may subject them to discrimination. Therefore there is a significant need for replicable, inexpensive, and adaptable devices for individuals to utilize in these settings. The study observed an individual with limited hand mobility and strength. An antique fractal vise design released by Mantle & Co in 1922 was adapted to be fully 3D-printable and adjustable to stabilize lab glassware. Additionally, a 3D-printed gear system was developed to enable index finger flexion to replace the thumb opposition of a micropipette. Functional performance tests will be conducted to evaluate the effectiveness of these devices. The study will observe if the user can more efficiently and for longer durations complete wet lab tasks using the fractal vise and micropipette adapter. Multiple trials of cell media changes will be conducted without devices, with only the vise, with only the adapted pipette, and both devices together. Significance will be assessed through t-tests, with each test separated by a one-hour rest period. These devices can be 3D printed and adapted with CAD parameterization to fit the user's needs, providing a low-cost and adjustable method for individuals with disabilities to engage in lab work independently.

Keyword(s):

Assistive Devices, Accessibility, Disabilities, 3D Printing, Pipetting

Mentor(s):

Bradley Duerstock (Engineering); Mitchell Sanchez (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 561
Presentation Time: 7/27, GRIS 125 at 2:20pm-2:40pm

Decoding fNIRS Neural Responses: A Machine Learning Approach

Author(s):

Dalton Aaker† (Engineering)

Abstract:

The aim of this project is to develop a machine learning model that accurately identifies positive auditory-evoked neural responses while controlling for factors that introduce noise to the neural signal and observe the effects of decoding these interferences. Human neuroimaging data collected via fNIRS from a single subject twice daily for five consecutive days was analyzed. The data followed a block-design paradigm with two conditions: meaningful auditory speech and silence serving as a baseline control. Hemoglobin concentration data was collected using a continuous-wave fNIRS system (NIRx NIRSport2) with specific source-detector pairs optimized for the regions associated with sound acquisition and language comprehension. Standard fNIRS data cleaning and preprocessing practices were applied and Python's Sci-kit learn library was utilized for decoding and prediction on the extracted datasets. Estimators were trained on hemoglobin concentrations and applied stimuli, with cross-validation using Stratified K Folding. Some estimators required training on both physiological and fNIRS datasets, using a feature union technique to join the relevant features. Preliminary analysis revealed that the model achieved the strongest predictive ability using only the oxygenated hemoglobin signal. At low subject counts, the best decoding accuracies were achieved using a combination of Galvanic Skin Response (GSR) and oxygenated hemoglobin signals. In general, physiological data did not consistently improve decoding accuracy, except for GSR data. This study provides insights applicable to machine learning, neuroscience, and optical engineering and the ability to combine cofactors for maximum prediction capabilities in machine learning models is a key area of ongoing research.

Keyword(s):

Machine Learning, Functional Near Infrared Spectroscopy, Galvanic Skin Response, Brain Computer Interface

Mentor(s):

Maureen Shader (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 562
Presentation Time: 7/27, GRIS 125 at 2:40pm-3:00pm

Topological Insulators using DFT and NISQ Simulations

Author(s):

Gustavo Sáez Cruz† (Science); Jessica John Britto† (Science)

Abstract:

Topological insulators have a gap in the bulk electronic band structure but have topological properties – such as finite Chern numbers. While the bulk gap prevents electrons from flowing freely in the bulk, the finite Chern numbers lead to chiral edge modes, i.e., conduction of electricity on the surface. The chiral edge currents are strong indicators of the topological phase, and are sensitive to changes in the topology of the material, especially through a topological phase transition. In this project, we intend to take a step forward toward the realization of topological quantum devices by investigating phase transitions in topological insulators. In an attempt to do this, we take a two-pronged approach. In the first part, we investigate Topological Phase Transitions(TPT) in 1D and 2D Topological Matter along with their simulations on NISQ Devices [1]. In particular, we calculate the winding which is a topological invariant. Our goal is to extend the concept towards Hamiltonians which can be naturally found in nature, such as those found in candidate topological insulators Bi2Te2Se, and others. In the second part, we guide our choice of experiments via the calculation of the Density functional theory (DFT)[2] to unravel the band structure and the gauge symmetry structure of candidate materials in the 1D and 2D limits.

References:

[1] Mei et al., PRL. 125, 160503 (2020).

[2] Lee et al., O.V. (2015). Book: Density Functional Theory Calculations of Topological Insulators, Wiley.

Keyword(s):

Topological Insulators, Density Functional Theory, Topological Phase Transitions, Quantum Computing, Band Structure

Mentor(s):

Arnab Banerjee (Science); Varadharajan Muruganandam (Science); Sayan Roy (Engineering); Bishnu Prasad Belbase (Science); KEERTHI KUMARAN ALAGARSAMY MANIKANDAN (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 563
Presentation Time: 7/27, GRIS 126 at 2:00pm-2:20pm

SURF

Advancing Agricultural Extension & Outreach Through the Development of a Specialized Chatbot

Author(s):

Son Ha† (Science); Jungeun Hwang‡ (Science)

Abstract:

This research project explores the development of a specialized chatbot for farmers, leveraging advancements in large language models (LLMs) like ChatGPT by OpenAI. The objective is to create a conversational artificial intelligence (AI)-based system capable of providing practical insights and engaging in near-human conversations to assist farmers in their decision-making processes. The chatbot utilizes natural language processing techniques to interpret farmers' queries. By integrating the text-embedding-ada-002 from OpenAI, the content of various agriculture articles from the Purdue online library is vectorized. Then, the vectorized inputs would be sent to Pinecone for storage. Additionally, by utilizing the search vectors from PineCone and the OpenWeatherAPI, the chatbot can provide personalized recommendations for crop selection, irrigation schedules, and pest control measures.

Furthermore, the Word2Vec embedding and vectorization are also proposed and implemented manually as an alternative to OpenAI’s model. The chatbot's user interface (UI) is developed using React Native, allowing it to be easily deployed on iOS and Android environments. By providing practical insights and engaging in near-human conversations, a specialized chatbot is an advanced agricultural extension and outreach tool for farmers, aiding their decision-making processes for farm operations.

Keyword(s):

Chatbot, Conversational AI, Large Language Models

Mentor(s):

Dharmendra Saraswat (Agriculture); Varun Aggarwal (Engineering); Aanis Ahmad (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 564
Presentation Time: 7/27, GRIS 126 at 2:20pm-2:40pm

SURF

Feasibility of a PTM EV-Based Pipeline for Breast Cancer Subtype Differentiation

Author(s):

Mengting Xu† (Engineering)

Abstract:

The major challenge in breast cancer research today is tumor heterogeneity. Breast tumors have been divided into four primary categories includes triple negative, luminal A/B, and HER2. This research aims to non-invasively differentiate between the triple negative and luminal A/B subtypes of breast cancer by using post-translationally modified proteins in plasma extracellular vesicles (EVs). EVs are lipid-shelled vesicles found in almost all body fluids that carry biological components. Protein post-translational modifications (PTMs) have been identified as critical for protein degradation, and these modifications include phosphorylation, acetylation, and glycosylation. By examining data visualizations based on different modifications, including control, luminal A/B, and triple negative groups in formats such as heatmaps, histograms, PCA plots, etc., breast cancer subtypes can be identified through patterns. Running machine learning algorithms on existing datasets allows us to identify potential candidate biomarkers by discerning the top targets for breast cancer subtype identification. These results demonstrate the feasibility of a PTM EV-based pipeline for breast cancer, suggesting that a plasma EV pipeline could offer a new approach for detecting breast cancer diagnosis.

Keyword(s):

Breast Cancer, Machine Learning: Random Forest, Medical Science & Technology

Mentor(s):

Andy Tao (Agriculture); Marco Hadisurya (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 565
Presentation Time: 7/27, GRIS 126 at 2:40pm-3:00pm

SURF

Effect of Small Arms Fire-like Noise Exposure on the Central Auditory System

Author(s):

Emily Bell† (Science); Andres Navarro‡ (Science)

Abstract:

Noise-induced hearing loss (NIHL) results from loud, harmful noises, often experienced by military service members. The auditory system consists of the peripheral and central auditory systems (PAS, CAS). Previous studies have suggested the PAS is more susceptible to noise-induced damage, requiring injury to structures preceding the auditory nerve (AN), such as the cochlea and hair cells. CAS damage involves impairment following the AN, influencing inhibitory and excitatory neural transmission. While damage to the PAS is commonly observed in NIHL, fewer studies have investigated the characterization of central damage. This study aims to compare peripheral and central noise-induced damage in the auditory pathway. We predict NIHL will be characterized by reduced sensitivity to low-intensity sounds, portraying increased thresholds and decreased waveform amplitudes. F-344 rodents were exposed to 13 small arms fire-like biphasic pulses over 2.5 min at ~130 dB peak SPL. Auditory evoked potential (AEP) recordings were used to measure neural population function and estimated sensitivity thresholds in response to click and pure tone stimuli (20 - 80 dB). Distortion product otoacoustic emission (DPOAE) recordings were used to measure outer hair cell functionality. To assess changes within the auditory pathway, we compared amplitudes and thresholds across days 0, 7, 14, and 28. Subsequently, preliminary analysis of the click AEPs and 2, 4, and 8 kHz DPOAEs show increased thresholds and decreased amplitudes compared to baseline, indicating reduced cochlear sensitivity. We also observed a trend in female rats exhibiting lower thresholds than males, aligning with other studies indicating unknown underlying mechanisms of neural protection.

Keyword(s):

Central Auditory Processing, Hearing Loss, Noise Exposure, Auditory Evoked Potential, Distortion Product Otoacoustic Emission

Mentor(s):

Ed Bartlett (Science); Meredith Ziliak (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 566
Presentation Time: 7/27, GRIS 133 at 2:00pm-2:20pm

SURF

Mobility Evolution in the US: Evidence from Electric Vehicle Adoption

Author(s):

Shreejit Poudyal† (Clarkson University)

Abstract:

Electric vehicles (EVs), compared to conventional vehicles, have significantly lower emission levels and are a promising alternative to address sustainability concerns. Amidst growing technological innovations, EV registrations have risen substantially in the U.S. This raises sufficient investment and developmental strategizing concerns for essential advances in EV and charging infrastructure to suit future requirements. We use EV registration data with economic and socio-demographic variables – as factors that influence EV adoption – for 17 states from 2010-2021. This study aims to: (a) visualize EV registration trends across states by EV makes, models, powertrain types and gross vehicle weight categories, (b) identify economic and socio-demographic factors affecting EV penetration rate across U.S. counties to understand future EV penetration (total EVs/total vehicle population), and (c) understand the influence of cross-county proximity on other counties' EV penetration through spatial time-series analysis. California, New York, and Washington have shown the highest number of EV registrations over the years, with light-duty EVs having the highest share in EVs and an increased adoption in heavy-duty EVs post-2018. We find charging stations availability, average household income and commute time to have a significant impact on EV penetration rates. Furthermore, we find strong correlation in increased EV penetration between neighboring counties, and counties with higher EV penetration to have a stronger influence than others. We contribute by identifying definitive factors that influence EV adoption and forecast penetration to suggest policy implications to manufacturers for adequate future investment planning in EV infrastructure expansion.

Keyword(s):

Ev Penetration, ARIMA Modeling, Spatial Time-Series Analysis, Forecast, Economic, Socio-Demographic

Mentor(s):

Nadia Gkritza (Engineering); Prasanna Humagain (Engineering); Ricardo Chahine (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 567
Presentation Time: 7/27, GRIS 133 at 2:20pm-2:40pm

SURF

Deep Learning-based Classification of Trust in Future Construction Sites Using Neuro-Psychophysiological Measurements

Author(s):

Nestor Felipe Gonzalez Garcia† (Universidad de los Andes)

Abstract:

As technological advancements emerge, state-of-the-art robotic technologies will be progressively integrated into future construction sites. Hence, it is inevitable that future construction workers will have to share their workspace with such technologies. Additionally, establishing trust among workers in these technologies is important for safer and more effective interaction. However, trust is dynamic as it can be impacted by many factors, and monitoring its status is crucial in future construction workplaces. This study aims to develop a deep-learning-based model using neuro-psychophysiological signals and subjective trust data to measure and predict human-robot collaboration (HRC) tasks. A virtual reality bricklaying simulation was developed to collect data from 90 participants while several manipulations were incorporated to affect their trust in robots (e.g., robot failure). Neuro-psychophysiological (i.e., brain oxygenation, heart rate and electrodermal activity) and biomechanical (i.e., head motion) responses were then collected as they were completing the bricklaying task. Then, features were extracted through a convolutional autoencoder and long-short-term memory networks to train a deep learning model for classifying trust. The models were tuned by adjusting different hyperparameters and psychophysiological measurements to optimize their performance. Finally, using the proposed model, workers' trust could be predicted from real time data to provide insights into strategies for them to appropriately calibrate their trust and have successful HRC in future construction sites.

Keyword(s):

Human-Robot Trust, Deep Learning, Future Construction, Neuro-Psychophysiological Responses

Mentor(s):

Sogand Hasanzadeh (Engineering); Woei-Chyi Chang (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 568
Presentation Time: 7/27, GRIS 133 at 2:40pm-3:00pm

SURF

Biofilm Impact on Absorbed Contaminants on Microplastics and Drinking Water Safety

Author(s):

Hannah Tharrington† (Science); Catherine Fleming* (Engineering)

Abstract:

Microplastics, a water contaminant, possess qualities making them susceptible to biofilm growth. Biofilm is a collection of microorganisms growing within a matrix known as the extracellular polymeric substance, or the EPS. Microbial growth is amplified on non-polar, hydrophobic surfaces; degradation of plastic polymers into carbon provides an ample energy source for these microbes. Concerns of biofilm growth surround the potential of bacteria to absorb and transport contaminants from the surrounding waters. We hypothesize that the growth of biofilm on microplastics impacts the adsorption of waterborne contaminants. This study utilized the BioMig procedure to grow biofilm on 5mm glass beads and microscope slides, which were submerged in water from the Wabash River and tap water from the Hampton Hall of Civil Engineering. A phosphate buffer, iron solution, and sodium acetate solution serving as a carbon source, were then added to the water. Observations were taken over a week, while flow cytometry was performed to analyze cell count. Next, to examine the role of biofilm on contaminant absorption, biofilm was grown in vials containing 5mm glass beads and low-density polyethylene pellets. These vials are to be contaminated and further analyzed. Our observations show that biofilm rapidly grows in both varieties of water, with added carbon increasing the rate of growth. Subsequently, analysis of the vials is expected to show the relationship between biofilm and contaminant adsorption. The relationship between biofilm, microplastics, and contaminant fate is intended to provide solutions for concerns of plastic's use in water distribution systems.

Keyword(s):

Biofilm, Microplastics, Microbial Growth, Water Systems

Mentor(s):

Paula Coelho (Engineering); Paula Coelho (Engineering); Caitlin Proctor (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 569
Presentation Time: 7/27, GRIS 134 at 2:00pm-2:20pm

SURF

The Mechanical Behaviors of a Confining Extracellular Matrix during Cell Division

Author(s):

Matthew Boyd† (Engineering)

Abstract:

In several physiological processes, such as tumor cell growth, cell division occurs within an extracellular matrix. The success of mitosis relies on whether cells can overcome the physical restriction from the extracellular matrix. Although previous studies have shown that cells secure a space for their division by generating mechanical forces, the responsive behaviors of the extracellular matrix during cell division are largely unknown. In this study, we sought to define how the extracellular matrix deforms in response to mitotic cellular forces to better understand mitosis in confining microenvironments. We employed a computational model to investigate the division of a single cell occurring within an extracellular matrix consisting of discrete fibers cross-linked to each other. The cell is simplified into a membrane structure subjected to two types of forces generated by the cytokinetic ring and mitotic spindle. It is assumed that cross-linking points between fibers can break in a force-dependent manner, which varies the connectivity of the matrix over time. We observed that the connectivity of the extracellular matrix affects the success of mechanically-confined mitosis through tensile force relaxation, which primarily occurs in proximity to the cell membrane. Additionally, we established how the connectivity varies the distribution of tension along both the elongation and division axes, as well as the physical work done by the cell. Our results reveal fundamental characteristics of a confining extracellular matrix, providing insights into understanding how single cells can divide in the presence of a constraining environment.

Keyword(s):

Cell Division, Extracellular Matrix Behavior, Cellular Biophysics

Mentor(s):

Tae Yoon Kim (Engineering); Md Foysal Rabbi (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 570
Presentation Time: 7/27, GRIS 134 at 2:20pm-2:40pm

SURF

The Impact of Lactation and Early Weaning on Cardiac Physiology

Author(s):

Charlotte Cleary† (Engineering)

Abstract:

Pregnancy induces significant physiological changes in both the mother and fetus, impacting their survival. Hormonal expression during and after pregnancy has a notable effect on cardiovascular complications and maternal hemostasis. However, there is a significant knowledge gap regarding the influence of maternal behaviors, specifically lactation, on cardiac remodeling. This study investigates the effects of lactation on cardiac parameters, including stroke volume and wall thickness, by weaning mice at 1 week. We assess cardiac impact using a 4D graphical user interface (GUI) developed by Purdue University, collecting and segmenting data from gestational days (6.5, 12.5, 15.5, and 18.5) and postpartum days (ppDay 1, 4, 7, 14, and 21). Blood pressure is measured using a tail-cuff system (Coda, Kent Scientific), while ultrasound images of the left ventricle were collected in long-axis and short-axis positions with a VEVO 3100 ultrasound (FUJIFILM VisualSonics). A MATLAB GUI enables the generation of 4D heart segmentations, facilitating serial cardiac ultrasound measurements. We anticipate significant increases in cardiac output, cardiac compliance, stroke volume, and blood pressure, peaking during mid-pregnancy, stabilizing until postpartum, after which it may decreases over two weeks. Relative wall thickness is expected to gradually increase throughout pregnancy and lactation, reaching a plateau after weaning. Through visualizing changes in the endocardium and epicardium using the Purdue MATLAB GUI, we aim to understand why lactation influences cardiac remodeling and its impact on post-childbirth health.

Keyword(s):

Medical Science & Technology, Biological Characterization and Imaging, Biotechnology Data Insights, Biological Simulation & Technology

Mentor(s):

Craig Goergen (Engineering); Elnaz Ghajar-Rahimi (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 571
Presentation Time: 7/27, GRIS 134 at 2:40pm-3:00pm

SURF

Low-dose isoproterenol administration in the murine mdx model unmasks progression of Duchenne-associated cardiomyopathy

Author(s):

Alyssa Richards† (Engineering)

Abstract:

Cardiomyopathy is a result of the cardiovascular phenotype of Duchenne muscular dystrophy (DMD), which leads to congestive heart failure and early mortality. Cardiomyopathy remains the number one cause of death in DMD. Our objective was to characterize the progression of cardiomyopathy in a murine model of DMD. We hypothesized that a genetic mouse model of DMD will exhibit significantly lower function over time as measured by ejection fraction when given an isoproterenol challenge. The murine model of DMD C57BL/10ScSn-Dmdmdx/J (B10.mdx; n=6 female) was examined in comparison to the wild-type control strain C57BL/10ScSnJ (B10; n=6 female). Intraperitoneal isoproterenol administered via daily injections at 3 mg/kg were given for five consecutive days. Cardiac function was assessed by 2D cine ultrasound using a Vevo3100 imaging system (FUJIFILM, VisualSonics) and 4D ultrasound using a MATLAB graphical user interface. Decreases in ejection fraction between baseline and day 7 occurred in both groups following the isoproterenol injections. The changes in B10.mdx ejection fraction decreased significantly from 66% to 45%. Significant decreases in strain in the B10.mdx group between baseline and day 7 were observed in the basal circumferential strain, mid-LV circumferential strain, mid-LV surface area strain, apical surface area strain, and anterior longitudinal strain (p<0.05). Murine B10.mdx models exhibit DMD-associated cardiomyopathy comparable to humans. A series of low-dose isoproterenol injections has the potential to unmask changes such as ejection fraction and strain within 7 days.

Keyword(s):

Biomedical Imaging, Duchenne Muscular Dystrophy, 4D Ultrasound, Murine Model

Mentor(s):

Craig Goergen (Engineering); Conner Earl (Engineering); Steven Welc (Indiana University); Larry Markham (Indiana University); Mark Kowala (Indiana Biosciences Research Institute)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 572
Presentation Time: 7/27, GRIS 118 at 3:00pm-3:20pm

REU in Structural and Computational Biology & Biophysics

Numerical Assessment at Equilibrium of the Binding Between One Ligand and Multiple Targeted Proteins: A Web Based Application

Author(s):

Bobby Estrada† (Science)

Abstract:

In cases where one ligand binds to multiple proteins, it is important to quantify how these molecules will interact with one another. However, current tools do not characterize binding between a single ligand and multiple targeted proteins. This project helps fill this gap by generalizing previously known models for binding among one ligand and multiple targeted proteins, then numerically solving for free ligand concentrations. To assist with the process of finding the fraction of ligand-bound protein, an easily accessible web app was constructed through Streamlit. With this web app, researchers can better quantitatively understand the competitive interactions before experimentation, with the only necessary inputs from experimental parameters. Thus through this model, researchers can gather predictive insights about the fraction of ligand-bound protein.

Keyword(s):

Protein, Ligand, Web App

Mentor(s):

Wen Jiang (Science); Xiaoqi Zhang (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 573
Presentation Time: 7/27, GRIS 118 at 3:20pm-3:40pm

REU in Structural and Computational Biology & Biophysics

Expression and Purification of a DAG Biosensor

Author(s):

Soren Spina† (Clemson University)

Abstract:

Phospholipase C (PLC) is essential to study due to its ability to generate second messengers IP3 (inositol triphosphate) and DAG (diacylglycerol) through its hydrolysis of the membrane lipid phosphatidylinositol 4,5-bisphosphate (PIP2). IP3 triggers Ca2+release, which is important for normal cardiac contractility, while DAG production activates protein kinase C, causing downstream expression of pro-inflammatory genes. Thus, PLC signaling is directly implicated in cardiovascular disease and many other health complications. We are working to detect DAG produced in the membrane, as its presence is directly proportional to PLC activity. We generated a construct to express a DAG biosensor, consisting of the rat PKCδ C1 domain tagged with GFP. Fluorescent measurements of DAG production in the presence of purified PLC can allow for direct qualitative and quantitative conclusions about PLC activity.

We are generating this biosensor by utilizing rigorous cloning, transformation, and protein purification techniques. The biosensor is being expressed in E. coli due to the versatility, quick growing times, and decreased cost of bacterial cells compared to eukaryotic cells. Our biosensor has been successfully cloned and sequenced, and next steps are to optimize protein expression conditions, purify the biosensor, and test the biosensor in a model membrane system using total internal reflection fluorescence microscopy. With this biosensor, research involving PLC and similar DAG-induced systems will have more easily interpretable data, allowing it to be used as an impactful tool in research for years to come.

Keyword(s):

Biosensor, Fluorescence, Diacylglycerol, Phospholipase C, Cardiovascular Disease

Mentor(s):

Angeline Lyon (Science); Ketaki Mahurkar (Science); Elisabeth Garland-Kuntz (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 574
Presentation Time: 7/27, GRIS 118 at 3:40pm-4:00pm

REU in Structural and Computational Biology & Biophysics

Structural Insight into SHP-1 Inhibition by M029

Author(s):

Amanda Xu† (Cornell University)

Abstract:

Protein tyrosine phosphatases (PTPs) are signaling enzymes that play a key role in regulating a broad range of biological pathways. Following recent biochemical studies and through new drug development techniques, PTPs have been indicated as prospects for drug discovery. Src homology 2 containing phosphatase 1 (SHP-1) is a cytosolic PTP with the ability to inhibit a number of pathways which enhance macrophage and T cell function. Thus, blocking SHP-1 activity is anticipated to magnify innate and adaptive immunity against tumor cells, characterizing SHP-1 as a novel target for cancer immunotherapy. One small molecule drug that has displayed promise for its ability to inhibit SHP-1 is M029, however, no structure of this complex has been reported. The goal of this project is to obtain a detailed visualization of such a structure in hopes of providing a more direct approach to fully understanding the nature of interactions between SHP-1 and M029. In this study, nickel-affinity purification and size exclusion chromatography were used for the purification of SHP-1. Subsequently, crystals of SHP-1 were soaked with M029 for X-ray diffraction experiments. Data were collected from these crystals and is currently being processed for structure determination. Additionally, the SHP-1 expression construct is undergoing further optimization to increase compactness and improve crystallization screening. Crystal soaks and co-crystallization will then be performed using the new construct. Since preliminary data suggests M029 as a potential contributor to anti-cancer immunity, solving the SHP-1/M029 complex structure will provide direct evidence for the potency and selectivity of M029 binding.

Keyword(s):

Tyrosine Phosphatase, SHP-1, M029, X-Ray Crystallography, PTPN6

Mentor(s):

Nick Noinaj (Science); Zhong-Yin Zhang (Pharmacy); Evan Billings (Science); Zihan Qu (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 575
Presentation Time: 7/27, GRIS 125 at 3:00pm-3:20pm

Pharmacy Research Fellows

Effect of IRBIT on Insulin Regulation in Vivo

Author(s):

Gabrielle Bailey† (Pharmacy)

Abstract:

This summer, the Hockerman lab and I sought to study IRBIT (IP3 Receptor Binding Protein activated by Inositol 1,4,5 Triphosphate) and its effect on insulin transcription and regulation. This past year the lab has been transitioning from a cell model to a mouse model to observe the effects of IRBIT in vivo and learn more about its mechanisms in the body. From the cell model, we know IRBIT is vital in insulin transcription and regulation. We performed a series of glucose tolerance tests on three groups of mice: one with both copies of the IRBIT-encoding gene intact, one with only one copy intact, and one group with IRBIT completely knocked out of the beta cells of the pancreas. Throughout these tests, we have found that knocking out half of IRBIT content seemed to affect glucose levels most prominently. This seems to imply that there is some mechanism of compensation for insulin production in the body when IRBIT is completely knocked out. This makes the IRBIT heterozygous mice unable to produce insulin in response to high glucose levels, and the IRBIT knockout mice able to stabilize blood sugar levels at a normal rate. We also found that in comparison with the males, female glucose levels were consistent throughout the different groups of mice. Additionally, adding an anti-muscarinic drug, atropine, altered male glucose levels substantially, yet female groups were much less affected. Our postulation is that because estrogen is heavily involved in insulin regulation, IRBIT is not as important in female mice's ability to produce insulin.

Keyword(s):

IRBIT, Glucose Regulation, Insulin, Beta Cells, Estrogen

Mentor(s):

Greg Hockerman (Pharmacy)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 576
Presentation Time: 7/27, GRIS 125 at 3:20pm-3:40pm

Analyzing Lafayette Northend Livability Through Neighborhood Retention

Author(s):

Andy Kim† (DSB, JMHC); Jennifer Yang* (Engineering, JMHC); Kevin Potthast* (Engineering)

Abstract:

In light of persistent decline in community wellbeing in the Lafayette Northend, there is increasing demand for identifying areas for growth within the Northend neighborhoods. This study hopes to identify such areas, primarily through the lens of livability – the “environmental life chances” that are available to Northend residents (Veenhoven, 1999). This study plans to compare expected local migration rates in both the United States and Indiana to local migration rates observed in the Northend of Lafayette, IN. Expected migration rates were calculated using data and methodology provided by the United States Census, while the observed migration rates were calculated using data from the Polk Directory. By comparing expected migration rates to observed migration rates, we will be able to determine which factors in the Northend may be impacting neighborhood retention. This may help to identify the most prominent concerns within the Northend, and through our partnership with the City of Lafayette, our hope is to make recommendations that benefit the residents of the Lafayette Northend.

Keyword(s):

Community Wellbeing, Livability, Neighborhood Retention, Neighborhood Revitalization

Mentor(s):

Jason Ware (JMHC)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 577
Presentation Time: 7/27, GRIS 125 at 3:40pm-4:00pm

Summer Stay

Organizational Goal Conflict Perception and Implications

Author(s):

Ziqi Yao† (HHS); Bhavti Shah* (HHS, Polytechnic Institute); Brandon Krivsky* (HHS)

Abstract:

For decades, enhancing employees' work performance was considered as the most important goal in organizations. However, as the workforce became increasingly diverse, many organizations started to pursue the goal of recruiting and maintaining a diverse group of employees. To help organizations make decisions related to these two goals, research in Industrial-Organizational Psychology has been focusing on the tradeoff between performance and diversity when using different predictors in selection and recruitment. However, little work has examined how lay people think about these two goals. This is important because individuals' perceptions of these goals may influence their support toward organizational diversity policies. To address this gap, we drew on the goal conflict literature in motivation science, and proposed that people have different beliefs about the conflict between performance goal and diversity goal: inherent conflict and/ or resource conflict beliefs. We conducted an online survey (n = 157) to examine if people have these two beliefs and whether they could predict people's attitudes and behaviors toward organizational diversity management. Results showed that resource and inherent conflict beliefs were two separate dimensions. Those with higher inherent, but not resource, conflict belief supported more integrating strategy and less avoiding or choosing strategy in managing performance and diversity goals. Moreover, inherent (compared to resource) conflict belief predicted more negative attitudes toward diversity policies in organizations. Moving forward, we expect to further analyze the data, including participants' qualitative responses to our open-ended question on how companies can manage the two goals.

Keyword(s):

Diversity, Performance, Goal Conflict Management, Multiple Goal Pursuit, Organizational Policies

Mentor(s):

Franki Kung (HHS); Zhixu (Rick) Yang (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 578
Presentation Time: 7/27, GRIS 126 at 3:00pm-3:20pm

SURF

Synthesis and Characterization of a Conductive and Solution-Processable Modified Transparent Conducting Polymer

Author(s):

Matthew Schiavone† (Engineering)

Abstract:

Transparent conductors (TCs) are vital materials used in optoelectronic devices, such as touch screens, solar cells, and light emitting diodes. The premiere TC, indium tin oxide (ITO), however, is limited by its poor flexibility and the rarity of indium, leading to the development of alternatives, including transparent organic conductors (TOCs). One recently published and promising TOC is the n-doped poly(3,7-dihydrobenzo[1,2-b:4,5-b′]difuran-2,6-dione) (nPBDF), which rivals the performance of ITO. Herein we report a modification of nPBDF and measure its electronic and optical properties. The monomer was synthesized in five linear steps from commercial materials, and the polymer was subsequently synthesized via a copper catalyzed dual cascade oxidative polymerization and reductive doping. Thin-film samples of the polymer were prepared to measure the photophysical, optical, and electrical properties for use as a TOC. The effect of this modification will be determined by comparing the properties of the modified polymer with the original nPBDF. If this new polymer has comparable properties to nPBDF, it could be used for similar applications. Additionally, the modifications on this new polymer could open opportunities for novel derivatives by further reactions.

Keyword(s):

Polymers, Electrical Conductivity, Electrical Conductors, Thin Films

Mentor(s):

Jianguo Mei (Science); Mustafa Ahmed (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 579
Presentation Time: 7/27, GRIS 126 at 3:20pm-3:40pm

SURF

Two-Photon Excited Fluorescence as a Chiral-Specific Surface Spectroscopy Model

Author(s):

Julia Ku† (Engineering); Camila Strachan‡ (New York University); Matthew Wilson‡ (Science)

Abstract:

A theoretical foundation and experimental apparatus is described for a new interface-specific chiral spectroscopy based on two-photon excited fluorescence (TPEF) and second harmonic generation (SHG). More than half of the medical drugs that are manufactured and sold today are chiral molecules. Understanding and analyzing the chemical behaviors of enantiomers can help predict how pharmaceutical compounds will affect and interact with molecules in our body. Although they have similar chemical properties, chiral molecules have the inherent property of non-superimposability, which is when the mirror image of a molecule is not identical to its original image. Optical activity in chiral molecules has been studied for decades in isotropic systems. This study analyzes and develops a mathematical framework of naproxen's chirality using circular dichroism (CD) spectroscopy performed for the nonlinear optical processes TPEF and SHG. A sample of naproxen microcrystals is prepared on silica microscope slides by solvent evaporation from a saturated methanol solution. In addition to measuring the difference in right-handed and left-handed circularly polarized light by CD, predicted chiral-specific results from SHG and the intensities emitted from two-photon fluorescence are also recorded. This work builds on previous theoretical and experimental work with a prior SURF student (Camila Strachan) using linear spectroscopy for interface-specific absorbance circular dichroism (in press in J. Phys. Chem). Further research will be on fluorescence optical rotary dispersion (F-ORD), in which a chiral sample is illuminated by an ultraviolet light source to selectively probe and interpret orientated chiral molecules at interfaces.

Keyword(s):

Circular Dichroism Spectroscopy, Nonlinear Optics, Chirality, Two-Photon Fluorescence, Second Harmonic Generation

Mentor(s):

Garth Simpson (Science); Kevin Murati (Science); Gwendylan Turner (Science); Caitlin Dunlap (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 580
Presentation Time: 7/27, GRIS 126 at 3:40pm-4:00pm

SURF

Enhancing Air Quality Predictions: Integrating Stable Isotopes and Machine Learning in Atmospheric Models

Author(s):

Anusha Waseem† (Engineering)

Abstract:

Air pollution is increasingly becoming a major global concern as the quality of our air continues to degrade. To address this issue, it is crucial to improve our understanding of air pollution and our ability to predict it accurately. This study proposes a new approach by incorporating stable isotopes into models that simulate the chemical reactions causing air pollution.To accomplish this, we have developed a simulation mechanism that captures the different reactions and substances involved in air pollution. The simulation, utilizing a specialized software known as the Music-Box simulator, generates datasets that capture the complicated interactions among pollution sources and their collective influence on air quality.We have also introduced a special kind of isotope, called 15N, into the model to track its behavior. By using advanced mathematical models, we explore how pollution sources are connected and how this affects the distribution of the 15N isotope.To validate the approach, a comparison is made between the simulations and real-world observations of specific compounds.This study aims to provide a better understanding of how certain isotopes behave during the chemical processes that cause air pollution. Additionally, we will evaluate how well machine learning models can predict air quality indicators.By combining simulation and machine learning, we hope to expand our knowledge of air pollution dynamics and contribute to the development of effective strategies to reduce air pollution.

Keyword(s):

Air Pollution, Simulation, Machine Learning, Mathematical Models, Effective Strategies

Mentor(s):

Greg Michalski (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 581
Presentation Time: 7/27, GRIS 133 at 3:00pm-3:20pm

SURF

Real-Time VOC Measurement Applications in Disaster Relief

Author(s):

Grayson Wittbrod† (Engineering)

Abstract:

The growing complexity and economic relevance of commercial manufacturing necessitates increasingly precise and accurate analysis of contaminants to facilitate effective regulation. Human and environmental health is jeopardized by insufficient understanding of the components of such activity. A recent disaster in East Palestine, Ohio, has underscored the importance of proper contamination assessment; on February 3rd, 2023, a Norfolk Southern train derailment led to the controlled burning of over 100,000 gallons of a known carcinogen, vinyl chloride, as well as leaking of various other hazardous compounds into creeks, soil, air, and homes. To gauge the extent of contamination and potential for health-related concerns, state-of-the-art proton transfer time-of-flight mass spectrometry (PTR-TOF-MS) has been utilized to analyze water samples in real time with a sensitivity to volatile organic compound (VOC) concentrations under 10 parts per trillion. Ionizing VOCs allowed for high resolution measurement of mass (over a thousandth of an AMU) and identification of compounds based on a mass to charge ratio spectrum. Quantifying the released compounds will allow for well-informed health advising, more effective cleanup methods, and a more steadfast metric to assess accountability from Norfolk Southern. The results should serve to aid in disaster relief efforts in East Palestine as well as improving standard practices pertaining to sustainable, safe practices in industrial manufacturing, human and environmental health monitoring, transportation, and disaster remediation.

Keyword(s):

PTR-TOF-MS, VOC, Air Quality, Disaster, Environmental Health

Mentor(s):

Brandon Boor (Engineering); Nusrat Jung (Engineering); Jinglin Jiang (Engineering); Xiaosu Ding (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 582

Presentation Time: 7/27, GRIS 133 at 3:20pm-3:40pm

SURF

An Origami-inspired Multi-type Locomotive Planetary Exploration Robot

Author(s):

Aditya Arjun Anibha† (Engineering); Harrison Booker‡ (Engineering); Ansh Mishra* (Georgia Institute of Technology); Sumaira Khan* (Habib University); Yuto Tanaka* (Engineering)

Abstract:

Extraterrestrial planetary exploration is a pertinent challenge for humanity's expansion into space. The return and first ventures of humans to the Moon and Mars raise an urgent demand for advanced technologies and exploration systems to facilitate long-term and successful settlement on extraterrestrial planetary bodies. Traditional rover designs can only access a limited range of environments and locations. It is crucial to create a sustainable, efficient, inexpensive, and adaptable autonomous system to support human exploration across many surfaces. This project develops a planetary exploration robot with multiple locomotive modes to achieve this goal. It is supplemented by the unique properties of 3D printed origami patterns, such as the cylindrical bellow Yoshimura to create a compressible, lightweight, and flexible structure. Multiple origami patterns and designs were manufactured using 3D-printing technology for easy production. Tests across the desired locomotive abilities were conducted to assess the robot's capabilities. Mathematical modeling and numerical methods were used to determine critical factors for performance improvement. A tension-based actuation mechanism using strings reeled in by servos was used with autonomous obstacle navigation algorithms to enable mobility. The resultant product has a broader range of locomotive modes at a human scale than previous origami robots and is robust and compatible with space missions. This study demonstrates the feasibility of developing an autonomous origami robot that can transform across multiple locomotive modes to adapt to most potential environments and surfaces. The design approach outlined in this project establishes an improved precedent for future methodologies to develop versatile robotic exploration systems.

Keyword(s):

Space Robots, Origami-Inspired Deployable System, Planetary Exploration, Autonomous Control, Optimal Design

Mentor(s):

Ran Dai (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 583
Presentation Time: 7/27, GRIS 133 at 3:40pm-4:00pm

SURF

Manufacturing and Characterization of Alumina/Thermoplastic Polyurethane Composite for the Production of FFF Filament Used in AM Processes

Author(s):

Joseph Meier† (Engineering)

Abstract:

Composites are vital to many engineering fields, including mechanical, civil, and aerospace, due to their versatility and customizability. Incorporating composites into additive manufacturing (AM) allows for great improvements to the complex geometric capabilities of printed components by being able to tailor material properties to specific applications. For example, combining ceramic particles and elastomers, desirable mechanical properties can be enhanced, including increased compressive Young's modulus compared to unmodified elastomer and increased failure stress compared to unmodified ceramic. Ceramic/elastomer composites have yet to make their way into the realm of AM despite their potential for enabling the production of intricate components with improved mechanical properties. To address this lack of ceramic/elastomer composites in AM, this work describes the manufacturing and characterization of a representative alumina ceramic modified thermoplastic polyurethane (TPU) composite filament for fused filament fabrication (FFF). Alumina/TPU composite material was manufactured using a novel wet mix method previously developed within this research group. Composites of 10, 20, and 30 wt.% alumina to TPU were manufactured and extruded to produce filament for FFF. These materials, along with unmodified TPU, were mechanically characterized using tensile, compressive, and impact loading states. The results of the mechanical tests will be compared to examine the effect of the ceramic inclusions on Young's modulus in tension and compression, elongation at break, and energy absorption. Gaining an understanding in fabricating ceramic/elastomer composite filament presents an exciting opportunity to manufacture FFF printed components with customizable and tailorable mechanical characteristics such as improved impact resistance and biaxial stiffness properties.

Keyword(s):

Ceramic Composites, Ceramic/Elastomer Composites, Additive Manufacturing, Fused Filament Fabrication

Mentor(s):

Tyler Tallman (Engineering); Julio Hernandez (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 584
Presentation Time: 7/27, GRIS 134 at 3:00pm-3:20pm

SURF

Design and preliminary evaluation of an engineered polymerizable type I collagen material as a regenerative vascular patch

Author(s):

Jarrett Fowler† (Texas A&M University)

Abstract:

Atherosclerosis, a plaque build-up in vessels, often leads to cardiovascular dysfunction, including heart attacks, strokes, and ischemia, and contributes to over 700,000 deaths annually in the US. One treatment option for narrowed arteries involves surgically opening the artery and removing the plaque, after which a vascular patch may be applied to assist with vessel closure and reducing restenosis rates. Standard patches (e.g., bovine pericardium, and Dacron) are recognized as foreign materials and lack regenerative capabilities, leading to post-surgical complications. Therefore, new therapeutic options are needed that will reliably support the restoration of vascular structure and function while minimizing post-surgical bleeding, infection, arterial restenosis and occlusion, and aneurysm formation. Our proposed solution represents a vascular patch made of engineered polymeric collagen material that possesses regenerative capabilities without inducing undesirable inflammatory responses and supports the customization of microstructural and mechanical characteristics. As a first step, two collagen patch materials were fabricated using compression densification at varied strain rates to yield different fibrillar microstructures. Patches were then evaluated and compared based on tensile strength, Young's modulus, and suture retention strength. Finally, patches were sutured into a porcine carotid artery within a continuous flow loop to test burst strength and characterize patch performance under constant pressures. Results showed that patch mechanical properties and performance were highly dependent on fibrillar microstructure, verifying the significance of this criterion in vascular patch design. These studies represent an important step toward the engineering of next-generation vascular patches and replacements to restore vascular structure and function.

Keyword(s):

Vascular Patch, Fibrillar Microstructure, Polymerizable Collagen, Remodeling, Mechanical Properties

Mentor(s):

Rachel Morrison (Engineering); Sherry Harbin (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 585
Presentation Time: 7/27, GRIS 134 at 3:20pm-3:40pm

SURF

Developing Tuneable Granular Hydrogels with High Porosity for Tissue Engineering Applications

Author(s):

Leia Schiltz† (Engineering)

Abstract:

Injectable biomaterials are attractive treatment strategies for tissue engineering applications because they allow

minimally invasive delivery and facilitate the filling of unevenly shaped wounds. However, in synthetic biomaterial

systems, it is challenging to simultaneously optimize several properties including porosity, mechanical stiffness,

and injectability. For instance, traditional injectable hydrogels have low porosity that hinders cell invasion and

tissue growth. The goal of this SURF project was to develop granular hydrogels with tunable stiffness and porosity

for use in tissue repair. We used a photocurable norbornene-modified hyaluronic acid (Nor-HA) polymer at varying

concentrations and degrees of crosslinking and characterized mechanical properties (e.g., elastic modulus) using

a uniaxial compression test. Bulk Nor-HA hydrogels were fragmented via extrusion through syringe needles into

microparticles, and the resulting polydisperse population was sorted using a strainer into small and large particle

fractions. Unsorted and sorted particles were then assembled into granular hydrogels by vacuum filtration. Particle

size was imaged using fluorescence microscopy and hydrogel porosity was visualized using confocal microscopy;

results were quantified via ImageJ. We found that particle size and degree of packing significantly influence

hydrogel porosity and rheological behavior. Rheological data indicates that the size and degree of packing also

affect the shear strain response and the yield strain value, impacting the extrudability of the hydrogels. Overall,

our findings suggest that granular hydrogels made with fragmented particles are promising biomaterials with

properties to support tissue regeneration by providing more space and stability to promote cell growth.

Keyword(s):

Biomaterials, Tissue Engineering, Injectable Hydrogels, Stiffness, Porosity

Mentor(s):

Taimoor Qazi (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 586
Presentation Time: 7/27, GRIS 134 at 3:40pm-4:00pm

SURF

Examination of Sex Differences Using 4D Ultrasound Analysis in Murine Models of Myocardial Infarction

Author(s):

Amelya Fox† (Engineering, JMHC)

Abstract:

Cardiovascular disease (CVD), including myocardial infarction (MI), is the leading cause of death worldwide for both sexes. MI occurs when blood flow to the myocardium is obstructed, often by an occlusion of the coronary artery. The infarcted region typically becomes stiff and fibrous as healthy myocytes are replaced by scar tissue, and the heart remodels to compensate. Dilation and wall thinning in the ventricle during the remodeling process can lead to heart failure. Sex differences in the mechanisms of myocardial infarction and cardiac remodeling exist but are poorly understood, leading to sex-based discrepancies in diagnosis and prognosis. In this study, we seek to develop a better understanding of the physiological sex differences that govern the heart's adaptation to injury and progression to heart failure. We induced MI in a mouse model using permanent ligation of the left coronary artery (LCA) in both and males (n=7) and females (n=8). We then imaged the left ventricle of the heart using 2 and 4-dimensional ultrasound (4DUS) at various time points up to 28 days following the infarct, analyzing the images to calculate metrics of left ventricular function. The resulting data will be statistically analyzed to determine if there are differences between the male and female groups. Our results and this methodology can likely be used to inform further studies aimed at achieving equitable health outcomes for CVD patients of both sexes.

Keyword(s):

Biomedical Imaging, Ultrasound, Cardiovascular Disease, Sex Differences, Myocardial Infarction

Mentor(s):

Craig Goergen (Engineering); Luke Schepers (Engineering); Conner Earl (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 587
Presentation Time: 7/27, GRIS 118 at 4:00pm-4:20pm

REU in Structural and Computational Biology & Biophysics

Structural and Functional Analysis of Enterovirus D68 VP1 F159V

Author(s):

Alejandra Johnson† (Science)

Abstract:

Redacted.

Keyword(s):

Enterovirus, Mutation, Cryo-EM, Antiviral Resistance

Mentor(s):

Richard Kuhn (Science); Thomas Klose (Science); Jacqueline Anderson (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 588
Presentation Time: 7/27, GRIS 118 at 4:20pm-4:40pm

REU in Structural and Computational Biology & Biophysics

Measuring single molecule membrane penetrating peptide-lipid interactions using in vitro reconstitution

Author(s):

Emmaleigh Shinno† (Pennsylvania State University); Andrew Walke‡ (Science)

Abstract:

Cationic amphiphilic polyproline helices (CAPHs) are cell penetrating peptides (CPPs) with great promise as a vehicle for drug delivery or direct bacterial killing within a cell. To maximize CAPH utility, a molecular understanding of binding and activity thresholds is needed. Structure-function relationships have been established for some CPPs but the kinetics of individual peptides interacting with the membrane may provide new insights to improve targeting and dosing. Single molecule binding on and off rates can be measured using in vitro reconstitution using glass-supported lipid bilayers (SLBs) of controlled composition. Fluorescently tagged CAPHs interacting with the membrane can be visualized with high spatial and temporal resolution in a total internal reflection fluorescence (TIRF) configuration that is membrane selective. Lipid charge, character, and densities can all be modulated and stacked supported SLBs can be used to measure the extent of membrane penetration. Some CAPHs are more cationic than others and this investigation focuses on a +9 peptide that is strongly membrane penetrating. We show that this CAPH is sensitive to membrane cholesterol suggesting that this membrane component impacts efficacy of CAPH delivery. Ongoing efforts are focused on modulating CAPH charge and increasing complexity of model membranes to recapitulate more realistic cell surfaces.

Keyword(s):

In Vitro Reconstitution, Engineered Peptides, Fluorescence Imaging, Binding Kinetics, Protein Lipid Interactions

Mentor(s):

Shalini Low-Nam (Science); Andrew Walke (Science); Vinay Menon (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 589
Presentation Time: 7/27, GRIS 118 at 4:40pm-5:00pm

Creating Robust Deep Neural Networks through Human Behavior Alignment

Author(s):

Bharath Anand†

Abstract:

The remarkable success of deep neural networks (DNNs) has led to great interest in their adoption in critical applications such as healthcare, autonomous vehicles, and law enforcement. However, DNNs produce significantly more errors under real-world noisy inputs, presenting a major bottleneck to their use in applications where lives, safety, or significant resources are at stake. Prior efforts to address this problem greatly increase training time and produce improvements only on specific types of noise. Our research is motivated by the observation that humans are resilient to a broad range of noisy inputs that challenge DNNs – in fact, humans barely perceive perturbations that cause ANNs to fail spectacularly. We hypothesize that statistically aligning DNNs to human behavior during training can cause them to inherit desirable robustness traits. We propose BrainTrain, a framework to create more robust DNNs through human behavior alignment that consists of (i) a cross-platform mobile application that enables the collection of human behavioral data at scale, (ii) a novel training method that uses a composite loss function to co-optimize accuracy and human behavior alignment during stochastic gradient descent (SGD) based DNN training, and (iii) an evaluation framework to compare BrainTrain-ed DNN models with conventional models. We implemented BrainTrain using open-source software frameworks and applied it to state-of-the-art DNNs. BrainTrain-ed DNNs showed up to 26% higher accuracy under a wide range of noisy inputs and up to 16 times lower calibration error without increasing training time. BrainTrain offers a pathway to enabling the adoption of DNNs in critical applications.

Keyword(s):

Artificial Intelligence, Neural Networks, Robustness, Training, Human Behavioral Alignment

Mentor(s):

Sarada Krithivasan (Engineering); Michael Lee (Massachusetts Institute of Technology)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 590
Presentation Time: 7/27, GRIS 125 at 4:00pm-4:20pm

Vet Med Summer Research

Canine necropsy cases with unexplained hemorrhaging: investigation of von Willebrand disease type 1 variant

Author(s):

Rebecca Chenoweth† (Veterinary Medicine)

Abstract:

Canine necropsy cases with unexplained hemorrhage typically trigger anticoagulant toxicity testing in diagnostic laboratories. However, when these toxicity tests are negative, the bleeding etiology is not usually further pursued. DNA was previously extracted from banked tissues of canine necropsy cases with unexplained bleeding and negative anticoagulant tests (n = 62) or positive anticoagulant tests (auxiliary controls, n = 5). These dogs were genotyped for a Factor VII variant known to cause variable bleeding phenotypes in many breeds of dogs; all results were negative. As a next step, the present study investigated the known von Willebrand disease type I (vWDI) variant (c.7437G>A) in the same population. The mode of inheritance for vWDI is autosomal with incomplete penetrance, although the expressivity on different breed backgrounds is variable. To identify the vWDI variant, the DNA extractions were run through PCR and then submitted for Sanger sequencing. Four heterozygous dogs were identified in the sample population. Each of the identified carriers is from a breed known to possess the vWDI variant in its gene pool (German Shepherd, American Staffordshire Terrier, and Miniature Australian Shepherd) except for the Newfoundland. Our results provide a likely explanation for the bleeding phenotype observed in these four cases, however, the lack of von Willebrand's factor plasma quantification means this conclusion has some uncertainty. Incorporation of routine vWDI genotyping for such cases in the future may be reasonable depending on the dog's breed, although the likelihood of successful diagnostic resolution is moderate, given the rarity observed in our sample population.

Keyword(s):

von Willebrand Disease Type I, Unexplained Bleeding, Canine Necropsy, Genetic Mutation, Dog

Mentor(s):

Kari Ekenstedt (Veterinary Medicine)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 591
Presentation Time: 7/27, GRIS 125 at 4:20pm-4:40pm

Thermal performance simulations for HL-CMS Inner Tracker detector components

Author(s):

Yuvraj Chauhan† (Engineering)

Abstract:

The high luminosity upgrade for the Compact Muon Solenoid detector at CERN – LHC will push the limits of structural support materials with high radiation environment and the need for robust cooling. The detector support structure consists of a composite cross-section that acts as a thermal pathway for cooling silicon modules and chips. This study utilized Ansys Workbench to investigate the thermal runaway management methods for a carbon fiber plate integrated with detector chipsets, which generate substantial amounts of heat. Two different approaches were analyzed: a sandwich carbon foam design and a U-shaped carbon foam design. Both foam designs were bonded with epoxy interfaces to the plates and utilized stainless steel cooling pipes to conduct heat away from the assembly. Additionally, the study examined the impact of varying the thickness of the epoxy interfaces between the foams and carbon plate. The results indicated that the thickness of the epoxy interfaces had a negligible effect on the maximum temperatures experienced by the plates. Furthermore, the sandwich foam design exhibited significantly superior performance, with an average temperature difference of nearly 15 degrees Celsius compared to the U-shaped foam design. These findings emphasize the effectiveness of the sandwich carbon foam approach in mitigating thermal runaway in carbon fiber plates integrated with heat-generating detector chipsets. The results from this parametric study will be used to inform the design and prototyping phase for the Inner Tracker Forward Pixel Detector Dees at Cornell University.

Keyword(s):

Thermal Runaway, Carbon Fiber Composites, Detector Chipsets, Ansys Workbench

Mentor(s):

Andreas Jung (Science); Sushrut Karmarkar (Engineering); Benjamin Denos (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 592
Presentation Time: 7/27, GRIS 125 at 4:40pm-5:00pm

MetaFAIR: An online sensor metadata visualization and exploration tool for FAIR science

Author(s):

Kayla Xu† (Engineering)

Abstract:

Increasing volumes of energy related sensing data are created by diverse sources such as IoT enabled smart manufacturing facilities and environment monitoring sensors. It enables researchers to develop new data-driven machine learning models to study building energy consumption, prediction, and optimization. However, researchers face multiple challenges in querying, accessing, and processing these sensing data. For example, building/energy sensing data typically come with diverse, non-standardized metadata, making it hard for users to correctly understand the semantic attributes, relationships, and structures of the data.

As a first step to tackle this metadata challenge, my project aims to develop a novel online metadata visualization and exploration tool that enables researchers to intuitively discover, interact, and investigate the organization, relationship, and hierarchy of large amounts of sensing data for building energy efficiency. It is funded by the AnalytiXIN initiative sponsored by the Central Indiana Corporate Partnership. This tool was developed in Python using Jupyter Notebook. It retrieves the metadata of diverse building/energy sensing data from real-world manufacturing buildings from AnalytiXIN's Data Lake via a data query API. The metadata is then transformed into a graph model with nodes and edges. The ipcytoscape library is leveraged to create a dynamic and interactive graph representation of the hierarchical structures and relations among the data. Users can view and interact with the graph representation intuitively. This tool is generic and can be easily adapted to work with sensing data from other domains beyond the manufacturing energy community, making data more findable, accessible, interoperable, and reusable (FAIR).

Keyword(s):

Metadata Visualization, FAIR Data, Streaming Data, Jupyter Notebook Tool, Energy Optimization

Mentor(s):

Ming Qu (Engineering); Jaewoo Shin (Science); Dikai Xu (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 593
Presentation Time: 7/27, GRIS 126 at 4:00pm-4:20pm

SURF

Simulating Realistic Patterns: Image Processing for Zebrafish

Author(s):

Kotekar Annapoorna Prabhu† (Engineering); Caroline Henson* (Engineering, JMHC)

Abstract:

Zebrafish (Danio rerio) are small, striped fish that are important in biomedical research, primarily due to their genetic similarity to humans. One of the pigment cell types in zebrafish, melanophores, are closely related to human melanocytes, making them valuable in studying melanoma, a form of skin cancer. Zebrafish stripes take about 3 months to fully develop, making the process of studying their patterns time-consuming. To this end, mathematical models have been developed to simulate stripe formation in zebrafish. However, the simulated patterns produced by these models lack the realism of real fish. The goal of our research is to develop image-processing software that can create realistic zebrafish patterns using mathematical model data. We construct the simulated patterns by sampling different pigment cells from real zebrafish. To make the pattern appear realistic, we select each pigment cell in the simulated stripe by taking the age of the fish and the pigment cell's proximity to the center of the pattern into consideration. Augmenting this approach, we also use a conditional generative adversarial network (cGAN) to generate realistic zebrafish stripes using plots of pigment cell coordinates. In particular, we use 80 pairs of real zebrafish images and their corresponding plots of pigment cell coordinates. Our post-processing software can render a realistic timelapse of zebrafish stripe formation in minutes instead of months, and can be used to review mathematical models of zebrafish both quantitatively and qualitatively. Additionally, we are adapting our methods to produce realistic images for other biological systems, such as fern development.

Keyword(s):

Zebrafish, Simulated Images, Image Processing Software, Zebrafish Patterns, Pattern Formation

Mentor(s):

Alexandria Volkening (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 594
Presentation Time: 7/27, GRIS 126 at 4:20pm-4:40pm

SURF

MUTATIONS OF THE EBOLA VIRUS VP40 PROTEIN

Author(s):

Manuel Torres Narvaez† (Pharmacy); Samuel Wilson* (Pharmacy); Valentina Toro* (Pharmacy)

Abstract:

In 1976 a new virus was discovered, the Ebola Virus (EBOV). This microorganism is part of the Filoviridae family, a filamentous virus with a lipid-envelope, which is extracted from the plasma membrane of the host cell during infection. The EBOV genome is a negative sense RNA, which means the EBOV can replicate more easily in the cytoplasm of the infected cell. EBOV can cause a hemorrhagic fever with a high fatality rate and is classified as a category A pathogen by the National Institutes of Health. It is important to know how the EBOV proteins work, so a therapeutic target can be developed. This paper will be focused on the function of the matrix protein of EBOV known as viral protein 40kDa (eVP40). eVP40 can influence the regulation of gene expression, the formation of virus assembly and budding from the host cell. Additionally, it has been seen that eVP40 is sufficient to form virus-like particles in the absence of other EBOV proteins. The way of investigating eVP40 interactions will be by inducing amino acid mutations in key regions of the protein to determine the presence of different eVP40 conformations, monomer, dimer, or octamer. These different conformations have been linked to different steps of the virus life cycle. Is expected that if the mutations work the presence and amount of these conformations in the host cells will change. This work could help to develop small molecules or antibodies that alter the VP40 conformations as a way to provide a potential treatment.

Keyword(s):

Ebola Virus, Medical Science, Mutations, eVP40

Mentor(s):

Rob Stahelin (Pharmacy)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 595
Presentation Time: 7/27, GRIS 126 at 4:40pm-5:00pm

SURF

Quantification of intervertebral disc strain from high-resolution ultrasound imaging during dynamic loading

Author(s):

Diya Sakhrani† (Engineering)

Abstract:

Lower back pain burdens two-thirds of people, with herniated discs commonly occurring in 20–40-year-old patients. A healthy intervertebral disc (IVD) has an increased pressure measured inside the nucleus pulposus when experiencing an applied load, which then causes tension in the fibers of the annulus fibrosis. The mechanics leading to annular tears, which contribute to the high occurrence of herniated discs, remain insufficiently understood. This highlights the urgent need for research into the mechanisms of disc herniation to better understand the progression of this condition. Bovine caudal spine segments were prepared to isolate the IVDs by removing surrounding tissue and creating bone-disc-bone (BDB) segments by making cuts along the mid?transverse plane of the spine. The ends of the BDB segments were potted in polymethyl methacrylate and then an axial compression was applied to the samples using a custom-built testing device. Through the analysis of 2-dimensional direct deformation estimation, this study expects to see an estimated axial IVD strain with high frequency ultrasound. The IVD curvature is expected to increase as well as the strain with the increased axial compression of the IVD. This strain assessment will aid in the existing knowledge of IVD mechanical behavior with the goal to integrate advanced high-resolution ultrasound imaging and texture correlation techniques to accurately measure strain profiles within the IVD under dynamic loading conditions.

Keyword(s):

Intervertebral Disc, High-Frequency Ultrasound, Strain, Direct Deformation Estimation

Mentor(s):

Craig Goergen (Engineering); Elnaz Ghajar-Rahimi (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 596
Presentation Time: 7/27, GRIS 133 at 4:00pm-4:20pm

SURF

Mimicking Sonographer’s Expertise: Learning Robotic Ultrasound using Behaviour Cloning

Author(s):

Byung Wook Kim† (Engineering); Hyunjun Park‡ (Engineering)

Abstract:

Ultrasound scanning is the most widely used medical imaging modality for various diagnostic procedures and its utilization has increased significantly in resource limited settings. This is due to its affordable cost, non-radiative nature, and ability to provide real-time diagnostic feedback. However, it is a highly expert-dependent modality, which often leads to inconsistent results, erroneous diagnoses, and inaccessibility in rural areas where expert sonographers are available in limited capacity. To address this issue, Autonomous Robotic Ultrasound Systems (A-RUS) implementing model-based and model-free methods for robotic probe motion were introduced. Yet, these existing systems failed to incorporate expert knowledge and technique in their framework leading to their limited clinical adaptability in diverse physiological procedures. In this research, we propose a learning-from-expert demonstration framework to train the RUS that emulates the training process of novice sonographers under expert supervision. First, the RUS is trained using a dataset comprising probe motions and corresponding ultrasound images acquired during the expert's demonstration. Then, the model aims to learn the expert's probing technique using behavioral cloning framework and to predict the next robotic probe movement that an expert sonographer would have performed. The expected outcome of this framework is the prior motion model that can be executed on a RUS for imitating the expert's decision-making skills. We will conduct rigorous validation studies by comparing the proposed RUS for mimicking the skills of different ultrasound experts at IU School of Medicine. Later, this model can be subsequently trained using reinforcement learning policies for efficient intra-patient robotic ultrasound procedures.

Keyword(s):

Medical Ultrasound, Autonomous Robotic Ultrasound System, Image Quality, Behavioral Cloning, Learning From Demonstration

Mentor(s):

Deepak Raina (Polytechnic Institute); Richard Voyles (Polytechnic Institute)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 597
Presentation Time: 7/27, GRIS 133 at 4:20pm-4:40pm

SURF

Quenching in Cooking Oils? A Search for Environmentally Friendly and Non-Toxic Quench Oils

Author(s):

Sydney Belk† (Engineering, JMHC); Yichu Xu* (Liberal Arts, Science); Jackson Truitt* (Engineering)

Abstract:

For metallurgists, quenching is a critical step in processing metals to achieve the desired strength of the material; however, common quenchants are toxic. Due to the necessity of quenching, specifically austempering, this study looks to find and possibly develop an alternative quenchant that is both sustainable and presents the optimal characteristics to allow metals to undergo austenitization. The development and fabrication of a quench apparatus was required to test oils according to ASTM D6710-21. With the collected data, a cooling curve was produced, specific to each quenching oil tested. This in combination with specific heat capacity obtained through a differential scanning calorimetry machine, degradation point obtained through thermogravimetric analysis, and flash point found using a flash point tester, allowed for a clear picture of each oil's potential as an alternative to the current industry quenchants. With thorough analysis and potential refining of oils complete, recommendations will be made for non-toxic quench oil replacements. The data collected will be placed in a catalog, providing a way to easily compare the characteristics of quenchants. Additional research and development are needed to yield more optimal alternatives for specific applications, as well as continuing to characterize additional quenchant candidates.

Keyword(s):

Oil Quenching, Metal Processing, Austempering, Sustainability, Alternative Quenchants

Mentor(s):

Jeffrey Youngblood (Engineering); Michael Titus (Engineering); Rodrigo Orta (Engineering); David Johnson (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 598
Presentation Time: 7/27, GRIS 133 at 4:40pm-5:00pm

SCALE,SURF

Low-Temperature Solder Alloying

Author(s):

Hevi (Tash) Medde-Witage† (Engineering)

Abstract:

Solder joints in electronic packaging undergo deformation due to thermal cycles and mechanical loads. High reflow temperatures in manufacturing cause warpage and manufacturing defects lowering the reliability of the package. Thus, it is important to develop solders with low-melting temperatures to prevent such manufacturing defects. Solder joints are vital components to ensuring reliable mechanical and electronic connections between computer board components. When solder joints deform, these electrical connections weaken, inhibiting electrical components' functionality and eventually ending the component’s life cycle. Modern-day low-temperature solder joints are commonly made of eutectic Sn-Bi. Although eutectic Sn-Bi has a low melting temperature, it performs poorly at high strain rates. By improving the ductility and strength of solder joints, with the addition of alloy elements to the Sn-Bi structures, these solder joints’ life cycles will increase. This project uses microstructure analysis of various solder joints that undergo aging, thermal cycling, and creep testing. Aging tests replicate the long-term behavior of solder joints and thermal cycling simulates the repeated heating and cooling of solder joints. Additionally, creep testing simulates the resistance to deformation based on a mechanical load. The microstructure analysis involves analyzing grain boundaries and intermetallic components within the solder alloy. This research aims to determine the optimal alloy structure and conditions to maximize the reliability of low-temperature solder alloys. Additionally, testing has determined that antimony and silver additions increase the ductility and strength of eutectic Sn-Bi. Aging tests have revealed the development of an intermetallic Cu_6Sn_5 layer and Cu_3Sn layer which causes brittle failure.

Keyword(s):

Solder Alloying, Sn-Bi, Intermetallic, Aging

Mentor(s):

Carol Handwerker (Engineering); John Blendell (Engineering); Hannah Fowler (Engineering); Lijia Xie (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 599
Presentation Time: 7/27, GRIS 134 at 4:00pm-4:20pm

SURF

Hydrolytically Degradable Granular Hydrogels for Tissue Engineering

Author(s):

Nikki Kulkarni† (Engineering)

Abstract:

Biomaterials with tunable degradability to optimize drug delivery and create space for new tissue growth are becoming increasingly necessary for tissue engineering applications. Granular hydrogels are an emerging class of biomaterials with inherent porosity and injectability that have proven to be superior in terms of promoting cell growth as compared to non-porous bulk hydrogels. However, most granular hydrogels are made from covalently crosslinked polymers that show long-term stability raising concerns of unwanted long-term presence in the body. Our study aims to fill an important gap in literature by developing a granular hydrogel system with tunable degradation rate. We synthesized degradable and non-degradable photocurable polymers based on norbornene modified hyaluronic acid and used a microfluidics approach to create spherical polymer droplets that are photo-crosslinked into 100-150 μm microgels. A fluorescent molecule (fluorescein dextran) was encapsulated within the microgels to mimic a drug and a separate fluorescent molecule (rhodamine-thiol) was covalently attached to the polymer to track microgel degradation. Release of the drug mimic was tracked through characterizing the concentration of supernatant over time using a plate reader and morphological degradation was analyzed using fluorescence microscopy. We found that the degradation rate can be tuned by changing the concentration of the polymer, with lower concentrations degrading faster than higher ones. Future work will characterize degradation kinetics and changes in mechanical properties as a function of polymer concentration. Completion of these studies will establish a novel formulation of degradable granular hydrogels that can be used for diverse applications in tissue engineering.

Keyword(s):

Biomaterials, Granular Hydrogels, Hydrolytically Degradable, Tissue Engineering, Drug Delivery

Mentor(s):

Taimoor Qazi (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 600
Presentation Time: 7/27, GRIS 134 at 4:20pm-4:40pm

SURF

Computational Modeling of the Role of Ca2+ Flux Frequency Decoding by Calmodulin and CaMKII Role on Actin Polymerization Dynamics and Dendritic Spine Morphology

Author(s):

Shiv Shukla† (Engineering)

Abstract:

Dendritic spines, tiny protrusions along the length of excitatory neurons, are the sites for synaptic contacts on dendrites. Spine morphology plays an important role in dynamic changes in strength of synaptic connections (known as synaptic plasticity) and are important in learning and memory. Dynamic remodelling of the actin cytoskeleton is the driving force behind the structural alterations of spines which occur within minutes of glutamate-activated calcium (Ca2+)-flux through NMDA receptors at the head of the spine. Actin cytoskeleton remodeling is regulated by complex interactions between actin-binding proteins (ABP) and other regulators which are downstream of the Ca2+/calmodulin-dependent protein kinase II (CaMKII) protein signaling pathway. We aim to develop a deterministic model of the calcium signalling cascade that mediate CaMKII-dependent actin remodelling. We generated ordinary differential equations (ODE) for each species using mass-action kinetics. Upon thorough parameterization and validation by global sensitivity analysis, we explore how Ca2+ flux frequency regulates the molecular pathways that regulate actin remodelling dynamics, and consequently, dendritic spine morphology. This study compares the results from the simulation of different Ca2+ flux signals and provides conclusions and recommendations based on our observation of unique binding and activation dynamics of ABPs, particularly ADF/cofilin and profilin. Using the sensitivity analysis, we also quantify the robustness of the model output to input parameter variability.

Keyword(s):

Cellular Biology, Biological Signaling, Computational Biology, Synaptic Plasticity, Biological Simulation & Technology

Mentor(s):

Tamara Kinzer-Ursem (Engineering); Barrett Davis (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 601
Presentation Time: 7/27, GRIS 134 at 4:40pm-5:00pm

SURF

Spatial Localization of Proteins in Structural Homeostatic Plasticity

Author(s):

Ethan John† (University of Evansville)

Abstract:

Actin filament (F-actin) is a prevalent protein found in all organisms, serving as a structural regulator in multiple body systems. This protein plays a crucial role in synaptic plasticity by affecting dendritic morphology. Recent advancements in super-resolution microscopy have revolutionized imaging protocols for these smaller-scale molecules, enabling more precise visualization of biomolecule function. This study investigated F-actin regulation by exploring the function of Drebrin1, the primary regulator of F-actin, and F-actin itself at dendritic sites. The interactions between these two proteins were key to the study as Drebrin1 has unique properties that allow it to effectively bundle F-actin for regulation, while F-actin can affect Drebrin1 concentration and expression in cells as needed. Preliminary experiments were conducted using indirect immunofluorescence staining to verify the function and presence of Drebrin1 near dendrites. Confocal microscopy was employed to observe and analyze Drebrin1 behavior at dendritic sites, revealing a significant colocalization between Drebrin1 and MAP2, a protein that identifies dendrites, with about 92.5% overlap. Subsequent experiments involved the development of DNA point-accumulation-for-imaging-in-nanoscale-topography (PAINT) probes that facilitated more effective fluorophore binding to the target protein. The creation of this superior conjugate was validated through gel electrophoresis showing distinct bands around 12 and 25 kDa, indicating a successful conjugation. Future plans include introducing imager strands to these conjugates under microscopy, enabling imaging to occur at a level closer to super-resolution. These experiments will serve to improve understanding of the mechanisms involved in how F-actin regulation affects the structural homeostatic plasticity of dendrites.

Keyword(s):

Biological Signaling, Biomedical Sensing & Imaging, Medical Science & Technology

Mentor(s):

Tamara Kinzer-Ursem (Engineering); Eugene Kim (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

POSTER SYMPOSIUM

Posters sorted by program (if any) and the last name of first author within each session. Names as submitted.

MORNING POSTER SESSION | 10:00AM-11:30AM

ANALYZE THIS! ANALYTICAL CHEMISTRY REU

100 *Keriany Fuentes†*
Mentor(s): Hilkka Kenttämaa; Annika Little

101 *Tierah Macon†*
Mentor(s): Graham Cooks; L. Edwin Gonzalez; Thomas Sams; Eric Dziekonski

102 *Philip Mancino†*
Mentor(s): Lauren Ann Metskas; Ryan Gray; Debbie Mettle; Rose Wilfong

103 *Taylor Ortiz†*
Mentor(s): Gaurav Chopra; Caitlin E. Randolph; Pooja Saklani; Connor H. Beveridge

104 *Nicole Plein†*
Mentor(s): Andy Tao; Will LeFever

105 *Emma Scurek†*
Mentor(s): Danzhou Yang; Mercedes DeMoss

106 *Michael Vullo†*
Mentor(s): Jeffrey Dick; Joshua Reyes Morales; Saptarshi Paul; Myles Edwards

ASPIRE REU

107 *Abigail Miller†*
Mentor(s): Brandon Allen

108 *Rachel Salazar†*
Mentor(s): Rosalee Clawson; Whitney Tyler

BIOCHEMISTRY REU

109 *Amira Bailey†*
Mentor(s): Humaira Gowher; Isaiah Mensah

110 *Alex Cain†*
Mentor(s): Seema Mattoo; Sherlene Brown

111 *David Centeno†*
Mentor(s): Ann Kirchmaier; Ronard Kwizera

112 *Aidan Edge†*
Mentor(s): Natalia Dudareva; Ji Hee Lee

113 *Jorge E. Hernández Domínguez†*
Mentor(s): Mark Hall; Kevin G. Velázquez-Marrero

114 *Ethan A. Muñiz Carrasco†*
Mentor(s): Catherine Searle; Aura Y. Muñiz Torres

115 *Maxwell Sutherland†*
Mentor(s): Vikki Weake; Sarah Stanhope

116 *Cynthia Vazquez†*
Mentor(s): Scott Briggs; Justin Gregor

COLOMBIAN RESEARCH SCHOLARS

117 *Luisa Baracaldo†*
Mentor(s): Sandra Ordonez; Emily Dykhuizen

118 *Sara Inar Otalora Guerrero†*
Mentor(s): Zoe Taylor; Alexia Carrizales; Yumary Ruiz

REEU – DATA SCIENCE FOR AGRICULTURE

119 *Ja'Quan Battle†*
Mentor(s): Dharmendra Saraswat

120 *Karla Dominguez†*
Mentor(s): Ankita Raturi; Steven Doyle

121 *Alaina Gartner†*
Mentor(s): Dennis Buckmaster

122 *Jolene Morris†*
Mentor(s): Dennis Buckmaster

123 *Emma Newton†*
Mentor(s): Mark Daniel Ward; Luiz Brito

124 *Mario Perez-Ahuatl†*
Mentor(s): Luiz Brito

125 *Ellarose Strasser†*
Mentor(s): Dennis Buckmaster; Andrew Balmos

126 *Kate Veltri†*
Mentor(s): Dharmendra Saraswat

GROWING ENTREPRENEURIALLY-MINDED RESEARCHERS REU

127 *Patrick Chuang†*
Mentor(s): Sunghwan Lee; Dong Hun Lee

SCARF

128 *MarySara Albert†*
Mentor(s): Ying Li

129 *Connor Baker†*
Mentor(s): Scott McAdam

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

130 *Chloe Chui†*
Mentor(s): Xing Liu

131 *Christopher D'Acosta†*
Mentor(s): Mark Hall; Kevin G. Velázquez-Marrero

132 *Marcella Dibble†*
Mentor(s): Mark Hall; Andrew DeMarco

133 *Addison Hill†*
Mentor(s): Theresa Casey; Linda Beckett

134 *Shayden Jones†*
Mentor(s): Luiz Brito; Henrique Mulim

135 *Makayla Marlin†*
Mentor(s): Vikki Weake; Gaoya (Grace) Meng

136 *William Petrusson†*
Mentor(s): Steve Lindemann; Adam Quinn

137 *Sophia Pruitt†*
Mentor(s): Vikki Weake; Sarah McGovern; Seth Lammert

138 *Alyssa Smith†*
Mentor(s): Alex Pasternak

139 *Payton Taylor†*
Mentor(s): Roli Wilhelm

140 *Alice Westermann Villwock†*
Mentor(s): Joe Ogas; Jiaxin Long; Jacob Fawley

141 *Madelyn Whitaker†; Catie Fleming*; Will Townsend*; Alex Mate*; Emily Spicuzza**
Mentor(s): Caitlin Proctor

SURF

142 *Valentina Aguirre Garrido†*
Mentor(s): Barrett Caldwell; Cassandra McCormack

143 *Mustapha AL Hassan†; Lev Titov‡*
Mentor(s): Sandro Matosevic; Soumyajit Das; Shambhavi Borde

144 *Karla Alvarado†; Jinyang Du‡*
Mentor(s): Luis Solorio; Siting Zhang; Claudia Benito Alston

145 *Sarah Alvarez†; Sajal Salim‡*
Mentor(s): Mike Reppert; Jacob Hnatusko

146 *Umar Arshad†*
Mentor(s): Chen-Lung Hung

147 *David Arteaga†*
Mentor(s): Andrea Kasinski; Zulaida Soto-Vargas; Humna Hasan; Ikjot Sohal

148 *Sachi Barnaby†*
Mentor(s): Philip Paré; Brooks Butler

149 *Amina Basharat†*
Mentor(s): Tamara Kinzer-Ursem; Agnes Doszpoly

150 *Mariana Benavides†*
Mentor(s): Severin Schneebeli; Anthony Mena

151 *Gavin Bidna†*
Mentor(s): Arun Mannodi Kanakkithodi; Habibur Rahman; Jiaqi Yang

152 *Harrison Booker†; Aditya Anhiba‡; Ansh Mishra*; Sumaira Khan*; Yuto Tanaka**
Mentor(s): Ran Dai

153 *Aidan Brown†*
Mentor(s): Jonathan Wilker; Aaron Mena

154 *Lorenzo Cacciapuoti†*
Mentor(s): Krishna Jayant; Hammad Khan; Shulan Xiao

155 *Brandon Camp†*
Mentor(s): Matthew Krane; Kevin Trumble

156 *Chevaugn Campbell†*
Mentor(s): Jeffrey Youngblood; Carlos Martinez; Ronaldo Franjul; Elizabeth Malek

157 *Malina-Elena Cantemir†*
Mentor(s): Lia Stanciu; Abbey Koneru

158 *Chijhi Chang†*
Mentor(s): Robert Loweth

159 *Hyunwoo Cho†*
Mentor(s): Antonio Bobet; Juan Jimenez

160 *Nicholas Colvin†*
Mentor(s): Christina Li; William Swann

161 *Adam Cover†*
Mentor(s): Brandon Pitts; Maya Luster

162 *Mitchell Cox†*
Mentor(s): Paul Mort; Kendra Erk; Kayli Henry

163 *Fiona Crenshaw†*
Mentor(s): Bruno Roseguini; Bohyun Ro

164 *An Dang†; Ishika Jindal‡*
Mentor(s): Brandon Boor; Nusrat Jung; Satya Patra

165 *Aislinn Davis†*
Mentor(s): Daniel Suter; Paola Vega Rodriguez

166 *Autumn Denny†*
Mentor(s): Ankita Raturi; Juliet Norton; Steven Doyle

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

167 *Jinyang (Jessie) Du†; Karla Alvarado‡*
Mentor(s): Luis Solorio; Claudia Alston; Siting Zhang

168 *Jorge Duarte†*
Mentor(s): Nadia Gkritza; Ricardo Chahine; Prasanna Humagain

169 *Paige Edens†*
Mentor(s): Alexander Chubykin; Sanghamitra Nareddula; Michael Zimmerman

170 *David Flores†*
Mentor(s): Richard Voyles; Upinder Kaur

171 *Madeline Frasure-Lauth†*
Mentor(s): Paula Coelho; Gracie Fitzgerald; Paula Belmont

172 *Paula Galindo Moreno†*
Mentor(s): Catherine Searle; Jonathan Lopez

173 *Braden Garretson†*
Mentor(s): Dan Milisavljevic

174 *Mason Giacchetti†; Sean Flanary*; Karrick McGinty**
Mentor(s): Andreas Jung; Andrew Wildridge

175 *Gabriel Goodwin†; Lauren Bell**
Mentor(s): Arnab Banerjee; Jhinkyu Choi

176 *Peter Hays†*
Mentor(s): Lance Parson; Morgan Broberg; Lisa Choe; Amit Varma

177 *Elizabeth Hernandez Perez†*
Mentor(s): Stanton Gelvin; Nana Liu; Lan-Ying Lee

178 *Jack Herrema†*
Mentor(s): Janelle Wharry; Grayson Nemets; Elliot Marrero Jackson

179 *Emma Hoffman†*
Mentor(s): Julia Laskin; Syeda Nazifa Wali

180 *Sophia Horn†*
Mentor(s): Maria Sepúlveda; Anna Bushong; Tyler Hoskins

181 *Jungeun Hwang†; Son Ha†*
Mentor(s): Dharmendra Saraswat; Varun Aggarwal; Aanis Ahmad

182 *Jonathan Ibinson†*
Mentor(s): Vitaliy Rayz; Mohammadreza Balouchestani Asl; Neal Patel; K. Kondratiuk

183 *Ambrosia Ingoglia†*
Mentor(s): Brandon Pitts; Maya Luster

184 *Shreya Ompreeti Ippili†*
Mentor(s): Lin Tan; Jiang

185 *Smit Kapadia†; Nikolai Baranov**
Mentor(s): Li Qiao; Holman Lau

186 *Ethan Kaser†*
Mentor(s): Anjali Iyer-Pascuzzi; Abbie Rogers

187 *Faarza Khan†*
Mentor(s): Greg Michalski

188 *Sumaira Khan†; Aditya Arjun Anibha‡*
Mentor(s): Ran Dai

189 *Carolina Kim†*
Mentor(s): GuangJun Zhang; Ziyu Dong

190 *Kyung Min Ko†*
Mentor(s): Lin Tan; Jiang

191 *Breana Lavallee†*
Mentor(s): Melba Crawford; Ana Morales Ona; Daniel Quinn

192 *Edwin Legall†*
Mentor(s): richard kuhn; Jacqueline Anderson

193 *Andy Liu†*
Mentor(s): Kurt Ristroph

194 *Rashmika Manipati†*
Mentor(s): Nusrat Jung; Brandon Boor; Jordan Cross

195 *Manuel Francisco Martinez Motta†*
Mentor(s): Michelle Thompson; Laura Chaves

196 *Kathryn McGregor†*
Mentor(s): Arielle Borovsky; Amanda Yuile

197 *Jenna McLean†*
Mentor(s): Ranjie Xu; Yanru Ji

198 *Alexander McQuade†*
Mentor(s): Lia Stanciu; Amit Barui; Sunil Vasu

199 *Zach Miles†*
Mentor(s): Ruichao Ma; Sheng-Wen Huang; Ramya Suresh; Kevin Barrow; Jian Liao

200 *Angus Moore†*
Mentor(s): Ala Eddin Douba; Kendra Erk

201 *Kyle Mundy†*
Mentor(s): Majid Kazemian; Luopin Wang

202 *Erbol Nishanov†*
Mentor(s): GuangJun Zhang

203 *Douglas Nyberg†; Matthew Beecher‡*
Mentor(s): Neera Jain

204 *Gerald Obuseh†*
Mentor(s): Denny Yu; Guoyang Zhou

205 *Rio Ohtake†*
Mentor(s): Danzhou Yang; Sarah Dagher; Yichen Han

206 *Noor Owayni†*
Mentor(s): Betsy Parkinson; Namuunzul Otgontseren; Christina Martinez-Brokaw

207 *Laurel Patterson†*
Mentor(s): Tae Yoon Kim; Jeffery Coulter; Donghyun Yim

208 *Henry Peng†; Ahn Nhu‡; Yuke Zhang‡*
Mentor(s): Lei Wang; Valentina Castañeda

209 *Ethan Pinarski†*
Mentor(s): Kyoung-Soo Lee; Vandana Ramakrishnan

210 *Heiner A. Quintero†*
Mentor(s): Fang Huang; Yilun Li

211 *Graham Ragland†*
Mentor(s): Deva Chan; Rahaf Salim; Cameron Villarreal

212 *Yaisa Ramirez†; Javier Castillo‡*
Mentor(s): Ernesto Marinero; Juan Carlos Verduzco; Sebastian Calderon

213 *Tyler Ramsey†*
Mentor(s): Justin Hess; Andrew Gray

214 *Lainie Rapp†*
Mentor(s): Maggie Perlman; Joshua Harmon; Lisa Choe; Amit Varma

215 *Karlianie Rivera†*
Mentor(s): Qing Deng; Shelly Tan

216 *Cristian D. Rosario-Marcano†*
Mentor(s): Chris Staiger; Weiwei Zhang

217 *Ryan Rushing†; Bianca Caminada‡; Eleazar Gonzalez**
Mentor(s): Ken Ritchie

218 *Claire Russell†*
Mentor(s): Michael Titus; Kenneth Sandhage; Akhil Bejjipurapu

219 *Jefte Santiago†*
Mentor(s): James Goppert; Worawis Sribunma; Jaehyeok Kim

220 *Faith Scott†*
Mentor(s): Uma Aryal; Rodrigo Mohallem

221 *Stuti Shah†*
Mentor(s): Martin Kruczenski; Derek Ping; Syeda Neha Zaidi

222 *Samuel Spears†*
Mentor(s): Pritee Pahari; Pritee Pahari

223 *Grace Stanton†*
Mentor(s): David Porterfield; Manisha Dagar; Alexander Baena; Marshall Tabetah

224 *Priyadarshini Subramaniam†; Shayak Chatterjee**
Mentor(s): Steve Wereley; Pranshul Sardana; Hui Ma; Zhengwei Chen; Jacqueline Linnes

225 *Kiran Sultana†*
Mentor(s): John Howarter; Jeffrey Youngblood; Geeta Pokhel

226 *Stefanie Surdyka†*
Mentor(s): Paula Coelho; Paula Coelho

227 *Amani Talbert†*
Mentor(s): Deva Chan; Janice Evans; Aritra Chatterjee; Dhulika Ravinuthala

228 *Hareem Tariq†*
Mentor(s): Tamara Kinzer-Ursem; Agnes Doszpoly

229 *William Townsend†; Madelyn Whitaker‡; Alex Mate‡*
Mentor(s): Caitlin Proctor; Emily Spicuzza

230 *Ryan Toy†*
Mentor(s): Denny Yu; Marian Obuseh; Nicholas Anton

231 *Corin Tuinstra†*
Mentor(s): Joe Sinfield

232 *Hector Valenzuela†*
Mentor(s): Richard Voyles; Upinder Kaur

233 *Nicolas Vivas Rincon†*
Mentor(s): Ana Estrada Gomez; Manni Zhang

234 *Liam West†; Nicholas Babusis‡*
Mentor(s): Alexey Shashurin; Lee Organski

235 *Yichu Xu†; Sydney Belk*; Jackson Truitt**
Mentor(s): Jeffrey Youngblood; Michael Titus; David Johnson; Rodrigo Orta Guerra; Lipi Roy

236 *Tongwei Zhang†*
Mentor(s): Denny yu; Guoyang Zhou

237 *Rachel Zheng†*
Mentor(s): Kurt Ristroph

238 *Daniel Zou†*
Mentor(s): Severin T. Schneebeli; Olav Vestrheim

SURF - CISTAR

239 *McKenna Clinch†*
Mentor(s): Christina Li; Joanna Rosenberger

SURF - SCALE

240 *Brendan Duffy†; Rongkai Yu**
Mentor(s): Ganesh Subbarayan; Sean Lai; Sukshitha Achar; Carol Handwerker

241 *Samuel Hyde†*
Mentor(s): Rahim Rahimi; Sina Nejati

242 *Rongkai Yu†; Brendan Duffy**
Mentor(s): Ganesh Subbarayan; Carol Handwerker; Sean Lai; Sukshitha Achar

VERTICALLY INTEGRATED PROJECTS

243 *Siya Sharma†*
Mentor(s): Jim Ogg; Aarom Ault

AFTERNOON POSTER SESSION | 1:00PM-2:30PM

300 *Emma Bartley†; Dylan Seets†; Andrew Keck†*
Mentor(s): Darrin Karcher; Carl Kroger

301 *Min Yong Chun†; Harry K. Lee‡*
Mentor(s): Garam Kim

302 *Michayla Dinn†; James MacKinnon**
Mentor(s): Theresa Casey; Linda Beckett; Kelsey Teeple

303 *Denisse Victoria Gutierrez†*
Mentor(s): Steve Lindemann; Tianming Yao

304 *Hope Harlow†; Muhan Wang*; Conrad Otterbacher**
Mentor(s): Yang Yang; Maria Olivero-Acosta

305 *Camille Higgins†*
Mentor(s): Ramaswamy Subramanian; Vijayan Dhanabalan

306 *Carson Huber†*
Mentor(s): Danzhou Danzhou; Luying Chen

307 *Logan Kitts†; William Lock Falcon‡; Emma Jeffries‡; Maren Gingrich‡*
Mentor(s): Gudrun Schmidt

308 *Bryn Kozuch†*
Mentor(s): Rosalee Clawson; Terri Towner

309 *Alex Mate†; Madelyn Whitaker‡; William Townsend‡; Emily Spicuzza‡*
Mentor(s): Caitlin Proctor

310 *Jhon Brandol Munoz Romero†*
Mentor(s): Gabriel Aguirre Cruz; Lia Stanciu

311 *Lorraine Prevost†*
Mentor(s): John Christian; Amanda Bettag

312 *Sathveka Sembian†*
Mentor(s): Natalia Rodriguez; Jacqueline Linnes; Luke Brennan; Layla Claure; Lara Balian

313 *Krisha Shah†*
Mentor(s): Ximena Bernal; Richa Singh

314 *Alexandra Wildridge†*
Mentor(s): Jennifer Brown; Stephen Beegle; Dylanne Twitty

315 *Zhujin Xia†*
Mentor(s): Mike Ladisch; Fernanda da Cunha; Diana Ramirez Gutierrez; Xueli Chen

316 *David Yin†*
Mentor(s): Riyi Shi; Siyuan Sun

CILMAR

317 *Nathan Bitner†*
Mentor(s): Aparajita Jaiswal; Gaurav Nanda

COLOMBIAN RESEARCH SCHOLARS

318 *Ricardo Andrés Calvo Méndez†; Parth Doshi*; Kyle Alexander Robinson**
Mentor(s): James Davis; Paschal Chukwuebuk Amusuo

319 *Mariana Guzman Sanchez†*
Mentor(s): Steve Lindemann; Rubesh Raja

320 *Alison Mesa†*
Mentor(s): Rakesh Agrawal; Shubhanshu Agarwal

321 *Ricardo Pardo†*
Mentor(s): Tim Gavin; Ivan Alonso; Linda Adeyemo; Lundon Burton

322 *Juan Raffaeli†*
Mentor(s): Rong Huang; Yi-Hsun Ho

DUIRI

323 *Sarah Grev†; Claudia Albrecht**
Mentor(s): Craig Goergen; Luke Schepers; Jennifer Anderson

324 *William Messman†*
Mentor(s): Lei Wang; Guang Lin; Zhaoyu Liu

325 *Kah Soon Ngooi†*
Mentor(s): ChengCheng Tao; Jan Olek

326 *Petra Schwaab†*
Mentor(s): Melba Crawford; Cary Troy; Keith Cherkauer; Zhi Zhou; Sheng Tan

327 *Nellie Walthery†*
Mentor(s): Andrew Flachs; Steve Hallett

328 *Megan Webb†*
Mentor(s): Karin Ejendal; Tamara Kinzer-Ursem

329 *Xihui Zhao†*
Mentor(s): Chongli Yuan; Shichen Wu

330 *Ellison Zhu†; Dongting Cai‡*
Mentor(s): Rebecca Ciez; Meenakshi Narayanaswami; Ivan Arturo Nunez

GROWING ENTREPRENEURIALLY-MINDED RESEARCHERS REU

331 *Gabriel A Baquero†; Bianca Perez‡; Ndongo Njie‡*
Mentor(s): Daniel Leon-Salas; Lisa Bosman

332 *Devon Fears†*
Mentor(s): Sunghwan Lee; Dong Hun Lee

333 *Quin Howell†; Ryder Michael†; Emanuel Lugo†*
Mentor(s): Jose Garcia-Bravo

334 *Amy LeGrande†; Brandon Yonnie‡*
Mentor(s): Lisa Bosman; Esteban Soto; Gnanaprakash Athmanathan

335 *Ndongo Njie†; Bianca Perez‡; Gabriel A Baquero‡*
Mentor(s): Daniel Leon-Salas; Lisa B Bosman

336 *Bianca Perez†; Gabriel Baquero‡; Ndongo Njie‡*
Mentor(s): Daniel Leon-Salas; Lisa Bosman

337 *Aurora Raygoza†; Julie Ware†; Brandon Dickenson†*
Mentor(s): Jason Ostanek

338 *Brandon Yonnie†; Amy LeGrande‡*
Mentor(s): Lisa Bosman; Esteban Soto; Gnanaprakash Athmanathan

LSAMP

339 *Violet Saldarriaga†*
Mentor(s): Alexander Chubykin; Sanghamitra Nareddula; Michael Paul Zimmerman

ASPIRE YES-EV REM

340 *Georgia Alexander†; Aspen Arnold*; Daniel White*; Kaydence Hall*; Francisco Hurtado**
Mentor(s): Brandon Allen; William Walls

341 *Aspen Arnold†; Georgia Alexander*; Francisco Hurtado*; Jarret Harris*; Daniel White*; Kaydence Hall**
Mentor(s): Brandon Allen; William walls

342 *Kaydence Hall†*
Mentor(s): Brandon Allen; William Walls

343 *Jarrett Harris†; Francisco Hurtado*; Kaydence Hall*; Aspen Arnold*; Daniel White*; Georgia Alexander**
Mentor(s): Brandon Allen; William Walls

344 *Francisco Hurtado†; Aspen Arnold*; Jarrett Barkley*; Daniel White*; Kaydence Halls*; Georgia Alexander**
Mentor(s): Brandon Allen; William Walls

345 *Daniel White†; Aspen Arnold*; Kaydence Hall*; Georgia Alexander*; Francisco Hurtado*; Jarrett Harris**
Mentor(s): Brandon Allen; William Walls

PURE-PD

346 *Jennah Brown†*
Mentor(s): Cankui Zhang; Hannah Levengood; Samantha Barker; Jing Huang

347 *José David Colón Miranda†*
Mentor(s): Jen Wisecaver; Nathan Frederick Watervoort; Timilehin Jeje

348 *Audrey Couturier†; Stephen Mills‡*
Mentor(s): Christopher Oakley; Juan Diego Rojas Gutierrez

349 *Alison Garland†*
Mentor(s): Damon Lisch

350 *Chase Hearn†*
Mentor(s): Clint Chapple; Zhiwei Luo

351 *Manasvi Lingampally†*
Mentor(s): Gyeong Mee Yoon; Hye Lin Park

352 *Olivia Moffett†*
Mentor(s): Yun Zhou; Chong Xie

353 *Connor Murray†*
Mentor(s): Stan Gelvin; Lan-Ying Lee

354 *Joy Richardson†*
Mentor(s): Leonor Boavida

355 *Kaitlin Riggan†*
Mentor(s): Natalia Dudareva; Shannon Stirling; Varun Dwivedi

STRUCTURAL AND COMPUTATIONAL BIOLOGY & BIOPHYSICS REU

356 *Adriana A. Bustos Torres†*
Mentor(s): Ximena Bernal; Ana Maria Ospina

357 *Alexander Crook†*
Mentor(s): John Tesmer; Chun-Liang Chen; Pooja Yadav

358 *Javier Joel Diaz Laboy†*
Mentor(s): Fang Huang; Cheng Bi

359 *Marielle Denise Melendez†*
Mentor(s): Leifu Change; Dan Xie

360 *Hugo Ortiz-Garcia†*
Mentor(s): Seema Mattoo; Ben G Watson

361 *Kanishka Singh†*
Mentor(s): Ximena Bernal; Richa Singh

SROP

362 *Brielle Lowther†; Abdulrazzaq Altararwa†; Libbie Lawson†*
Mentor(s): Jennifer Brown; Stephen Beegle

SUMMER STAY

363 *Marcelo Inaki Guerrero Montalvan†*
Mentor(s): Steve Lindemann; Miguel Alvarez

SURF

364 *Avi Amalanshu†*
Mentor(s): David Inouye

365 *Valentina Andrade Pérez†*
Mentor(s): Xiaoping Bao; Yun Chang; Jingqiao Shen

366 *Kathryn Ault†*
Mentor(s): Linda Wang; Cagri Un; Clayton Gentilcore

367 *Eshaana Aurora†*
Mentor(s): Peter Bermel; Geoffrey Sanchez; Changkyun Lee

368 *Matthew Beecher†; Douglas Nyberg‡*
Mentor(s): Neera Jain

369 *Dongting Cai†; Ellison Zhu‡*
Mentor(s): Rebecca Ciez; Meenakshi Narayanaswami; Ivan Arturo Nunez

370 *Alan Chen†*
Mentor(s): David Cappelleri; Aarya Deb; Kitae Kim

371 *Conor Costello†*
Mentor(s): Steve Son; Thomas Hafner

372 *Hyungjun Doh†*
Mentor(s): Karthik Ramani; Rahul Jain; Jingyu Shi

373 *Connor Durkin†*
Mentor(s): James Krogmeier; Sneha Jha

374 *Newt Fey†*
Mentor(s): James Gibert; Xinhao Quan

375 *Evan Frishholz†; Donovan Simonton‡; William Appel*; Morgan Smith**
Mentor(s): Yi Xie

376 *Emmanuel Gichaba†*
Mentor(s): Adrian Buganza-Tepole; Elsje Pienaar; Norma Perez-Rosas

377 *Samuel Greenaway†*
Mentor(s): Yi Xie

378 *Bora Haller†*
Mentor(s): Carlo Scalo; Forrest Lim; Vaibhav (Havi) Rajora

379 *Tejaswini Haraniya†*
Mentor(s): Letian Dou; Qixuan Hu

380 *Sahda Haroon†*
Mentor(s): David Warsinger; Xavier Morgan-Lange

381 *Ian Holda†*
Mentor(s): Kevin Webb; Christopher Lacny

382 *Connie Kang†*
Mentor(s): David Inouye; Surojit Ganguli

383 *Nachiketh Karthik†*
Mentor(s): Karthik Ramani; Runlin Duan

384 *Kashif Khan†*
Mentor(s): Vivek Narsimhan; George Curtis

385 *Ohik Kwon†*
Mentor(s): Tiwei Wei; Shuhang Lyu

386 *Tim Lane†; Donovan Simonton*; Andrew Bergeon**
Mentor(s): Shripad Revankar; Derek Kultgen

387 *Qingyuan Li†*
Mentor(s): Milind Kulkarni; Vidush Singhal

388 *Darren Lie†; Maxwell Bolt*; Andrew Showalter**
Mentor(s): David Warsinger; Sandra Cordoba

389 *Josephine Lesley Liebrata†*
Mentor(s): Michael Harris; Che-yu Chou

390 *Andrew Lykken†*
Mentor(s): Mark Johnson; Cole Nelson

391 *Jalen Magee†*
Mentor(s): Ivan Christov; Pranay Nagrani; Shrihari Pande

392 *Christine Mayo†*
Mentor(s): Alina Alexeenko; Petr Kazarin; Andrew Strongrich

393 *Dhruv Mendpara†; Jayden Pierce**
Mentor(s): Rex Reklaitis; Yan-Shu Huang; Marcial Gonzalez; Zoltan Nagy

394 *Nodebechukwu Mgbodille†*
Mentor(s): Bryan Boudouris; Dharini Varadharajan; Letian Dou

395 *Nathan Miles†*
Mentor(s): Glynn Gallaway

396 *Ansh Mishra†*
Mentor(s): David Warsinger; Jinwoo Oh; Setareh Heidari

397 *Lukas Peng†*
Mentor(s): Bryan Boudouris; Hyunki Yeo

398 *Nathan Petrucci†*
Mentor(s): Xiaoping Bao; Yun Chang; Jingqiao Shen

399 *Khoi Pham†; Alina Stuleanu‡*
Mentor(s): Alexander Kildishev; Samuel Peana; Vladimir Shalaev

400 *Bao Quoc Phan†; Alex Wang‡*
Mentor(s): Neera Jain; Michael Williamson Tabango; Sibibalan Jeevanandam

401 *Hithesh Rai Purushothama†*
Mentor(s): Letian Dou; Ke Ma; Jiaonan Sun

402 *Amritanshu Ranjan†*
Mentor(s): David Inouye; Surojit Ganguli

403 *Rodrigo Romero†*
Mentor(s): Dezhi Wang; Luis Gomez

404 *Luke Sanders†*
Mentor(s): Ivan Christov; Shrihari Pande; Pranay Nagrani

405 *Arghya Sarkar†*
Mentor(s): Neera Jain; Madeleine Yuh

406 *Daksh Kumar Singh†*
Mentor(s): Alexandra Boltasseva; Blake Wilson; Yuheng Chen; Alexander Kildishev; Vladimir Shalaev

407 *Michael Solmos†*
Mentor(s): Hany Abdel-Khalik; Arvind Sundaram

408 *Yubo Song†*
Mentor(s): Tiwei Wei; Zheng Gong

409 *Ashwin Sreedhar†; David Fall‡; Nikhil Pisolkar‡*
Mentor(s): Hany Abdel-Khalik; Arvind Sundaram

410 *Sreevickrant Sreekanth†; Dulani Wijayarathne‡*
Mentor(s): Milind Kulkarni; Raghav Malik

411 *Yashaswini Subramaniam†*
Mentor(s): Arvind Sundaram; Tyler Lewis; Hany Abdel-Khalik

412 *Brooklin Toombs†*
Mentor(s): Amy Reibman

413 *Nathon Tubbs†*
Mentor(s): Airehenbuwa Blessing

414 *Amanda Walenciak†*
Mentor(s): Luis Gomez; David Czerwonky

415 *Clayton Walker†*
Mentor(s): Sanjay Rao; Ehab Ghabashneh

416 *Benjamin Wassgren†*
Mentor(s): Xianfan Xu; Yikang Chen

417 *Dulani Wijayarathne†; Sreevickrant Sreekanth†*
Mentor(s): Milind Kulkarni; Raghav Mailk

418 *Chloe Yoder†*
Mentor(s): Hany Abdel-Khalik; Arvind Sundaram; Tyler Lewis

419 *Lijun Zhu†*
Mentor(s): Ziyi Liu

SURF - CISTAR

420 *Camden Bettag† (CISTAR Young Scholar)*
Mentor(s): Jeffrey Greeley; Luke Pretzie; Anik Biswas

421 *Jackson Boodry†; Mahagani Lasciers‡*
Mentor(s): Raj Gounder; Angel Santiago-Colon; Justin Rosa-Rojas

422 *Carson Felton†*
Mentor(s): Can Li; Kaiyu Cao; Asha Ramanujam

423 *Kyla Fung†*
Mentor(s): Raj Gounder; Diamarys salome rivera; Ricem Diaz Arroyo

424 *Rebecca Hurwitz†; Hallie Todd‡; Logan Maddox‡; Alexa Earle**
Mentor(s): Brian Tackett; Ashutosh Bhadouria

425 *Emmanuel Ortiz†; Matthew Gerona‡*
Mentor(s): Jeff Miller; Ted Kim

426 *Cora Powell† (CISTAR Young Scholar)*
Mentor(s): Jeffery Miller; Ted Kim; Wei-Ling Huang; Hamta Bardool; Shan Jiang

SURF - SCALE

427 *Lavinia Barker†*
Mentor(s): Tiwei Wei; Shuhang Lyu; Keyu Wang

428 *Antariksh Krishnan†*
Mentor(s): Tiwei Wei; Keyu Wang; Shuhang Lyu

429 *Reagan McCafferty†*
Mentor(s): Allen Garner; Lorin Breen

430 *Andrew Modin†*
Mentor(s): Tiwei Wei; Shuhang Lyu; Keyu Wang

431 *Kyle Wiegand†*
Mentor(s): Shubhra Bansal

432 *Elliot Wong†*
Mentor(s): Peter Bermel; Allen Garner; Sayan Roy

VET MED SUMMER SCHOLARS

433 *Dawn Burch†*
Mentor(s): Ourania Andrisani; Zhili Li

434 *Paola Diaz†*
Mentor(s): Steve Hooser

435 *Camila Gutierrez†*
Mentor(s): Mike Childress; Deborah Knapp; Danzhou Yang; Deepika Dhawan; Alexander Enstrom

VIP – VERTICALLY INTEGRATED PROJECTS

436 *Zeyad Aljaali†*
Mentor(s): Aravind Machiry

437 *Natasha Gundapaneni†*
Mentor(s): Yung-Hsiang Lu

438 *Vikram Oddiraju†; Zachary Heskett†*
Mentor(s): Wei Zakharov; Siqing Wei; Yung-hsiang Lu

439 *Yiyang Shui†; Boheng Zhao‡; Edmund Leung‡*
Mentor(s): Mark Johnson; Cole Nelson

440 *Benjamin Zou†; Steven Huang†; Niels Van Ritbergen*; Rauf Erkiletlioglu*; Ferati Ogunwemimo*; Dila Bodur**
Mentor(s): Mark Johnson

Poster Presentation Abstract Number: 100
Presentation Time: 7/27, Session 1: 10am-11:30am

Analyze This! Analytical Chemistry REU

Diagnostic gas-phase ion-molecule reactions for the mass spectrometric identification of secondary N-oxides by using tris(dimethylamino)borane (TDMAB)

Author(s):

Keriany Fuentes† (Science)

Abstract:

N-oxides are compounds wherein an oxygen atom is directly attached to the nitrogen atom of an amino group. They play crucial roles in metabolic pathways, including the metabolism of amino acids and in the biosynthesis of nitric oxide. Being able to unambiguously identify N-oxides would enhance our understanding of health, disease, and biological processes. However, the study of N-oxides is limited by the absence of analytical techniques for their identification in mixtures. Mass spectrometry is a powerful analytical technique that plays a crucial role in the identification and analysis of molecules, often directly in mixtures. Mass spectrometry separates ionized analytes based on their mass-to-charge ratio (m/z).

In tandem mass spectrometry experiments, all the mixture components are first ionized. The analyte ion of interest is isolated and subjected to dissociation or gas-phase ion-molecule reactions (MS2 experiments). The product ions can then be isolated and subjected to further reactions (MS3 experiments). Gas-phase ion-molecule reactions of tris(dimethylamino)borane (TDMAB) have been used previously to identify and distinguish tertiary N-oxides from other types of compounds, such as amines and sulfoxides, by using MS3 experiments. Here, this work was expanded to include secondary N-oxides. Protonated secondary N-oxides react with TDMAB to form an adduct that has eliminated a dimethylamine molecule, just like tertiary N-oxides. However, when these product ions were subjected to collision-activated dissociation (CAD), diagnostic fragmentation reactions were detected. These reactions involved elimination of (CH3)2N-B=O (MW 71 Da) or both (CH3)2N-B=O (MW 71 Da) and dimethylimine (MW 43 Da).

Keyword(s):

Mass Spectrometry, Ion-Molecule Reactions, Ion-Molecule Reactions

Mentor(s):

Hilkka Kenttämaa (Science); Annika Little (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 101
Presentation Time: 7/27, Session 1: 10am-11:30am

Analyze This! Analytical Chemistry REU

High Throughput Analysis of Biological Systems using DESI 2D-MS/MS

Author(s):

Tierah Macon† (Vanderbilt University)

Abstract:

Desorption electrospray ionization (DESI) is an ambient ionization method in which charged microdroplets, carried by a sheath gas, impact on a sample's surface thereby generating secondary splashed droplets that contain the ionized analyte. In this case, the ionized analytes were characterized using two-dimensional tandem mass spectrometry (2D-MS/MS)—an untargeted method of analyzing complex mixtures—featuring one dimension of ion abundance and two dimensions of mass-to-charge: precursor ion m/z and their resulting product ion m/z values. When these two methods are coupled, high throughput experimentation (HTE) with both broad chemical structural coverage (precursor ion and product ion ranges (m/z) 400 – 1100 and 150 – 800, respectively, per second) and unprecedented speed (3 seconds per sample for a 3-scan average) is possible.

In this work, two biological systems—bacteria and banked mouse brain tissue lysates—were analyzed using DESI 2D-MS/MS to demonstrate how these methods are applicable to various biological systems with minimal sample preparation and can be used with HTE.

Bacteria were cultured in the wells of a polypropylene 96 well plate with an equal amount of lysis solvent added to each well, while a premade solution of lysates from the banked brain tissue was used. The lipid profiles of each of the systems were analyzed using DESI 2D-MS/MS after spotting 2-3 µL of the lysates on a Teflon slide. Our results show that characteristic lipid profiles and structural information from precursor/product ions of each of the systems can be rapidly obtained by HTE with minimal sample preparation.

Keyword(s):

High Throughput Analysis/Experimentation, Desorption Electrospray Ionization, Two-Dimensional Tandem Mass Spectrometry

Mentor(s):

Graham Cooks (Science); L. Edwin Gonzalez (Science); Thomas Sams (Science); Eric Dziekonski (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 102
Presentation Time: 7/27, Session 1: 10am-11:30am

Analyze This! Analytical Chemistry REU

Reverse Engineering Cryo-Electron Tomography Data to Solve the Structure of α-Carboxysomes

Author(s):

Philip Mancino† (Purdue University, Cornell University)

Abstract:

Although the importance of microcompartments is widely recognized in structural biology and bioengineering, methods that do not account for structural heterogeneity prevent a full understanding of ultrastructure and function. Modern methods such as cryo-electron microscopy work to combat this issue and better characterize the underlying structure of samples. Recent work done by the Metskas Lab utilizes cryo-electron tomography to image α-Carboxysomes, a microcompartment facilitating carbon fixation in many cyanobacteria and chemoautotrophs (Metskas et al., 2022). The lab investigates the structure of the Carboxysome shells using the positions and orientations of the internal Rubisco enzymes to extrapolate information about the Carboxysome–a highly generalizable method. Here, we use standard methods of computational biophysics to reverse engineer the analyses of the Metskas Lab into reusable form via MATLAB programming. We solve for the Carboxysome structure by using the Quickhull algorithm to approximate the location of the shell, and compute local and global orientations using vector and tensor analysis. We also compute the volume, Rubisco concentrations inside and on the shell, Euler angles, among other parameters and visualizations. The module was able to exactly reproduce the analyses of the Metskas Lab, and was able to perform computations that were previously impractical, such as the inner Rubisco concentration. The module can easily be expanded to include further calculations, such as Polymerization Affinity computations, local concentrations of Rubisco for arbitrary volumes, and solutions for the missing-wedge effect to aid with tomogram reconstruction. With proper documentation, the release of the module can serve in general structural analyses of beyond the Carboxysome.

Keyword(s):

Carboxysome, Rubisco, Computational Biophysics, Structural Biology, Matlab

Mentor(s):

Lauren Ann Metskas (Science); Ryan Gray (Science); Debbie Mettle (Science); Rose Wilfong (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 103
Presentation Time: 7/27, Session 1: 10am-11:30am

Analyze This! Analytical Chemistry REU

Mass Spectrometry Lipid Profiling to Understand the Role of ELOVL1 Inhibitors in Very Long Chain Fatty Acids

Author(s):

Taylor Ortiz† (Science)

Abstract:

Fatty acids exist throughout the body in numerous forms performing a variety of functions essential to the host. While fatty acids are necessary for survival due to their roles in metabolism, insulation, and regulation of hormones, there are some forms of fatty acids that prove to be dangerous when exceeding specific quantities. Very long chain fatty acids, which are found in tissues, the liver, the brain, and other specific areas, prove to be damaging in larger quantities, contributing to neurodegenerative disorders such as Adrenoleukodystrophy and Alzheimer's disease. The gene for orchestrating the construction of these prolonged fatty acids is elongation of very long chain fatty acid 1 enzyme (ELOVL1). This study investigates the possibility of ELOVL1 as a therapeutic target for lowering VLCFAs and their precursor LPC (lysophosphatidylcholine). We will use particular drug treatments that are intended to block ELOVL1 activity. We aim to illustrate the importance of these compounds in alleviating VLCFA-associated pathologies by examining the effects of these treatments on ELOVL1 and subsequent VLCFA levels using HEK 293 cells. Lipids run in triple quad mass spectrometry will be analyzed by an in-house generated software and incorporated into the poster.

Keyword(s):

Mass Spectrometry, Lipid Profiling, ELOVL1, Lipidomics

Mentor(s):

Gaurav Chopra (Science); Caitlin E. Randolph (Science); Pooja Saklani (Science); Connor H. Beveridge (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 104
Presentation Time: 7/27, Session 1: 10am-11:30am

Analyze This! Analytical Chemistry REU

Enrichment of N-terminal acetylated peptides

Author(s):

Nicole Plein† (Webster University)

Abstract:

Characterization of proteins and their post translational modifications are a key aspect to determine their functionality and activity within the body. Some post translational modifications such as N-terminal acetylation play a key role in various cellular processes such as DNA transcription and RNA modification and have been linked to neurodegenerative diseases such as Alzheimer's and Parkinson's disease. One method for determining changes in N-terminal acetylation in patients with Alzheimer's is through bottom-up proteomics. Bottom-up proteomics utilizes enzymes, such as trypsin, to cleave the protein into peptides prior to analysis and identification by mass spectrometry. N-acetylated proteins generate one peptide containing the N-termini and dozens of internal peptides without acetylation. However, current methods to separate N-acetylated peptides from the others after digestion have low selectivity and reproducibility. The N-terminal peptides also have a lower signal when analyzed by mass spectrometry than the more abundant charged internal peptides as the N-acetylated group has less charge reducing its ionization efficiency. This study aims to develop a method for enrichment of acetylated peptides through use of aldehyde-coated magnetic resin beads. These beads will selectively and reproducibly covalently bond with the internal peptides allowing for them to be removed from the sample leaving just the enriched n-acetylated peptides. This technique allows for more N-acetylated peptides to be identified through tandem mass spectrometry and peptide identification and quantification without interference from the internal peptides.

Keyword(s):

Proteomics, Acetylation, Mass Spectrometry, Magnetic Beads, Neurodegenerative Disease

Mentor(s):

Andy Tao (Science); Will LeFever (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 105
Presentation Time: 7/27, Session 1: 10am-11:30am

Analyze This! Analytical Chemistry REU

Characterizing the Binding Affinity of Indenoisoquinolines to the MYC Promotor G-quadraplex using Fluorescence Spectroscopy

Author(s):

Emma Scurek† (Iowa Central Community College)

Abstract:

MYC is an oncogene that is over-expressed in the majority of cancers and helps drive cancer progression. In the promoter region of MYC there is a G-quadruplex which forms and acts as a transcriptional silencer. G-quadruplexes are noncanonical, four-stranded, secondary structures that form in guanine-rich regions of DNA. Indenoisoquinolines were originally developed as topoisomerase I inhibitors, however, our lab has previously shown that they also bind and stabilize the MYC G-quadruplex and inhibit MYC. The goal of this project is to determine the binding affinity of indenoisoquinoline compounds to the MYC promotor G-quadruplex using fluorescence spectroscopy. Fluorescence titrations are a commonly used method for determining binding affinity due to the high sensitivity of fluorescence. I used fluorophore-labeled MYC G-quadruplex DNA as a probe. I titrated indenoisoquinoline compounds into the probe. The changes in the fluorescence emissions were measured to calculate the dissociation constant (Kd) of each compound. I titrated, in duplicate, each indenoisoquinoline compound to the probe to measure binding affinity. I was able to successfully replicate both my own data as well as our lab's previous data, allowing for a more accurate comparison of the binding affinities of the different analogs. This data will be used in combination with other biophysical and cellular studies to further understanding of MYC G-quadruplex binding and stabilization and MYC downregulation. This information will help us in the development of indenoisoquinoline compounds as MYC G-quadruplex targeted anti-cancer agents.

Keyword(s):

G-Quadruplex, Indenoisoquinoline, Fluorescence Spectroscopy, MYC Oncogene

Mentor(s):

Danzhou Yang (Pharmacy); Mercedes DeMoss (Pharmacy)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 106
Presentation Time: 7/27, Session 1: 10am-11:30am

Analyze This! Analytical Chemistry REU

Electrochemical-Shock Synthesis of Solid-Solution High Entropy Alloy Nanoparticles

Author(s):

Michael Vullo† (Science)

Abstract:

Due to the increased demand for energy, hydrogen as a fuel source has been highly regarded as a potential alternative for decades. The hydrogen evolution reaction (HER) has been a sought-after method for producing clean and zero-emission hydrogen gas. Alloys in previous works have been reported as having good catalytic properties for HER. Alloys containing five or more components are referred to as High Entropy Alloys (HEAs). HEAs have been shown to have exceptional strength, thermal resistance, and toughness. HEAs also have tunable properties depending on the combination of metals used. Therefore, HEAs have been used as catalysts for many different reactions. Here, we took advantage of a method named nanodroplet-mediated electrodeposition to electrodeposit a HEA nanoparticle onto a glassy carbon surface. The method consists of an emulsion solution, where equal concentrations of the metal salt precursors of Au, Ag, Pt, Pb, and Pd were confined in aqueous nanodroplets suspended in 1,2-dichloroethane. These nanodroplets collide directly onto the electrode surface, allowing the synthesis of HEAs via electrochemical reduction. Chronoamperometry at –0.6 V vs. Ag/AgCl was used to electrodeposit the HEA nanoparticles. The morphology of our nanoparticles was observed via a scanning electron microscope, and elemental composition was confirmed via energy-dispersive X-ray. Rotating disc electrode voltammetry was used to demonstrate the electrocatalytic activity of the HEA for HER. The synthesized HEA nanoparticles showed long-term stability for over two hours. Hydrogen evolution activity was 11 mV lower compared to Pt, while using 1/5 the amount of Pt. This opens new avenues for HEAs and their role in energy conversion systems.

Keyword(s):

High Entropy Alloys, Hydrogen Evolution Reaction, Electrocatalyst, Electrodeposition, Electrochemistry

Mentor(s):

Jeffrey Dick (Science); Joshua Reyes Morales (Science); Saptarshi Paul (Science); Myles Edwards (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 107
Presentation Time: 7/27, Session 1: 10am-11:30am

ASPIRE REU

Evaluating Equity: Quantifying the Elements of a Just Transition to Electrified Transportation Systems

Author(s):

Abigail Miller† (Front Range Community College)

Abstract:

Electrified transportation systems (ETS) offer enticing promises to advance international climate and energy goals, and mitigate public health concerns regarding internal-combustion engines. Disparities in access and affordability are, however, prevalent within early implementation of Electric Vehicle (EV) technologies. Without an early and deliberate focus on equity, within the development and rollout of EVs and related infrastructure, these technologies run the risk of exacerbating such disparities within the communities they could benefit most. Existing research on equity considerations and electric vehicles is framed by three main priories: cost, access, and environmental justice. Within this research there is, however, a notable absence of qualitative metrics for assessing adherence to equity principles in the implementation of EV technologies. This study outlines equity considerations in the ETS/EV conversation over the past 15 years, identifies research gaps in the interpretations and applications of equity in the same ETS/EV space, and makes a recommendation for quantifying equity, primarily composed of a formula which contains and emphasizes the priorities of current EV research. The following research questions were used to frame the objectives of this study: 1) What are the current equity considerations in the ETS/EV space?, 2) What considerations are missing in how equity is perceived in the ETS/EV space?, and 3) How can current literature on equity in the ETS/EV space be used to construct an index which measures the equity of new electrified technologies?

Keyword(s):

Electric Vehicles, Equity, Environmental Justice, Access, Cost

Mentor(s):

Brandon Allen (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 108
Presentation Time: 7/27, Session 1: 10am-11:30am

ASPIRE REU

Agenda Setting and Framing in El Diario de la Prensa: A Focus on Electric Vehicles and Equity

Author(s):

Rachel Salazar† (University of Texas at Arlington)

Abstract:

Technological advancements in the electric vehicle (EV) field leave many questions unanswered regarding equitable implementation and affordability. Frames in news articles can move the conversation and strengthen the discussion around particular aspects of EVs to influence the audience. By emphasizing certain EV topics, the media can set the agenda and therefore communicate to the audience which topics are most important regarding electric vehicles. Scholars have content analyzed media coverage of EVs in English-language newspapers in the United States, but no other languages have been researched in this diverse country. This study will analyze media coverage of EVs in a popular Spanish newspaper based in New York, El Diario de la Prensa, between 2017 and 2023. We will ask these questions: what is the general topic of an article surrounding electric vehicles? What frames are used when discussing electric vehicles? Within the article, is equity taken into consideration? How has the discussion of electric vehicles shifted through the years?

Keyword(s):

Electric, Vehicles, News, Media, Equity

Mentor(s):

Rosalee Clawson (Liberal Arts); Whitney Tyler (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 109
Presentation Time: 7/27, Session 1: 10am-11:30am

Biochemistry REU

The regulation of Wnt signaling by VEZF1 during mesoderm differentiation

Author(s):

Amira Bailey† (Agriculture)

Abstract:

The heart is the first organ that forms in mammalian development, which is mainly composed of progenitor cells derived from the mesoderm. While the Wnt signaling pathway plays a key role in mesoderm development, the direct transcriptional regulation of genes involved in the pathway is still unclear. The VEZF1 protein has been speculated to be involved in the regulation of Wnt signaling genes due to the impairment of mesoderm formation and reduced expression of Wnt signaling genes when VEZF1 is absent. We hypothesize that VEZF1 operates by binding and inducing the expression of Wnt signaling genes during mesoderm differentiation. To test our hypothesis, we grew and differentiated wild-type (WT), knockout (KO), and knockdown (KD) embryonic stem cells into mesoderm. We then used the differentiated cells to perform Chromatin Immunoprecipitation with the use of VEZF1 antibodies conjugated to magnetic beads to identify VEZF1 binding sites on DNA. Primers specific to Wnt signaling genes were designed using SnapGene and NCBI primer blast for putative VEZF1 binding sites. The primers were then utilized to perform quantitative-PCR to identify VEZF1 binding to Wnt signaling genes. The Dnmt3b gene was used as a positive control to verify the Chromatin Immunoprecipitation experiment. Our results show a significant binding of VEZF1 to the Dnmt3b promoter in WT cells, and reduced binding in both KO and KD cells, confirming the success of the ChIP experiment. Further investigation with the use of qPCR is currently being conducted with genes specific to the Wnt signaling pathway to determine the binding of VEZF1.

Keyword(s):

VEZF1, Wnt Signaling, qPCR, Chromatin Immunoprecipitation, Mesoderm

Mentor(s):

Humaira Gowher (Agriculture); Isaiah Mensah (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 110
Presentation Time: 7/27, Session 1: 10am-11:30am

Biochemistry REU

Characterizing Structure and Interactions of Bordetella bronchiseptica Fic Protein C-terminus

Author(s):

Alex Cain† (Virginia Weslayan University)

Abstract:

Fic (Filamentation induced by cAMP)-domain-containing proteins are an emerging family of enzymes known to carry out post-translational modifications (PTMs) via the addition of phosphate-containing groups, such as AMP, onto alcohol-containing amino acids of their target proteins. Fic-domain-containing proteins occur in a wide range of organisms, but many occur in bacteria, where they often function as a means of pathogenesis. We have discovered a highly conserved Fic-domain-containing protein in Bordetella bronchiseptica, a small gram-negative bacteria which sometimes infects household pets. Discovering more about the structure and binding targets of this protein (BbFic) may reveal important information about other Bordetella Fic-domain-containing proteins, such as that of Bordetella pertussis, which is responsible for whooping cough. BbFic has been found to carry out a previously unseen PTM, GMPylation, but the targets remain unclear. We solved the crystal structure of apo BbFic at 3.1 Å and using AlphaFold predicted a putative function of BbFic. This analysis predicts that the C-terminus of BbFic has a helix-turn-helix motif and translocates to the nucleus in mammalian cells, leading us to hypothesize that BbFic may be involved in DNA binding. Our experiments aim to express and purify the C-terminus of BbFic. Once the protein has been sufficiently purified, it will be used in X-ray crystallography and pulldown assays to determine its structure and binding targets, respectively.

Keyword(s):

Bordetella, Fic Protein, Helix Turn Helix

Mentor(s):

Seema Mattoo (Science); Sherlene Brown (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 111
Presentation Time: 7/27, Session 1: 10am-11:30am

Biochemistry REU

Exploring Fumarase's Role in DNA Repair: Colocalization and Interaction Analyses of Fum1p in Saccharomyces cerevisiae

Author(s):

David Centeno† (Universidad de Puerto Rico)

Abstract:

Redacted.

Keyword(s):

Fumarase, Double Stranded Breaks, Saccharomyces Cerevisiae, mCherry, Fluorescence Microscopy

Mentor(s):

Ann Kirchmaier (Agriculture); Ronard Kwizera (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 112
Presentation Time: 7/27, Session 1: 10am-11:30am

Biochemistry REU

Investigating the role of PhSV2 in volatile emission of Petunia hybrida

Author(s):

Aidan Edge† (St. Norbert College)

Abstract:

Volatile organic compounds (VOCs) are low molecular weight lipophilic molecules that are easily vaporized off the surface of plants and released into the atmosphere. VOCs play various roles in plant-plant interactions, pollinator attraction, allelopathy, and immune responses against pathogens and herbivores. Until recently, it was assumed that VOCs simply diffuse across the cell membrane onto the surface of the plant. For it to be possible to achieve this emission rate via simple diffusion, predictive modeling has theorized that the concentration of VOCs needed in the plasma membrane would result in cell toxicity. Attention has turned to uncovering the method of volatile transport through the cell onto the cell surface. RNA-seq data has shown that Petunia hybrida have three genes that fall into the target expression profile for high emission times of VOCs: PhSV2-1, PhSV2-2, PhSV2-3. These three genes are homologs of mouse synaptic vesicle protein 2A (MmSV2A); a protein known for its role in vesicle docking on target membranes. Generation of stable PhSV2 knockdown lines and analysis of VOC emissions revealed that emissions decrease in the PhSV2 knockdown compared to the wild type. This investigation aims to elucidate the mechanism behind the relationship of PhSV2s and VOC emission. We hypothesize that silencing PhSV2 will prevent vesicle trafficking of PhABCG1 (an identified VOC transporter) to the plasma membrane, and ultimately, reduce the level of VOC emission. This will be approached by visualizing the differences in the presence of PhABCG1 on the plasma membrane in PhSV2 knockdown and wild type petunias using Western blotting.

Keyword(s):

Petunia Hybrida, Volatile Organic Compounds, Vesicle Trafficking, PhSV2, PhABCG1

Mentor(s):

Natalia Dudareva (Agriculture); Ji Hee Lee (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 113
Presentation Time: 7/27, Session 1: 10am-11:30am

Biochemistry REU

Biochemical characterization of Cdc14 enzyme in Tetrahymena thermophila

Author(s):

Jorge E. Hernández Domínguez†

Abstract:

Cdc14 is a highly conserved protein phosphatase family, found throughout the eukaryotic kingdom, including in humans. In humans, Cdc14A mutation causes male infertility and loss in hearing because of defects in cilia function. It is still unclear why Cdc14A is important for cilia structure and function. For a better understanding of Cdc14 contributions to cilia function, we are using the ciliated protozoa Tetrahymena thermophila. My goal was to characterize the specificity of different Cdc14 isoforms in T. thermophila to help identify its biological substrates. I used the general phosphatase substrate pNPP to measure overall activity and a series of phosphopeptide substrates to characterize biological specificity. My results demonstrated that TtCdc14-6 has activity in the pNPP assay, although significantly lower than typical Cdc14 enzymes. In the phosphopeptide assay, TtCdc14-6 had the usual preference for phoshphoserine substrates common to other Cdc14s. Interestingly, it did not display a strong preference for Pro at the +1 position relative to the phosphoserine, thought to be a defining feature of Cdc14 enzymes. In addition, TtCdc14-6 exhibited an unusual preference for a Lys at +4 rather than +3 and a preference for Arg at +3 instead of Lys. The best substrate had basic amino acids at +3, +4, and +5. My data suggests that TtCdc14-6 has a different specificity compared with the other six T. thermophila Cdc14 isoforms and may have evolved to recognize distinct phosphosubstrates and perform different biological functions. More extensive characterization with larger substrate peptide pools will be important to fully understand TtCdc14-6 specificity.

Keyword(s):

Tetrahymena Thermophila, Phosphosubstrate, Cdc14, Specificity, pNPP

Mentor(s):

Mark Hall (Agriculture); Kevin G. Velázquez-Marrero (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 114
Presentation Time: 7/27, Session 1: 10am-11:30am

Biochemistry REU

Predicting Infection Prevalence of Batrachochytrium dendrobatidis from frog calling characteristics

Author(s):

Ethan A. Muñiz Carrasco† (University of Puerto Rico-Humacao and Purdue University)

Abstract:

Frog calls exhibit certain characteristics which could be used to predict infection rates within amphibian communities. It has been established in previous research that some species of amphibians alter their calling behavior when infected by pathogens. Amphibian populations worldwide have been experiencing declines due to the devastating impacts caused by the emerging fungal pathogen Batrachochytrium dendrobatidis (Bd). Survival to infection has been associated with host responses, especially the behavioral response towards Bd. The main objective of this study was to determine which aspects of the calls of three frog species (Hyla crysoscelis, Pseudacris crucifer and Lithobathes clamitans) are influenced by Bd. We predict that since H. crysoscelis and P. crucifer are not Bd reservoirs, they will go through terminal investment and enhance their calling frequency when infected with Bd. To the contrary, L. clamitans, a Bd reservoir, will not alter their call when infected. The approach taken was to record a five-minute audio call survey and then obtain skin swabs from frogs on five sites in Indiana sampled on a weekly basis. The samples were processed by DNA extraction and qPCR for pathogen detection, data was analyzed using various packages from R studio. We will present results correlating the frequency of the frog calls with the infection prevalence of Bd in the various sites per species. Our results could help us compare the various disease dynamics each species have and can lead us to less invasive disease mitigation strategies by predicting infection rates through call survey data analysis.

Keyword(s):

Disease Ecology, Chytridiomycosis, Amphibians, Calling Behavior, Conservation

Mentor(s):

Catherine Searle (Science); Aura Y. Muñiz Torres (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 115
Presentation Time: 7/27, Session 1: 10am-11:30am

Biochemistry REU

The loss of Ahcy family proteins do not lead to premature retinal degeneration in Drosophila melanogaster.

Author(s):

Maxwell Sutherland† (Ohio Northern University)

Abstract:

The eye is a high oxygen-consuming tissue because of phototransduction processes in the retina leading to oxidative stress. Oxidative stress is associated with an increased risk for ocular disease and disruption of epigenetic mechanisms in the eye. Methionine metabolism is important for combating oxidative stress via its role in antioxidant biosynthesis, and is necessary for all methylation reactions by producing S-adenosylmethionine (SAM) and breaking down S-adenosylhomocysteine (SAH). In this study, we used Drosophila melanogaster to determine if the knockdown of the essential enzyme, Adenosylhomocysteinase (Ahcy), and its noncanonical enzymes Adenosylhomocysteinase-like 1 (AhcyL1) and Adenosylhomocysteinase-like 2 (AhcyL2) leads to premature retinal degeneration in young flies. Ahcy is a homotetramer that functions in methionine metabolism to break down SAH. When SAM-dependent methyltransferases transfer a methyl group from SAM, they generate SAH, which inhibits methyltransferase activity. Without Ahcy, SAH accumulates inhibiting methylation reactions. To test if these enzymes are important for ocular health, we used the GAL4 UAS binary expression system that will knock down target genes at the mRNA level. We paired this Gal4 UAS system with a tissue-specific driver to knock down the target genes solely in the eye of the adult fly. We then imaged using optic neutralization to visualize the ommatidia and rhabdomeres, which are the functional optical unit of the compound eye. This live fly imaging technique enables us to characterize healthy or degenerating rhabdomeres. We found the knockdown of Ahcy, AhcyL1, and AhcyL2 showed no premature retinal degeneration when assessed through the presence or absence of rhabdomeres.

Keyword(s):

Adenosylhomocysteinase, Retinal Degeneration, Methionine Metabolism, Drosophila Eye

Mentor(s):

Vikki Weake (Agriculture); Sarah Stanhope (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 116
Presentation Time: 7/27, Session 1: 10am-11:30am

Biochemistry REU

Investigation of an intermediate sterol signaling pathway required for SET4 expression in Candida glabrata

Author(s):

Cynthia Vazquez† (Science)

Abstract:

Redacted.

Keyword(s):

Candida Glabrata, SET4, Ergosterol Pathway, Azole Resistance

Mentor(s):

Scott Briggs (Agriculture); Justin Gregor (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 117
Presentation Time: 7/27, Session 1: 10am-11:30am

Colombian Research Scholars Program

Evaluation of BRD7 inhibitors in prostate and breast cancer cell models

Author(s):

Luisa Baracaldo† (Pharmacy)

Abstract:

Bromodomain-containing protein 7 (BRD7) has been reported to be involved in the advancemen of several types of cancer. However, little is known about the role of BRD7 in prostate cancer (PCa). Previous efforts in our research group BRD7 knockdown results demonstrated that reduced expression of BRD7 decreased cell proliferation in androgen receptor(AR)-positive PCa cells, while having little to no effect on normal epithelial prostate cells or AR-negative PCa cells. To further study the role of BRD7 in PCa and demonstrate its value as potential therapeutic target, we developed two BRD7-selective inhibitors, 1-78 and 2-77, which are cellular active and inhibit proliferation in PCa cells at 1 µM. However, an IC50 for the compounds in different PCa cell lines had not been reported. Additionally, the compounds had not been tested in other models of disease. In the present study, we determined IC50 values of the inibitors in PCa cell-based models representing the different stages of the disease, and observed higher sensibility in AR-positive cells. Moreover, we tested the compounds in a triple-negative breast cancer cell model and observed BRD7 knockdown as well as treatment with 2-77 inhibit cell growth and migration.

Keyword(s):

Prostate Cancer, Breast Cancer, Bromodomain-Containing Protein 7, Inhibitors

Mentor(s):

Sandra Ordonez (Pharmacy); Emily Dykhuizen (Pharmacy)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 118
Presentation Time: 7/27, Session 1: 10am-11:30am

Colombian Research Scholars Program

Factors Associated with Obesity and Hypertension in Rural Latinx Youth in Indiana

Author(s):

Sara Inar Otalora Guerrero† (HHS)

Abstract:

Obesity and hypertension are serious public health concerns affecting about 14.7 million children and adolescents in the U.S. Latinx youth may be particularly at risk for health problems as they have a high prevalence of obesity (26.2%) and obesity-related illnesses such as hypertension (CDC, 2021). These rates are higher for those born in the U.S. compared to immigrants (D'Alonso et. al; 2012; Jones et al., 2022). Stress is linked to both obesity and high blood pressure (HBP) (Jones et al., 2022). Assessing factors that both are related to risk and that offer protection is therefore critical.

We examined 1) BMI and HBP in Latinx youth, and 2) the associations between stress (psychological stress, anxiety, and depression) and protective factors (sources of social support) and BMI and HBP. We used preliminary data from the Purdue Puentes Project, an on-going longitudinal study of rural Midwestern immigrant Latinx youth ages 10-15 (N=210, Mage=13.10, males=52.9%; 36.2% born outside of the U.S.).

Results found most youth were obese (41.3%) or overweight (23%), and 17.5 % had HBP. Regression analyses were run separately for BMI and HBP. Psychological stress, age, and born in U.S predicted BMI (but anxiety, depression and social support variables were non-significant). Age and anxiety were positively associated with HBP, and friend social support was negatively associated (but depression and psychological stress were non-significant).

These findings demonstrate that the high rates of BMI and HBP in Latinx adolescents are impacted by stress and could lead to future physical health issues.

Keyword(s):

Latinx Youth, Obesity, Hypertension, Rural

Mentor(s):

Zoe Taylor (HHS); Alexia Carrizales (HHS); Yumary Ruiz (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 119
Presentation Time: 7/27, Session 1: 10am-11:30am

Digital Ag REEU

Mental Wellbeing and Academic Performance: The Connection Between Healthy Eating, Food Insecurity, and Access to Resources

Author(s):

Ja'Quan Battle† (Engineering)

Abstract:

Highlighting the growing importance of understanding the connection between nutrition, mental wellbeing, and academic success in a society facing socio-economic challenges. Exploring and examining the prevalence of food insecurity, available food assistance programs, the number of supermarkets present, the accessibility of healthcare, and students' decline or increase in GPAs and test scores in specific populations. Also, comparing a more food insecure population to that of a more food secure population. Using data collected to create maps in ArcGIS to represent that data. Using a story map in ArcGIS to tell the story of the level of food insecurity and incorporating an interactive map showing the number of supermarkets available.

Keyword(s):

Data Cleansing, ArcGIS, Excel, Available Water, Map

Mentor(s):

Dharmendra Saraswat (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 120
Presentation Time: 7/27, Session 1: 10am-11:30am

Digital Ag REEU

Managing a horticultural research test bed for image data collection

Author(s):

Karla Dominguez† (Engineering, JMHC)

Abstract:

This horticultural research project seeks to establish a dedicated testbed for image data collection and analysis in order to improve crop performance comprehension and forecasting. The focus of the project is the management of a small research plot devoted to the cultivation of tomato and watermelon varieties, which provides an environment for imaging experiments. The primary objective is to create a pipeline for image data collection that captures LIDAR and RGB images of each crop throughout the growing season. This pipeline will facilitate the creation of a comprehensive image database, which will be used for the development of sophisticated models. An algorithm for image data processing will be devised to extract necessary variables, such as plant volume, for calibrating DSSAT crop models and machine learning models. These models will facilitate variety-specific yield prediction and corresponding analytic capabilities. The project will expand the team's knowledge of agricultural research plot management, including crop cultivation and maintenance. Using computer vision techniques, the team will acquire proficiency in developing Python scripts for image data processing. Extraction and transformation of data from LIDAR and RGB images will facilitate subsequent analysis. Additionally, the initiative will provide a unique opportunity to investigate the application of computer vision in the agricultural sector. The team seeks to improve crop monitoring, disease detection, and yield forecasting by utilizing advanced image analysis techniques and the incorporation of crop models. Aside from contributing to the field of agricultural informatics, this initiative will provide valuable insights for sustainable and effective crop management practices.

Keyword(s):

Crop Management, Horticulture, Computer Vision, Image Data Processing, Crop Modeling

Mentor(s):

Ankita Raturi (Agriculture); Steven Doyle (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 121
Presentation Time: 7/27, Session 1: 10am-11:30am

Digital Ag REEU

Off-Grid Solar Electrification for Greenhouses System Modeling

Author(s):

Alaina Gartner† (Agriculture, Engineering)

Abstract:

Greenhouses allow gardeners, farmers, and researchers to control the climate conditions for a range of plants that may not thrive in their particular region. Electrification of greenhouses provides power to systems which reduces the workload on growers. These systems may control fans, thermostats, side rollers, and hoses. Rural and urban areas alike may not have access or the means to power greenhouses using on-grid systems. Off-grid systems are a great alternative and provide many options to growers for more sustainable energy sources like solar panels and windmills. This Excel model is a user interface that allows greenhouse owners to select their conditions to calculate appropriate solar panel size, amount of batteries, relays, and sensors, as well as general cost outline.

Keyword(s):

Modeling, Greenhouse, Sustainable Energy, Digital Agriculture

Mentor(s):

Dennis Buckmaster (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 122
Presentation Time: 7/27, Session 1: 10am-11:30am

Digital Ag REEU

Fertilizer Sales Data Organized Using AIRTABLE

Author(s):

Jolene Morris† (Agriculture)

Abstract:

This project used data obtained by a family friend who is a farmer that also sells crop fertilizer to surrounding farmers. Using this data and the skills developed in the Digital Ag REEU Program I am making an AIRTABLE to organize and have a continuously running computation that totals his sales and inventory. His data is composed of information based on each farmer that purchased any singular product from him. This causes there to be a lot of blanks on his data set making it look messy. I plan to turn this data into a list of all his products he sells with the totals of each product. If he wishes to keep the information with the farmer, I will include a running list for each farmer as well but take out any unnecessary data. I will include a form for him to fill out each time he makes a fertilizer sale, the form will automatically output as a google sheet to keep all the data in one place. As a farmer I know the last thing they want to do is fiddle with their data so this will allow him to input his data with ease and have it look more organized.

Keyword(s):

Fertilizer Data, Airtable, Farmer, Sales/Inventory Totals, Data Organization

Mentor(s):

Dennis Buckmaster (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 123
Presentation Time: 7/27, Session 1: 10am-11:30am

Digital Ag REEU

Genetics Analysis

Author(s):

Emma Newton† (Agriculture, Engineering)

Abstract:

TBD

Keyword(s):

Genetics, Data, Data Analysis

Mentor(s):

Mark Daniel Ward (Science); Luiz Brito (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 124
Presentation Time: 7/27, Session 1: 10am-11:30am

Digital Ag REEU

Anayzing Gene Functions through QTLs

Author(s):

Mario Perez-Ahuatl† (Agriculture, JMHC)

Abstract:

Redacted.

Keyword(s):

Bioinformatics, Genomics, Digital Agriculture

Mentor(s):

Luiz Brito (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 125
Presentation Time: 7/27, Session 1: 10am-11:30am

Digital Ag REEU

The Applicability of the LoRaWAN Project

Author(s):

Ellarose Strasser† (Agriculture)

Abstract:

The growing population supplies a continuous need for better technology in agriculture to keep up with the demand for more food. Precise distribution of nutrients into crop fields is essential to producing the highest yield. Knowing specific field conditions helps the farm manager know exactly what needs to happen with fertilizer applications, irrigation, and more. This study focused on the applicability of a project that made use of readily available hardware and software. This project was developed by Adam Schreck to “present the abilities of IoT [Internet of Things] technologies, specifically LoRaWAN [Long Range Wide Area Network], to encourage data collection for agricultural applications”. The anticipated result from this project is a refinement of Schreck’s instructions to better suit consumer needs.

Keyword(s):

LoRaWAN, Raspberry Pi, Agriculture, Yield, Sensor

Mentor(s):

Dennis Buckmaster (Agriculture); Andrew Balmos (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 126
Presentation Time: 7/27, Session 1: 10am-11:30am

Digital Ag REEU

Socioeconomic Determinants of Health Insurance Accessibility and Affordability Among Farmers: A Comprehensive Analysis of Income and Geographic Disparities

Author(s):

Kate Veltri† (Pharmacy)

Abstract:

Farmers face unique challenges in obtaining adequate healthcare coverage due to their occupation and specific socioeconomic circumstances. These socioeconomic factors, such as income levels and geographic disparities, impact the accessibility and affordability of health insurance for farmers. Through a comprehensive analysis of literature, national surveys, and statistical data, this study dissects the relationship between income levels and health insurance availability among farmers, as well as the influence of geographic location on insurance accessibility.

Keyword(s):

Agriculture, Health Care, Socioeconomics, Insurance, Farmer

Mentor(s):

Dharmendra Saraswat (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 127
Presentation Time: 7/27, Session 1: 10am-11:30am

Growing Entrepreneurially-Minded Researchers REU

RF sputtering of P-type SnOx thin films using ceramic SnO targets: engineering and optimization

Author(s):

Patrick Chuang† (Polytechnic Institute)

Abstract:

Oxides were promising for electronic applications, such as thin film transistors (TFTs), due to their high mobility and low-temperature manufacturing process. P-type oxide has gained attention since most oxides available are n-type, limiting the development of bipolar application. In this study, sputtered tin monoxide (SnO) is used as the channel of TFT to confirm its p-type property. Although metallic tin (Sn) targets are commonly used to deposit p-type SnO, the ceramic SnO target is chosen in this study because it does not need an additional chemical reaction to become SnO thin film, offering improved structural stability and stoichiometry control. The objective of this research is to optimize the deposition process for p-type SnO thin film using radio frequency (RF) sputter deposition with SnO target. The samples were deposited under 50W to 100W RF power with Ar/O2 gas compositions of 0%, 5%, 13%, and 20% oxygen. All the results of samples that are deposited with more than 5% oxygen show the n-type semiconductor property. However, the SnO TFT deposited with 0% oxygen shows transition characteristics that are between p-type and n-type properties. This result shows the samples deposited with more than 5% oxygen are over-oxidized. Consequently, in the next step, gas compositions with less than 5% oxygen for the deposition will be tested to get the p-type TFT. The findings of this study are anticipated to contribute to the advancement of p-type oxides and their utilization in industrial devices such as TFTs, aligning with the existing processing demands.

Keyword(s):

Thin Film Transistor, SnO, P-Type, Oxide, Sputter

Mentor(s):

Sunghwan Lee (Polytechnic Institute); Dong Hun Lee (Polytechnic Institute)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 128
Presentation Time: 7/27, Session 1: 10am-11:30am

SCARF

Investigating within-generation stress memory during reoccurring nitrogen starvation stresses in Arabidopsis

Author(s):

MarySara Albert† (Agriculture)

Abstract:

Plants, including agricultural crops, must respond to biotic and abiotic stressors, often repeatedly over its lifetime. Plants have been hypothesized to “remember” these events through epigenetic regulation to better respond to iterated stressors, such as nitrogen deficiency, although possible epigenetic mechanisms remain presumptive. Here, using "Arabidopsis thaliana" and nitrogen deficiency as a model, I exhibit preliminary results that indicate a relationship between nitrogen deficiency stress memory and DNA methylation as an epigenetic regulation, along with technical insights for future experiment iterations. During this study, I grew wild type "Arabidopsis thaliana" under three nitrogen deficiency stress treatments: Group S2 experienced two stress periods, a 24-hour initial stress exposure and a 6-day extended stress; Group S1 experienced just the extended stress; and Group S0 remained in sufficient nitrogen. I grew mutant rdm1, who has inhibited RNA-directed DNA methylation, with the same three stress treatment groups, referred to as mS2, mS1, and mS0. My study showed improved chlorophyll levels in group S2 compared to S1, suggesting a stress memory phenotype, while that of the rdm1 mutant did not, hinting nitrogen deficiency stress memory is dependent on a DNA methylation. These promising preliminary results should be further examined in future experimental repeats, with improved growth conditions to minimize contamination and growth stressors. Better understanding nitrogen deficiency stress memory is vital for farmers in a world where fertilizers are becoming more expensive and environmentally damaging. By understanding its mechanism, stress memory could be utilized in maximizing the efficiency of fertilizer usage in major agricultural crops.

Keyword(s):

Abiotic Stress Memory, Nitrogen (N)-Deficiency, DNA Methylation, Arabidopsis Thaliana

Mentor(s):

Ying Li (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 129
Presentation Time: 7/27, Session 1: 10am-11:30am

SCARF

Drought-mediated Changes in Minimum Conductance

Author(s):

Connor Baker† (Agriculture)

Abstract:

To survive a drought, plants are tasked with limiting water loss while maintaining efficient metabolic activity. Stomata, or adjustable pores embedded in the epidermis of leaves, account for upwards of 90% of all evapotranspiration and as such their closure is pivotal to ensure survivability when water is scarce. During a drought abscisic acid is synthesized within the leaf to reduce the degree of stomatal aperture. During these periods of stress, water is still lost through incompletely closed stomata, the cuticle, and the periderm; a process termed minimum or residual conductance. It is currently unknown how climatic variables like precipitation, temperature, and relative humidity - vapor pressure deficit - affect a species rate of minimum conductance. Here we show, in the field, the effect of intermittent drought periods subsequently followed by rainfall events on a species minimum conductance during the months of June and July in two co-occurring deciduous trees, Tilia americana and Fagus grandifolia. Our results suggest that precipitation and vapor pressure deficit do not directly affect a species minimum conductance. Throughout the duration of the experiment T. americana exhibited no significant changes in minimum conductance while F. grandifolia exhibited minor changes in minimum conductance that were not correlated with precipitation or vapor pressure deficit. Interestingly, the proportion of water lost through residual pathways did change in response to fluctuations in abscisic acid concentrations. These findings suggest that a species cuticular and bark permeance may be key limiting factors to survival during drought. (Work in progress)

Keyword(s):

Drought, Tree Physiology, Minimum Conductance

Mentor(s):

Scott McAdam (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 130
Presentation Time: 7/27, Session 1: 10am-11:30am

SCARF

Identification of CAND1 and CAND2 interacting proteins using BioID

Author(s):

Chloe Chui† (Agriculture, JMHC)

Abstract:

Cullin-associated Nedd8-dissociated 1 and 2 (CAND1 and CAND2) are important regulators of cullin-RING ubiquitin ligases, which play key roles in protein ubiquitination through directly interacting with the cullin enzymatic cores. Misregulation of the ubiquitination pathway can lead to growth defects and diseases, including cancer. Although some interactions with CAND1 and CAND2 have been identified, there are many transient interactions that are unknown. In this study, we aimed to identify proteins that interact with CAND1 and CAND 2 via BioID proximity dependent labeling. To identify candidate interacting proteins, we fused the BioID with our bait proteins (CAND1 and CAND2) and expressed the fusion protein in HEK293 cells where CAND1 and CAND2 genes were knocked out. When the cells were supplied with biotin, BioID-fused CAND1/2 was able to promiscuously biotinylate proteins that typically interact with the bait proteins. By performing an affinity purification, we then isolated the biotinylated proteins and analyzed them via mass spectrometry. Upon receiving the mass spectrometry results, we will confirm the success of the BioID labeling by confirming that known interactions are present and identify new proteins that potentially interact with CAND1/2. Follow up experiments will be conducted to confirm interactions between CAND1/2 and the candidate proteins, and the confirmed interacting proteins will be further investigated for their role in regulating cullin-RING ubiquitin ligases and protein ubiquitination.

Keyword(s):

BioID, Mass Spectrometry, Proximity Labeling, CAND1, CAND2

Mentor(s):

Xing Liu (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 131
Presentation Time: 7/27, Session 1: 10am-11:30am

SCARF

Characterization and Specificity of Tetrahymena CDC14 Isoforms

Author(s):

Christopher D'Acosta† (Agriculture)

Abstract:

Cdc14 is a family of highly conserved phosphatases in most eukaryotic organisms. In humans, mutations in Cdc14 cause improper maintenance of structure in cilia. This defect of cilia causes deafness as well as sterility due to a lack of sperm motility. It is unknown what the specific roles of Cdc14 are in the maintenance of cilia. We are using the cilliated protozoan species Tetrahymena thermophila as a model organism to test the specific functions of Cdc14 in promoting cilia function. Tetrahymena possesses 7 unique Cdc14 isoforms, and my goal was to test the substrate specificity of 2 of these isoforms in order to help determine their functions. I used the generic phosphatase substrate pNPP to confirm that the isoform TtCdc14-5 has phosphatase activity and is inhibited by sodium orthovandate. Interestingly, in an assay using phosphopeptide substrates, TtCdc14-5 had no noticeable phosphatase activity in contrast to all other known forms of Cdc14. This suggests that Cdc14-5 may not be a protein phosphatase but may target other molecules such as phospholipids for and points to a different function than other known variants of Cdc14. We are currently searching for alternative substrates for ttCdc14-5.

Keyword(s):

Cdc14, Phosphatase, Tetrahymena Thermophila, Cillia, pNPP

Mentor(s):

Mark Hall (Agriculture); Kevin G. Velázquez-Marrero (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 132

Presentation Time: 7/27, Session 1: 10am-11:30am

SCARF

Testing the biological significance of fungal eisosome regulation by the PP2ARts1 phosphatase

Author(s):

Marcella Dibble† (Agriculture)

Abstract:

Eisosomes are protein complexes that assemble at the plasma membrane in fungi and are important for metabolic homeostasis, nutrient uptake, and regulating stress response signaling pathways, including the control of sphingolipid metabolism. Sphingolipids are critical signaling molecules and structural components of the cell membrane. The Hall lab recently discovered that the protein phosphatase PP2ARts1 controls the localization of eisosomes at the plasma membrane. The biological significance of eisosome regulation by PP2ARts1 is unclear. Since PP2ARts1 and eisosomes both have been linked to sphingolipid metabolism independently, we hypothesized that PP2ARts1 regulation of eisosome localization might play a role in sphingolipid homeostasis. To test this hypothesis, I used agar plate spotting assays to measure the sensitivity of yeast cells lacking the Rts1 subunit of PP2ARts1 to the sphingolipid synthesis inhibitor myriocin. I used the auxin-inducible degron (AID) system and gene deletions to disrupt Rts1, and plasmids containing the RTS1 gene to complement Δrts1. My results from the Δrts1 complementation assays and the AID system suggest that previous conclusions on the role of PP2ARts1 in sphingolipid metabolism need to be revised. We are currently exploring other hypotheses for the biological significance of eisosome regulation by PP2ARts1.

Keyword(s):

Eisosomes, Sphingolipids, PP2ARts1, Myriocin, AID System

Mentor(s):

Mark Hall (Agriculture); Andrew DeMarco (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 133
Presentation Time: 7/27, Session 1: 10am-11:30am

SCARF

Effect of Pyruvate Carboxylase Expression on Cell Growth and Proliferation

Author(s):

Addison Hill† (Agriculture)

Abstract:

Dairy cattle must synthesize 90% of their glucose requirements. Pyruvate carboxylase (PC) catalyzes the synthesis of oxaloacetate, which is a primary substrate for glucose production. Both saturated and unsaturated fatty acids regulate PC expression. The objective was to study the effect of altering fatty acids and PC expression in Madin-Darby Bovine Kidney (MDBK) cells on cell growth. We hypothesized that when PC expression is impaired by the addition of saturated fatty acids, or when PC is under-expressed, that cell growth would be impaired. MDBK cells were plated, grown overnight, and incubated for 21h in fatty acid treatments that totaled to 1mM, with varying ratios of palmitic acid to α-linolenic acid. Cells were counted to determine the total number and percent alive. In the second experiment, four cell lines were used: WT, PC shRNA scramble, PC shRNA knockdown, and PC overexpression. Cells were plated, grown overnight, and either treated with or without doxycycline. Cells were counted on d3, 5, and 7 for total cells and percent alive. Fatty acid treatment had an overall effect on total cells ($P=0.001$) and percent alive ($P=0.0001$), and the 1mM palmitic acid treatment reduced total cells and percent alive. There was a significant day effect on total cells and percent alive with d3 being different from d5 and 7 for total cells, but d5 not being different from d7. Overall, 1 mM palmitic acid appeared cytotoxic. PC knockdown did not impair cell growth, which suggests fatty acids control cell growth independent of PC.

Keyword(s):

Pyruvate Carboxylase, Madin-Darby Bovine Kidney Cells, Cell Growth

Mentor(s):

Theresa Casey (Agriculture); Linda Beckett (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 134
Presentation Time: 7/27, Session 1: 10am-11:30am

SCARF

Genomic Diversity of Continentally Separated Australian Merino and American Merino de Rambouillet Sheep Populations

Author(s):

Shayden Jones† (Agriculture, JMHC)

Abstract:

The objective of this research aimed to assess the genetic diversity of Australian Merinos and Merino de Rambouillet breeds, which originated from the Spanish Merino breed and underwent genetic isolation due to their separation in the 1700-1800s. The datasets used for this research were obtained from the Widde Database (http://widde.toulouse.inra.fr/widde/), genotyped using OvineSNP50, for single nucleotide polymorphisms(SNPs), and after QC included samples from 50 Australian Merino, 102 Rambouillet, and 20 Spanish Merino sheep used for historic comparison. These datasets were analyzed using PLINK software and RStudio. The genomic diversity analyses performed included principal component analysis(PCA), genomic inbreeding, runs of homozygosity(ROH), linkage disequilibrium, and effective population size. The PCA clearly differentiated the Australian Merino and Rambouillet populations, while also showing a closer association of Spanish Merino sheep to both populations. Genomic inbreeding was lower in the Merino breeds compared to other livestock populations, with average values of 0.0276 for Rambouillet, 0.0209 for Australian Merino, and 0.0543 for Spanish Merino. Runs of homozygosity (ROH) analysis using 1,586 ROHs from Rambouillet and 505 ROHs from Australian Merino revealed concentrated ROH regions on the first six chromosomes for both breeds. The average of linkage disequilibrium across all markers was 0.06 for the Australian Merino breed and 0.07 for the American Merino de Rambouillet breed, indicating that genomic selection would be equally feasible in both populations. In conclusion, our preliminary results indicate that geographical separation and differential selection strategies in worldwide Merino populations have made them genetically distinct breeds with prominent levels of genetic diversity.

Keyword(s):

Genetic Diversity, Merino-Derived Sheep Breeds, Merino Sheep, Genomic Analysis, SNP Data Analysis

Mentor(s):

Luiz Brito (Agriculture); Henrique Mulim (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 135
Presentation Time: 7/27, Session 1: 10am-11:30am

SCARF

Studying the Role of Histone Modifications in Fruit Fly Vision Neurons

Author(s):

Makayla Marlin† (Agriculture)

Abstract:

As an organism gets older, changes in gene expression occur, correlating to age-related ocular diseases. Histones play a critical role in the regulation of gene expression and chromatin structure, influencing a range of cellular processes, including age-related changes in the eye of Drosophila melanogaster or fruit fly. Histone modifiers or regulators such as histone acetyltransferases and histone methyltransferases add or remove acetyl and methyl groups. Manipulating such enzyme activities impacts histone marks and transcription, subsequently affecting age-related eye phenotypes. Prior studies in the Weake lab show a global decrease in histone 3 lysine 4 trimethylation (H3K4me3) and histone 3 lysine 36 trimethylation (H3K36me3) across expressed genes in fruit fly eyes as they age. However, many other modifications have not been studied in the aging eye. This study aims to elucidate how histone marks change in aging photoreceptors by examining D10 and D50 flies. By employing Nuclei Immuno-Enrichment (NIE) to affinity bind photoreceptor nuclei, coupled with Cleavage Under Targets and Release Under Nuclease (CUT&RUN), a chromatin profiling strategy, we will investigate how histone mark distribution and levels change as the flies age. This study could provide valuable insight into the molecular mechanisms responsible for age-related gene expression, along with ocular diseases that result from this.

Keyword(s):

Aging, Drosophila Melanogaster, Histone Marks, Nuclei, Ocular Disease

Mentor(s):

Vikki Weake (Agriculture); Gaoya (Grace) Meng (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 136

Presentation Time: 7/27, Session 1: 10am-11:30am

SCARF

Standardizing Fecal Fermentation Conditions for the Development of a Functional Bioassay

Author(s):

William Petrusson† (Agriculture)

Abstract:

Gut microbiomes are important to our overall health and can vary by composition, cell density, and fermentative ability of fibers. Gut community composition has been measured to assess and predict individual health, but to limited success due to extreme individuality within the population. Measuring functional capability of gut microbiota in vitro may be a more useful metric. To succeed in evaluating a wide variety of fecal communities in the human population, fermentation factors need to be understood and adjusted to an optimal and sensitive range. An iterative process was used to test fermentation conditions. Relevant conditions tested were buffer strength of the defined mineral media, substrate concentration, and substrate type. Various carbon sources tested were glucose, beta glucan, long-chain inulin, maltodextrin, resistant starch, wheat arabinoxylan, and digested wheat bran, listed in order of increasing complexity. Substrates were anaerobically fermented with fecal material collected from the same donor. Fermentation was evaluated by measuring pH change over time using batch fermentation. Substrates of lower complexity like glucose had a more dramatic pH change compared to higher complexity substrates. Increased fiber concentration was found to increase fermentation rate and decrease terminal pH slightly. Fluctuations in fermentation rates under constant conditions were attributed to differences in initial fecal samples collected on different days. Anoxic storage of fecal samples (4℃) limited these variations over a maximum period of 7 days. Understanding how different factors change rates of fecal fermentations with various fibers is fundamental for the selection of optimal conditions for a future functional bioassay.

Keyword(s):

Fecal Fermentation, Gut Microbiome, Dietary Fibers, Anaerobic Microbiology

Mentor(s):

Steve Lindemann (Agriculture); Adam Quinn (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 137
Presentation Time: 7/27, Session 1: 10am-11:30am

SCARF

The Role of the Circadian Rhythm in the Development of Retinal Degeneration in Aging Drosophila melanogaster Photoreceptors

Author(s):

Sophia Pruitt† (Agriculture, JMHC)

Abstract:

Age-related eye diseases that can cause blindness are becoming increasingly common with the shifting population, making it extremely important to study the aging eye. Drosophila melanogaster photoreceptors are known to degenerate with age, similar to human eyes. The circadian rhythm becomes dysregulated during age in both Drosophila and humans, which can contribute to developing eye disease. In order to identify the role of the circadian clock in photoreceptor health during aging, we aged several lines of Drosophila with core clock gene mutations to various time points and compared to wild-type Drosophila. We determined photoreceptor health by taking images of the eyes using optic neutralization. The images were scored for rhabdomere degeneration and compared to other genotypes and time points. We found that Drosophila with core clock mutations have increased premature rhabdomere degeneration when compared to wild-type specimens. These data suggest that circadian rhythm functionality is an important component of photoreceptor health during aging.

Keyword(s):

Drosophila Melonogaster, Circadian Clock, Photoreceptors, Aging Eye, Retinal Degeneration

Mentor(s):

Vikki Weake (Agriculture); Sarah McGovern (Agriculture); Seth Lammert (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 138
Presentation Time: 7/27, Session 1: 10am-11:30am

SCARF

Organ-Specific Cell Cycle Alterations Resulting from Methimazole-Induced Fetal Hypothyroidism

Author(s):

Alyssa Smith† (Agriculture)

Abstract:

In-utero hypothyroidism adversely affects fetal growth and maturation, however, the exact molecular mechanisms by which this occurs are unknown. The objective of this study was to examine the organ-specific effects of fetal hypothyroidism on the regulation of cell cycle progression in the late gestation porcine fetus. Eight pregnant gilts were dosed with either methimazole (MMI) or an equivalent negative control (CON) during days 85-106 out of 114 days of gestation. After the treatment period, the gilts were humanely euthanized, and tissue samples taken from two male and two female fetuses from each gilt (n = 32). Complete hypothyroidism of the MMI fetuses was confirmed via ELISA assay, and total RNA was then extracted from eight different tissues, including heart, ileum, kidney, lung, liver, muscle, spleen, and thymus. RNA was reverse transcribed to allow for analysis of the expression of three cell cycle promoters (CDK1, CDK2, and CDK4) and one cell cycle inhibitor (CDKN1A) by qPCR. The relative expression of these genes was compared between the MMI and CON groups, and initial results showed that each tissue experienced at least one significant up- or downregulation in the expression of the aforementioned genes as a result of treatment with MMI. Many changes in gene expression were observed in the muscle, which had significant downregulations of CDK1, CDK2, and CDK4. These findings indicate the occurrence of organ-specific disruptions in cell cycle progression as a result of in-utero hypothyroidism, which could be responsible for some of the detrimental effects of hypothyroidism on fetal development.

Keyword(s):

Hypothyroidism, Fetal Development, Cell Cycle

Mentor(s):

Alex Pasternak (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 139
Presentation Time: 7/27, Session 1: 10am-11:30am

SCARF

The Impact of Lignin Composition on Endophyte Populations

Author(s):

Payton Taylor† (Agriculture)

Abstract:

Phenolic acid degrading endophytes colonize the inner tissues of poplar and influence the rhizosphere environment by causing the soil priming effect and may be beneficial to the plant by fixing nitrogen. This study aims to explore the aromatic-degrading endophytic bacteria in three different transgenic poplar, growing at Luger Farm, which produces varying amount of phenolic monolignols derived from sinapyl (S) and coniferyl alcohols (G). We hypothesize that the composition of aromatics between high S:G (F5H85) and low S:G transgenic lineages (0998-45) will cause variation in the endophyte populations. Samples were collected from a high S line, a low S line, and a wild type poplar (WT 717). We selectively enriched for phenolic acid-degrading bacteria using minimal media containing Benzoic Acid or Hydroxybenzoic Acid as sole carbon sources. Additional enrichment culturing was conducted with or without a chemical nitrogen source (to select for N-fixing bacteria) and with or without Cycloheximide, a fungicide, to select for or against fungi. Enrichment culturing was performed on media with Hydroxybenzoic Acid or Benzoic Acid followed by a dilution series to estimate the number of active cells in each sample. The optical density was collected over time to monitor microbial growth and observe differences between treatment groups. The ODs of the wild type poplar were highest when cultured in Hydroxybenzoic Acid and lowest when cultured in media containing Nitrogen and Benzoic Acid. The two mutant poplars were only cultured in media containing Nitrogen, but both had the highest average optical densities in media containing Hydroxybenzoic Acid.

Keyword(s):

Lignin, Aromatics, Poplar, Endophytes

Mentor(s):

Roli Wilhelm (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 140
Presentation Time: 7/27, Session 1: 10am-11:30am

SCARF

The ATP-dependent Chromatin Remodeler PICKLE (PKL) and Histone Demethylase ELF6 Collaborate to Maintain Homeostatic Levels of the Repressive Epigenetic Mark H3K27me3

Author(s):

Alice Westermann Villwock† (Agriculture, JMHC)

Abstract:

Redacted.

Keyword(s):

Epigenetics, Chromatin

Mentor(s):

Joe Ogas (Agriculture); Jiaxin Long (Agriculture); Jacob Fawley (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 141
Presentation Time: 7/27, Session 1: 10am-11:30am

SCARF

Biofilm Modeling and Pathogen Prevention in Hydroponic Systems

Author(s):

Madelyn Whitaker† (Engineering); Catie Fleming* (Engineering); Will Townsend* (Engineering); Alex Mate* (Engineering); Emily Spicuzza* (Science)

Abstract:

Redacted.

Keyword(s):

Biofilm, Hydroponics, Chlorination, Bacterial Growth, Modeling

Mentor(s):

Caitlin Proctor (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 142
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Diffusion of innovations: Delivering conceptual and technical material on systems engineering and sleep management for educational purposes in Latin-American environments

Author(s):

Valentina Aguirre Garrido† (Universidad de los Andes)

Abstract:

The diffusion of innovation theory explains how a specific idea is able to be spread and adopted in different social systems. The need for innovations capable of producing desired outcomes in the real world has become an important opportunity for improvement in every field of human activity in the last century. These innovations and works deriving from them can include new techniques, concepts, or products. This article reviews the importance of diffusing innovations to engineering education and healthcare systems in Latin American environments. Thus, we will describe two conceptual types of research, not well known in Colombia, that seek opportunities in those fields: systems engineering and sleep management and monitoring. Firstly, systems engineering (SE) provides a way of delivering resources to multiple engineering students on “how to” address the complexity of problem-solving within an interconnected and changing world. Secondly, sleep management offers an opportunity for tracking and responding to sleep disruption and chronic disorders, which can encourage advances in both sleep medicine and treatments. Such innovations (SE concepts and techniques; sleep management techniques and products) are meant to improve the quality of life for people throughout Colombia. In that sense, finding a way to diffuse these innovations becomes an important goal to achieve. This paper will address the possibilities for grand engineering education and health challenges in Colombia as both conceptual and technical innovations regarding relevant factors that improve the impact of the diffusion processes.

Keyword(s):

Diffusion of Innovations, Education, Systems Engineering, Sleep Management, Healthcare

Mentor(s):

Barrett Caldwell (Engineering); Cassandra McCormack (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 143
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Cryopreservation of Natural Killer (NK) Cells for Cancer Immunotherapy: Optimization of Conditions for Recovery and Anti-tumor Function of NK cells

Author(s):

Mustapha AL Hassan† (Engineering); Lev Titov‡ (Agriculture)

Abstract:

ABSTRACT

Cryopreservation is a critical technique for the storage and preservation of cells, including natural killer (NK) cells, particularly important for the use of these cell in cancer immunotherapy. Traditional cryoprotectants, particularly DMSO, have high toxicity and can introduce safety issues. This project aims to establish guidelines for the cryopreservation of NK cells and evaluate their viability and function under different cryopreservation conditions using novel cryoprotectants which can maintain safety and potency after thawing. The NK-92 cell line was used as the model for this study. Various cryoprotectants, including dimethyl sulfoxide (DMSO), ethylene glycol, glycerol, polyethylene glycol, and trehalose, were tested for their effectiveness in preserving NK cell viability. The cryopreservation media were prepared using different concentrations of cryoprotectants and fetal bovine serum (FBS). The NK-92 cells were frozen in liquid nitrogen for 24-72 hours and then thawed and cultured for more than five days. Viability assessments were performed using trypan blue staining. Additionally, non-DMSO formulations of cryoprotectants were prepared to compare their freezing performance against DMSO. The viability and functionality of the thawed NK cells were evaluated and compared to fresh, non-frozen controls. The results of this study will provide valuable insights into the optimal cryopreservation conditions for maintaining the viability and function of NK cells, which will contribute to their successful application in research and clinical settings.

Keyword(s):

Cryopreservation, Viability, Natural Killer Cells, Cryoprotectants, Cell Culture, Freezing Performance

Mentor(s):

Sandro Matosevic (Pharmacy); Soumyajit Das (Pharmacy); Shambhavi Borde (Pharmacy)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 144
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

The Impact of the Lipid Formulation on Making Ultrasound Contrast Agents

Author(s):

Karla Alvarado† (Engineering); Jinyang Du‡ (Engineering)

Abstract:

In the medical field, biomedical ultrasound imaging has become an essential technique in managing diseases and improving diagnoses. Ultrasound contrast agents are small spheres of gas with low solubility in blood. However, ultrasound imaging has limitations like distinguishing tissue features which led to the formulation of nanobubbles as ultrasound contrast agents, which led to the discussion of which is the best composition that will provide uniform size, stability, and echogenicity. This study aims to find how the lipid composition affects the nanobubble's size, stability, and echogenicity. To create the lipid layer, DPPA, DPPE, and DPPC were the lipids of choice due to their ability to develop sphere-shaped particles and biocompatibility with living organisms. We used a 1:2:8 ratio to mix lipids with 1 mg of DiI, a fluorescent compound and later mixed them with chloroform. After combining the lipids, the DiI, and the chloroform in a 2 mL vial, it heated, which allowed the lipid shell to form. After removing contaminants, we rehydrated the lipid shell with PBS, a buffer, and entrapped the gas of choice in the vial. To measure, we use a technique called Dynamic Light Scattering, which allows us to measure the uniformity in size of the nanoparticles. Ultimately, we want to obtain data that will provide differences in size, behavior, echogenicity, and stability.

Keyword(s):

Ultrasound Contrast Agents (USCAs), Nanoparticles, Lipids, Gas Core

Mentor(s):

Luis Solorio (Engineering); Siting Zhang (Engineering); Claudia Benito Alston (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 145
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Isolating Chlorophyll a's Vibrational Peak Through Microsampling and Isotope Substitution

Author(s):

Sarah Alvarez† (Science); Sajal Salim‡ (HHS)

Abstract:

Sarah Alvarez*, Jacob Wat*, Sajal Salim*, Mike Reppert*

*Lab of Physical Chemistry, Department of Chemistry, Purdue University

Photosynthetic proteins have been optimized by evolution to provide for organisms' growth and survival; however, they are inefficient on a large scale, which is needed for biofuel production. By understanding the optical properties of chlorophyll-protein interactions we can manipulate these interactions and make light harvesting more efficient through site-directed mutagenesis. This research focuses on isolating the vibrational spectrum of chlorophyll a in a model protein environment. We focus in particular on the 1650-1700 cm-1 region, which provides us with information about chlorophyll-protein hydrogen interactions. Unfortunately it is masked by a protein peak, thus making it difficult to analyze the vibrational spectra of chlorophyll a. Preliminary measurements show a vibrational signal, but it is partially obscured by the protein vibrational background. Current experiments aim to use isotope substitution and microsampling to eliminate the protein vibrational signal and provide a clean window on chlorophyll vibrational properties in native proteins.

Keyword(s):

Photosynthesis, Vibrational Spectroscopy, Chlorophyll, Mutagenesis

Mentor(s):

Mike Reppert (Science); Jacob Hnatusko (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 146
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Exploring Photon Statistics with Two Quantum Emitters Coupled to a Micro-Ring Resonator

Author(s):

Umar Arshad† (Science)

Abstract:

Quantum physics allows us to venture into realms beyond our everyday experiences, where light doesn't merely illuminate but also behaves in ways that challenge our understanding. This paper explores a fascinating quantum setup: two atoms, or quantum emitters, interacting with a tiny loop of light, a micro-ring resonator. These atoms are stirred into action by a precisely tuned transmission probe, sparking a play of light and matter. Our investigations hinge on a mathematical tool called the correlation function. This tool allows us to explore the intricate behavior of the atoms and light within the system under different conditions, such as when we change the frequency of the atoms or the strength of their interaction with the resonator. One striking aspect we study is the emission of light from the system, and in particular, whether it exhibits "nonclassical" properties. This refers to behaviors that cannot be explained by classical physics, but rather, require the principles of quantum mechanics. A specific nonclassical feature we are interested in is 'bunching' or 'antibunching', which describes whether the emitted light particles, or photons, prefer to group together or stay apart. By delving into these phenomena, we aim to contribute to the broader understanding of quantum light-matter interactions, paving the way for advancements in quantum technologies. Our results provide valuable insights into how micro-ring resonators can be harnessed to create and control nonclassical light, opening doors for future experimental investigations in this dynamic field.

Keyword(s):

Quantum Optics, Light-Matter Interactions, Micro-Ring Resonators, Correlation Function, Bunching/Antibunching Phenomena

Mentor(s):

Chen-Lung Hung (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 147
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Oncogenic KRAS Signaling: Unraveling Tumor Microenvironment Modulation via Extracellular Vesicles

Author(s):

David Arteaga† (Science)

Abstract:

KRAS, a gene essential for regulating a multitude of cell autonomous processes involved in cell growth and survival, is the most mutated RAS isoform found in non-small cell lung cancer (NSCLC). Recent studies have highlighted the effects of aberrant KRAS signaling in promoting a pro-tumorigenic microenvironment characterized by increased tumorigenesis and immune evasion. Extracellular vesicles (EVs) in cancer are key mediators of intercellular communication and have been shown to facilitate malignant transformations of healthy cells and regulate immune responses. However, the mechanisms by which EVs shape the microenvironment of KRAS-mutant tumors remains understudied and unraveling these mechanisms could improve patient outcomes. In this study, we evaluated EVs isolated from mutant-KRAS NSCLC on their ability to drive migration of non-tumorigenic lung epithelial cells and their effects on T-cell proliferation with the use of transwell migration assays, T-cell proliferation experiments, and flow-cytometry. Our results revealed non-tumorigenic lung epithelial cells co-cultured with EVs derived from mutant-KRAS expressing cells had a higher rate of migration and blocking KRAS signaling disrupted this pro-migratory phenotype elicited by the EVs. Furthermore, T-cells co-cultured with EVs derived from mutant-KRAS expressing cells exhibited decreased proliferation. These results suggest mutant KRAS signaling could play a novel role in promoting the tumor microenvironment by regulating extracellular vesicles to elicit pro-migratory phenotypes in healthy recipient cells and modulate immunosuppression to promote further tumorigenesis of KRAS-mutant non-small cell lung cancer.

Keyword(s):

Extracellular Vesicles, Immunosuppression, Tumor Microenvironment, Cell Migration, Tumorigenesis

Mentor(s):

Andrea Kasinski (Science); Zulaida Soto-Vargas (Science); Humna Hasan (Science); Ikjot Sohal (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 148
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Minimizing Networked Epidemic Processes Using a Staggered Lockdown Strategy

Author(s):

Sachi Barnaby† (University of New Mexico)

Abstract:

During an epidemic, minimizing the infection peak, or “flattening the curve”, is essential to lowering the number of infections at any given time, avoiding overwhelming healthcare services, and saving lives. One strategy that has been developed to flatten the curve is a community lockdown where travel and business are restricted to reduce transmission of the disease. Though there are a variety of lockdown styles, this work focuses on a staggered approach where the populations implement a partial lockdown at different start times that limits most (not all) transmission of the disease for a fixed period of time. We modeled the spreading process using the SIR (Susceptible, Infectious, Recovered) framework on a two-population network. Our work shows the effect of these lockdowns on the populations using simulations, and we perform an exploratory analysis that provides insight into an optimal strategy for staggered lockdowns. We find the lockdown start time for each population that leads to its most flattened peak often occurs at the expense of the other population. By calculating an average of the populations’ maximum infection level, we find a separate global minimum for the infection peak that suggests an optimal staggered lockdown strategy for the whole network based on average flatness rather than individual population flatness. This work hopes to contribute to the growing body of research related to networked epidemic processes and could be extended for other lockdown approaches or epidemic models.

Keyword(s):

Epidemic Processes, Network-Based Spread, Optimal Control

Mentor(s):

Philip Paré (Engineering); Brooks Butler (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 149
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

ROLE OF ACTIN AND REGULATORY PROTEIN CAMKII IN SYNAPTIC PLASTICITY AND ALZHEIMER'S DISEASE

Author(s):

Amina Basharat† (Engineering)

Abstract:

Neuronal junctions have the ability to change their connective strength depending on the input signal received at the post-synaptic area. This concept, known as synaptic plasticity, is crucial for learning and memory formation. A major decline in synaptic plasticity is characteristic of patients with neurodegenerative diseases such as Alzheimer's (AD). To comprehend this decline, it is necessary to better grasp the protein interactions of this phenomenon. $Ca2+$ signaling is key in controlling long-term potentiation (LTP). Its influx into dendritic spines initiates signaling pathways that modify the shape of spines through actin remodeling. Within dendrites, actin filament structure and organization undergo dynamic modifications. Actin polymerization is mainly governed by $Ca2+$/Calmodulin Dependent Kinase II (CaMKII) activity. Calcium dysregulation renders the cells to lose structure and ability to form synaptic connections. Thus, there is a need to investigate the role of CaMKII and actin colocalization in the dendritic growth dynamics. Protein interactions were detected via the proximity ligation assay (PLA) to measure the proximity of actin and CaMKII colocalization after chemically induced LTP vs control. Immunostaining of rat cultured hippocampal neurons with antibodies visualized the proteins of interest to study these interactions in more detail. Fluorescence results in cellular imaging showed the proximity of labeled CaMKII and actin, as well as potential interaction sites in a given frame of time. These results give insights into how CaMKII and actin interactions occur in space and time, as well as how they influence dendritic dynamics to establish LTP.

Keyword(s):

Calcium Dysregulation, CaMKII, Actin Remodeling, LTP, Confocal Microscopy, Alzheimer's Disease

Mentor(s):

Tamara Kinzer-Ursem (Engineering); Agnes Doszpoly (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 150
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Synthesis of Hydrazone-Linked Supramolecular Tetrahedral Nano Cages Towards Selective Modification of Polymers Post-Synthesis

Author(s):

Mariana Benavides† (Los Andes University)

Abstract:

Abstract Redacted.

Keyword(s):

Hydrazone-Linked Cage, Catalyst, Derivatization, Post-Synthesis

Mentor(s):

Severin Schneebeli (Pharmacy); Anthony Mena (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 151
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

First Principles Modeling of Perovskite Surfaces for High Throughput Screening of Photocatalysts

Author(s):

Gavin Bidna† (Engineering)

Abstract:

Halide perovskite (HaP) semiconductors are a promising class of materials for a variety of photo-driven applications, including photocatalytic reduction of pollutants and photocatalytic electrolysis for green hydrogen generation. The optoelectronic and catalytic properties of HaPs are incredibly tunable via composition, structure, and surface engineering. The widely accessible chemical space of HaPs lends itself well to high throughput screening of materials

using machine learning, but to be able to predict photocatalytic behavior, the machine learning models require a database of surface and adsorption properties to learn from. Using first principles-based density functional theory (DFT) simulations, our group plans to calculate the surface energies and small molecule adsorption energies at various sites for a variety of different surface terminations and crystallographic orientations for a compound characteristic of

the chemical space, $CsPbI_3$. Once the favorable surface termination and adsorption sites are identified, surface and adsorption energies will be calculated for 8 other compounds belonging

to the family of compounds Cs(P b, Sn, Ge)(I, Br, Cl)3. From these calculations, we hope to gain preliminary insight in how different surface terminations and compositions affect the surface stability and adsorption behavior. Furthermore, the data generated by these calculations will be vital for training models for high throughput screening of materials for photocatalytic applications.

Keyword(s):

Halide Perovskite, Catalysis, Density Functional Theory, Computational Material Science, Surfaces

Mentor(s):

Arun Mannodi Kanakkithodi (Engineering); Habibur Rahman (Engineering); Jiaqi Yang (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 152
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

An Origami-inspired Multi-type Locomotive Planetary Exploration Robot

Author(s):

Harrison Booker† (Engineering); Aditya Anhiba‡ (Engineering); Ansh Mishra* (Georgia Institute of Technology); Sumaira Khan* (Habib University); Yuto Tanaka* (Engineering)

Abstract:

The exploration of extra-terrestrial bodies in the modern day relies on the use of robots that can go to places that humans cannot. However, these feats can be limited by the modes of transportation achievable by typical rovers. This project serves to address those limitations by creating a robot that has multiple modes of transportation achieved by manipulating origami features. In order to develop the prototype, two different materials are 3D printed in a specific pattern in order to be folded into the necessary shapes to be utilized as origami. Our design makes use of a Yoshimura cylinder as the frame, the characteristics of which are employed in order to facilitate a jumping motion. The frame can also articulate in any direction, creating a flexible body. In addition to the Yoshimura body, the robot also features unique origami wheels with flexible legs. These legs allow the diameter to be adjusted, creating a better grip on the various terrains they will traverse. They will be printed in the fully extended position with the different joint and body materials. It appears that the combined attributes of this design allow it to surpass the abilities of traditional rovers by its ability to roll, climb, and jump.

Keyword(s):

Robotics, Origami, Multimodal Robotics, Yoshimura

Mentor(s):

Ran Dai (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 153
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Substrate Surface Effects on Underwater Adhesion

Author(s):

Aidan Brown† (Engineering, JMHC)

Abstract:

When adhering two objects together, rough surfaces tend to provide better compatibility for adhesion than smooth surfaces; however, preliminary data suggests that the reverse is true when the adhesive cures underwater. Little is currently known about the effects that adherend surfaces have on underwater adhesion. Examining these effects could greatly impact the practical application of underwater adhesives in areas like construction and marine transportation. The goal of this project is to determine how modifications, such as sanding or polishing, to substrate surfaces affect adhesion in both dry and aqueous conditions. Lap shear testing was performed to quantitatively characterize the adhesive strength of commercial glues on different substrate types after they had cured in either salt water or air. Additionally, tensile strength testing was performed with mussel adhesive plaques on a variety of substrate surfaces. This was done in order to understand the effects that mussels have on the surfaces they adhere to. Confocal microscopy was used to image the surface effects of the substrates. Smooth lap shear substrates were able to reach a mean underwater adhesion strength upwards of ~6 MPa whereas rough substrates were only able to reach a mean underwater adhesion strength of around ~3 MPa. The data from these tests reveal that smooth surfaces make for significantly better underwater adherends than rough surfaces. Further study on the relationship between underwater adhesion and substrate surface nanobubbles is recommended.

Keyword(s):

Adhesives, Adhesion, Materials Characterization, Composite Materials

Mentor(s):

Jonathan Wilker (Science); Aaron Mena (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 154
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Artificial Brains for Artificial Intelligence

Author(s):

Lorenzo Cacciapuoti† (Engineering)

Abstract:

The most widespread artificial intelligence (AI) paradigm is the deep learning neural network. This type of AI arranges its neurons in consecutive, feed-forward layers and learns using the backpropagation algorithm. While proven effective, this type of AI has some significant drawbacks, notably the large network size required, its low data efficiency, and its tendency for catastrophic forgetting. To solve these issues, we propose the Interconnected Dendritic Network (IDN), a new type of neural network that takes close inspiration from biological neural networks of cortical pyramidal neurons. In an IDN, neurons are arranged in a multidimensional space, forming homogeneous connections across layers, allowing for recurrent information processing. Furthermore, neurons in an IDN receive their inputs through dendrites (hierarchically divided into branches of increasing order) that activate non-linearly while also considering inhibitory (depressing) inputs. This grants individual neurons greater pattern recognition abilities than that of current point-source models utilized in traditional neural networks. IDNs learn using a Hebbian learning rule regulating the variation of connection weights as well as the formation and destruction of connections. To quantify the efficacy of learning, the performance of IDNs on an image classification task (using the MNIST dataset) will be compared to that of traditional neural networks to determine the effectiveness of this type of model. The model will also be tested on its ability to retain information about multiple tasks at once to assess whether it also falls victim to catastrophic forgetting. These tests will serve to quantify the viability of IDNs for AI applications.

Keyword(s):

Neural Simulation, Machine Learning, Computational Neuroscience, Neural Network, Synaptic Plasticity

Mentor(s):

Krishna Jayant (Engineering); Hammad Khan (Engineering); Shulan Xiao (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 155
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Thermomechanical Properties Measurements for Residual Stress Prediction in Heat Treatment of High-Strength Aluminum Alloy

Author(s):

Brandon Camp† (Engineering)

Abstract:

The differential cooling of aluminum alloys in heat treatment quenching often results in residual stresses, prediction of which requires constitutive properties data on the thermomechanical response of the material. This work focuses on measuring the thermomechanical constitutive behavior needed for modeling residual stress development during the heat treatment quenching of high-strength 7050 aluminum alloy. These data are used in models based on either temperature dependent stress-relaxation or flow-stress responses. Existing constitutive data for 7050 found in the open literature does not capture the material response in the temperature range, stain rate range, or microstructural condition found during quenching following a solution heat treatment. Compression tests were performed in the range of 100 to 450 degrees Celsius with strain rates of 0.00001 to 0.001 1/s on an MTS Insight mechanical testing machine to produce true stress, true strain curves for the flow stress models. Data for the stress-relaxation were collected from tests performed in the range of 100 to 450 degrees Celsius. Force, displacement, and time data were converted to strain rate vs stress curves for the stress relaxation model. The mechanical tests will produce data for the 7050 alloy in the post heat treatment cooling condition over temperature and strain rate ranges applicable to heat treatment quenching. Such datasets will enable improved modeling of residual stress development during the heat treatment quenching of 7050 aluminum.

Keyword(s):

Thermomechanical Modeling, Compression Testing, Stress-Relaxation Testing, 7050 Aluminum, Constitutive Data

Mentor(s):

Matthew Krane (Engineering); Kevin Trumble (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 156
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Exploring Fatty Acid Amide Sulfonates as Renewable Surfactants: Synthesis, Characterization, and Sustainable Potential

Author(s):

Chevaugn Campbell† (Kenyon College)

Abstract:

Surfactants play a vital role in most modern industrial processes such as in agriculture, medicine, personal care, and petroleum. In general, they are obtained from petrochemical sources and thus pose problems in their environmental impact and sustainability. This study explores the potential of fatty acid amide sulfonates as environmentally friendly surfactants, considering their renewable origin from soybean oil. The synthesis process involves a two-step approach starting with the amidation of soybean oil to form a fatty acid amide thiol, followed by the oxidation of the thiol to sulfonate. The synthesized compounds will be characterized through FTIR, 1H-NMR, and 13C-NMR spectroscopy. The anticipated outcomes include the successful synthesis and characterization of fatty acid amide sulfonates, providing foundational knowledge for their future applications in various industries such as detergents and personal care products. Future work can be centered on characterizing their surfactant properties using tensiometer and dynamic foam analyzer measurements and the synthesis of surfactants from other food-grade oils such as corn and palm oil.

Keyword(s):

Fatty Acid Amide Sulfonate, Sustainable Surfactant, Amidation, Oxidation, Soybean Oil

Mentor(s):

Jeffrey Youngblood (Engineering); Carlos Martinez (Engineering); Ronaldo Franjul (Engineering); Elizabeth Malek (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 157

Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Colorimetric aptasensing of hemagglutinin in solution

Author(s):

Malina-Elena Cantemir† (Grinnell College)

Abstract:

Aptamers are single-stranded nucleic acid fragments designed to bind a molecular target with very high specificity, akin to antibodies. While the latter are frequently used in healthcare diagnostic devices, aptamers offer distinct advantages over antibodies in stability, choice of targets or cost and ease of synthesis. These properties pose aptamers as better candidates for biosensor applications than antibodies, especially for detecting targets which undergo frequent structural change due to high mutation rates, such as hemagglutinin (HA), a spike surface protein chiefly responsible for the infectivity of influenza A/B viruses. In this project, we report on progress made towards developing a colorimetric microfluidic paper-based analytical device (μ-PAD) by conducting initial optimization of HA detection in solution. Polystyrene beads decorated with gold nanoparticles (PS-AuNPs) were functionalized with aptamer RHA0385 which has broad specificity to HA proteins of different influenza strains. Detection relied on salt-induced microparticle aggregation which occurs when aptamers detach from the particles to bind their preferred targets, exposing particle surfaces to salt. Aggregation was marked by a transition from pink-red to purple, and quantitated spectrophotometrically. We identified ideal criteria relating to particle synthesis, salt type and concentration, and aptamer immobilization and surface blocking parameters. Ultimately, HA detection was conducted in Tris-EDTA buffer (pH 7.5) with 30 mM NaCl and presented in linear range of 0-100 μg/mL. The minimal HA concentration necessary for detection was observed as 5 μg/mL. These results suggest that further optimization of testing conditions is necessary to achieve lower limits of detection and improve assay sensitivity.

Keyword(s):

Hemagglutinin, Colorimetric, Aptasensing, μ-PADs, Gold Nanoparticles

Mentor(s):

Lia Stanciu (Engineering); Abbey Koneru (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 158
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Exploring Engineering Students' Information

Author(s):

Chijhi Chang† (Engineering)

Abstract:

The Accreditation Board for Engineering and Technology (ABET) emphasizes that engineering graduates must be able to apply engineering design to meet specified needs with consideration of broader societal factors such as public health, safety, economics, and the environment. However, undergraduate engineering curricula rarely include explicit instruction on how to incorporate information on broader societal factors into design projects. As a first step in developing appropriate pedagogy, this study sought to gather concrete and detailed data on how ten engineering students processed a variety of information, including information on different stakeholder groups and broader societal factors, provided to them for an open-ended design task: designing a campus study space. We provided each participant with our design prompt and 25 pieces of information related to the design instruction and asked participants to sort the provided information into three piles: clearly relevant, possibly relevant, and not relevant. We also asked participants to sort clearly relevant information based on topic and interviewed participants to learn their justifications for how they sorted the provided information. For clearly relevant information, we found that engineering students used keywords, criteria/constraints, and perceptions of user needs to group information under the clearly relevant category. Factors leading to the classification of information as possibly relevant or not relevant include it being outside the scope of engineering solutions and information that is not currently relevant but may be in the future. The information sorting approaches observed in this study can inform pedagogies on information gathering and synthesis in engineering design courses.

Keyword(s):

Information Sorting, Problem Definition, Design Education, Engineering Students, Open-Ended Design

Mentor(s):

Robert Loweth (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 159

Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Enhancing Design Methodologies for Predicting and Mitigating Earthquake-Induced Cracking in Embankments and Earth Dams

Author(s):

Hyunwoo Cho† (Engineering)

Abstract:

This research project addresses the urgent need for improved design methodologies to predict and mitigate earthquake-induced cracking in embankments and earth dams. Recent observations of extensive damage during seismic events (e.g. a dam was breached in the Orontes river in Syria due to the February 6, 7.7 magnitude earthquake in Turkey) highlight the criticality of developing better empirical and analytical tools to estimate damage to these earthen structures. The objectives of the research project are (i) the development and utilization of a comprehensive database of seismically induced damage of dams; (ii) test the hypothesis that the location of seismically-induced cracking can be accurately predicted through a static analysis of the structure; and (iii) questions the adequacy of two-dimensional plane-strain dynamic numerical analyses to estimate the extent and depth of cracking in earth dams and embankments. The paper focuses on the building and utilization of a database of field cases. Pertinent information regarding the characteristics of earth dams, past earthquake damage, and historical reports is being meticulously compiled and curated. Specific results or conclusions are not yet available. Around 50 dams affected by past earthquakes were analyzed to gather relevant data, including dam coordinates, earthquake epicenter, dimensions (length and height), magnitude, and observed damages (e.g., settlements, seepage, deformation, cracks). Earthquake information was sourced from USGS, while dam data was derived from historical records and Google Maps for coordinates. The coordinates of the dams were obtained using Google Maps. The anticipated outcome is the development of more robust tools for predicting and mitigating earthquake-induced cracking.

Keyword(s):

Earthquake-Induced Cracking, Embankments, Earth Dams, Seismic Damage, Design Methodologies

Mentor(s):

Antonio Bobet (Engineering); Juan Jimenez (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 160
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Directed Diastereoselective Hydrogenation of Tetrasubstituted Olefins Using Bimetallic Heterogeneous Catalyst

Author(s):

Nicholas Colvin† (Science)

Abstract:

Catalytic hydrogenation reactions are an important step in many organic synthesis pathways and are used in both commercial and academic settings. These reactions typically utilize a heterogeneous catalyst made up of a metal, which activates the hydrogen, and a support, which stabilizes the metal and provides a high surface area. Since some diastereomers have different properties, certain applications of this reaction require facial selectivity of hydride addition, referred to as directed hydrogenation, which is often achieved using a directing group on the substrate that binds to the catalyst to guide facially selective hydride addition to the molecule. By alloying second metal with the catalytically active metal in heterogeneous catalysts, we can further tune the active surface to increase product selectivity, which we then utilize in congruence with the inherent robustness and high activity of heterogeneous systems to hydrogenate tetrasubstituted olefins, a historically challenging transformation. In this work, we synthesize a series of cyclopentenols bearing a tetrasubstituted olefin and test these on our optimized catalyst. We find that not only is our catalyst capable of hydrogenating these substrates with high conversion and diastereoselectivity, but we also observe improved chemoselectivity in our system compared to a commercially available catalyst. This research can have significant impacts in medicinal and fine chemical production, but more work needs to be done to further expand the substrate scope and elucidate the nature of the active site.

Keyword(s):

Hydrogenation, Diastereoselective, Substrate Directed, Tetrasubstituted Olefin, Nanoparticles

Mentor(s):

Christina Li (Science); William Swann (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 161
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

The Impact of Situational Awareness via Eye-Tracking on Driving Performance Strategies for Effective Shared Vehicle Control

Author(s):

Adam Cover† (University of New Mexico)

Abstract:

As semi-autonomous vehicles become more prevalent on public roadways, it will become increasingly important to develop shared control strategies to ensure that drivers and vehicles collaborate effectively to achieve safe driving operations. One challenge in developing such strategies is accurately characterizing and predicting the behavior and actions of human drivers. Situation Awareness (SA) is a cognitive construct often used to assess the knowledge of human operators in dynamic environments. Recent investigations suggest that some eye-related measures can reflect SA, which may help to infer a person's planned actions. However, there still remains many unknowns regarding which particular eye metrics are best to use to infer SA. Therefore, the goal of this research is to analyze various eye tracking metrics, such as fixation sequence, saccade length, and concentrated gaze regions, to determine their associations with drivers' knowledge and actions. This research leverages data collected from an extensive driving study on obstacle avoidance using a medium-fidelity driving simulator and a remote eye tracking system. Insights from this work can be used to inform the development of control algorithms and adaptive automation to improve joint driver-vehicle interactions.

Keyword(s):

Situational Awareness, Driving Strategy, Eye-Tracking, Adaptive Automation

Mentor(s):

Brandon Pitts (Engineering); Maya Luster (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 162
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Evaluation of a Concentric Cylinder Rheometer for Granular Flow

Author(s):

Mitchell Cox† (Engineering)

Abstract:

Consistent flow of granular materials is crucial for many manufacturing processes. Powders with varying shapes and sizes do not flow predictably, yet the amount of material delivered to and acted upon within a process is vital to the resulting product. To address some of the challenges of granular flow, a custom concentric cylinder rheometer was developed in tandem with a computer model to measure flow and stress field behavior. The original device was designed as a chute with orthogonal shear and discharge orifice for testing the relationship of applied torque for a range of orifice sizes. However, data analysis was complicated because the shear axis was not aligned with gravity. In this work, components were redesigned to orient the rheometer such that the flow is aligned with gravity. Motor torque, material outflow, and other parameters were analyzed with Python scripts. Results from experiments with various tilt angles were compared to simulations and prior studies. The custom rheometer was able to improve the flowability of tested materials by preventing clogging and could be enhanced to measure the fill height or evaluate nonspherical materials. Conclusions and recommendations are provided for understanding granular flow and the ability to maintain constant flows with control inputs to the rheometer. In one aspect, the custom rheometer acts as a precision feeder even at low flow rates. Further research is necessary to understand granular flow and associated challenges including particle size and shape distributions, as well as constitutive and cohesive material properties.

Keyword(s):

Material Modeling & Simulation, Materials Processing, Characterization

Mentor(s):

Paul Mort (Engineering); Kendra Erk (Engineering); Kayli Henry (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 163
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Calf muscle bioenergetics and walking endurance in patients with lower extremity peripheral artery disease

Author(s):

Fiona Crenshaw† (Engineering)

Abstract:

Redacted.

Keyword(s):

Peripheral Artery Disease, Phosphocreatine Recovery, Plantar Flexion Exercise, Walking Ability, Phosphorus 31 Magnetic Resonance Spectroscopy

Mentor(s):

Bruno Roseguini (HHS); Bohyun Ro (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 164
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Physical Characterization of Indoor Dust across Urban and Suburban homes in the U.S.

Author(s):

An Dang† (University of Maryland, Baltimore County); Ishika Jindal‡ (Engineering)

Abstract:

Infants are prone to dust inhalation and ingestion through various indoor activities, including crawling, which can stir dust ladened with chemical and biological agents into the air and may settle in the infant's breathing zone. Considering that dust adhesion to an infant's palm and its deposition in their respiratory system depends on dust quantity, size, and morphology, it's vital to study the physical properties of indoor settled dust. This study aims to examine the variation in indoor dust mass loadings and their particle size distributions, density, and morphology across diverse home environments in the U.S., encompassing both suburban homes in West Lafayette/Lafayette and urban homes in New York. Indoor dust samples were collected from homes with infants using a standardized vacuum protocol, while questionnaires about occupants' activities were also administered. Preliminary results indicate dust mass loading on carpets was significantly higher than on hardwood across urban and suburban locations. Additionally, dust mass loading was found to be the highest in the entryway, followed by the living room, and least in the bedroom. Supplemental density analysis of dust collected from vacuum bags shows a size-dependency in dust true density implying a variation in composition across different dust sizes. Future research will analyze dust particle size distribution, imaging, morphology, and density data. The correlation between this data and questionnaire responses will provide an understanding of how the home environment impacts indoor settled dust, aiding in modeling infant dust ingestion.

Keyword(s):

Environmental Characterization, Indoor Aerosols, Particle Size Distributions, Dust Morphology

Mentor(s):

Brandon Boor (Engineering); Nusrat Jung (Engineering); Satya Patra (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 165
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Nox2/cybb Knock Down Using Morpholino Oligonucleotides to Investigate Tectal Innervation

Author(s):

Aislinn Davis† (Science)

Abstract:

Axons play a crucial role in the brain by transmitting information to other neurons, thereby creating neuronal connections. These neuronal connections are responsible for sensory, motor, and cognitive functions. When these connections become damaged, the brain's information processing is disrupted. This impairment can then lead to neurodegenerative diseases such as Parkinson's and Alzheimer's. Research shows that reactive oxygen species (ROS) play a critical role in axonal growth, which is essential for development and regeneration of the central nervous system (CNS). Insufficient or uncontrolled levels of ROS may cause neuronal damage and contribute to neural decline. To delve into this phenomenon, our study focuses on NADPH oxidase (Nox), a key generator of ROS. Previous studies have explored a mutation causing a significant truncation of the zebrafish Nox2 protein, a member of the Nox family. The mutant phenotype includes altered retinotectal connections and could be caused by changes in the expression of other Nox genes to compensate for the loss of the mutant gene. However, this phenotype was lost after several generations, causing us to employ alternative strategies to investigate the role of Nox2 in neural development. This involves examining the phenotypic effects of reducing Nox2 gene expression using a Morpholino oligonucleotide (MO). Therefore, we inject zebrafish embryos at a one-cell stage with a splice-modifying MO, which induces a frameshift mutation in the mRNA, triggering a stop codon to halt translation. To ensure the specificity of the MO, we will also conduct a control experiment. By comparing the phenotypic outcomes of the knockout and knockdown approaches, we aim to gather more evidence regarding the role of Nox2 in regulating retinotectal development in zebrafish larvae. This research will provide new insights into the function of Nox2 in establishing neuronal connections.

Keyword(s):

Neuronal Development, Retinotectal Innervation, Zebrafish, NADPH Oxidase, Axonal Guidance

Mentor(s):

Daniel Suter (Science); Paola Vega Rodriguez (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 166

Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

The Plant Data Service: The Development of an Open-Source, Open-Access Crop Data API

Author(s):

Autumn Denny† (Engineering)

Abstract:

The World Wide Web has experienced an explosion of available data within the past couple of decades. As more digital technologies are being used in agriculture to fight global climate challenges, there has been an increasing need for open-source software and accepted data models for crop and resource management. However, there exists a lack of standards that pertain to modeling agricultural data and developing software platforms for data sharing between institutions and groups. Computational ontologies, i.e., formal, machine-readable representations of knowledge within a domain, provide a starting point for data modeling. The Plant Data Service will use ontological representations of crop-related knowledge as standards to serve findable, accessible, interoperable, and retrievable plant data to promote sustainability efforts. Through the application of conceptual modeling techniques during development, the Plant Data Service is designed to be easily understood by humans and machines alike. Future efforts will be explored to expand the scope of the Plant Data Service's available crop data.

Keyword(s):

Agricultural Ontologies, FAIR Data, Open-Source Technology, Sustainable Agriculture, Conceptual Modeling

Mentor(s):

Ankita Raturi (Engineering); Juliet Norton (Agriculture); Steven Doyle (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 167
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Investigation of Fabrications and Materials of Liquid Core Ultrasound Contrast Agent

Author(s):

Jinyang (Jessie) Du† (Engineering); Karla Alvarado‡ (Engineering)

Abstract:

Medical ultrasound imaging is a widely used diagnostic technique for visualizing internal organs and vasculature. However, it possesses a limited contrast resolution which can impede the accurate identification of structures. The advent of ultrasound contrast agents (USCAs) has increased contrast and improved the diagnostic power of ultrasound imaging. Although gaseous-core USCAs have been approved for clinical use, liquid-core USCAs have demonstrated higher stability. Numerous manufacturing methods exist, though it remains uncertain which method yields the best results. Therefore, there is a need to identify which parameters change with respect to the manufacturing technique to identify the optimal manufacturing method. This project aims to address this issue by identifying the optimal materials and manufacturing methods, including shaking, double syringe technique, ultrasonic dispersion, and ultrasonic waterbath, for liquid cores to develop USCAs for clinical use. The study will explore the various compositions of liquid cores while using lipids of the same composition as the gas core shell to optimize the function of liquid core USCAs. The goal of our study is to refine the best fabrication and materials by first assessing monodispersity using DLS as well as conducting cytotoxicity tests and ultrasonic echo tests in vitro to assess criteria such as toxicity, stability, echogenicity, and acoustic interactions, and then comparing USCA made through different methods. In addition, this study will further determine the relationship between dose and viability and test ultrasound echogenicity in live mice by using the optimal liquid core USCA.

Keyword(s):

Nanotechnology, Ultrasound Contrast Agent, Medical Ultrasound Imaging, Echogenicity, Fabrications

Mentor(s):

Luis Solorio (Engineering); Claudia Alston (Engineering); Siting Zhang (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 168
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Evaluating the Effect of Protected Bike Lane Implementation on Ridership Usage in a Bike-Sharing System: A Difference-in-Difference and Spatiotemporal Analysis of New York's Bike Sharing System

Author(s):

Jorge Duarte† (New Jersey Institute of Technology)

Abstract:

Bike-sharing is an emerging transportation service that has been growing in popularity in the U.S. The service has been found to offer a sustainable and convenient option for transportation, especially in urban areas. Bike-sharing is environmentally friendlier than cars as it does not produce GHG emissions. It also complements transportation for public services such as buses, trains, or subways. Nevertheless, bike-sharing adoption remains low in comparison to car usage, potentially due to safety perception concerns, prompting research on boosting bike-sharing ridership and appealing to a wider user base. In this regard, this research aims to investigate the impact of bike lane implementation, which has been found to address safety concerns regarding bike sharing usage and analyze the interplay between bike lane introduction and ridership volumes, weather, and other relevant factors. The study will utilize the ridership data obtained from the Citi Bike System Data in New York City spanning the period from 2014 to 2018. Spatiotemporal analysis and difference-in-differences analysis is conducted to understand multiple factors such as weather, and demographics. Results demonstrate a ridership increase following the implementation of new bike lanes, and that this volume would increase more nearby protected bike lanes with a buffer or protection. Additionally, the study reveals lower ridership during unfavorable weather conditions. Findings can guide the development of effective bike infrastructure policies and foster sustainable transportation options. This would ultimately lead to insights that can inform future decision-making processes.

Keyword(s):

Bike-Sharing, Bike Lanes, Difference-in-Difference, Shared Mobility, New York City

Mentor(s):

Nadia Gkritza (Engineering); Ricardo Chahine (Engineering); Prasanna Humagain (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 169
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Investigating the role of PV interneurons in dictating visual processing and behavior through FX mice.

Author(s):

Paige Edens† (Agriculture)

Abstract:

Visual familiarity leads to the emergence of theta oscillations in the mouse primary visual cortex (V1). These oscillations are impaired in a model of Fragile X (FX) syndrome. However, the underlying mechanism of this impairment is not well understood. Parvalbumin-positive (PV) interneurons play a critical role in regulating the excitatory/inhibitory balance and the generation of theta oscillations. To understand the role of PV interneurons in visual processing and to determine the underlying cause of learning disability in FX, we studied the visual learning behavior of Fmr1 knockout mice (a model of FX syndrome), wild-type (WT) mice and Fmr1cON/PV-Cre mice, where the Fmr1 gene expression is rescued conditionally only in PV interneurons. While being blinded to their genotypes, a total of 20 mice were water restricted and trained in 4 stages to a Go/No-Go active visual discrimination task. Training scores were calculated based on the percent of correct trials (Hits and Correct Rejection) and percent of incorrect trials (False Alarm and Misses) to analyze the behavior. We found that WT had the highest training score, Fmr1 KO had the lowest training score, and Fmr1cON/PV-Cre had an intermediate score. A significant restoration in performance indicates that PV interneurons may play a critical role in visual processing and memory and underly the learning disability present in FX. These results provide an exciting avenue for future therapeutic treatments that focus on restoring the network impairments in the disorder rather than the resulting symptoms.

Keyword(s):

Autism Spectrum Disorder, Fragile X Syndrome, Parvalbumin Interneurons, Oscillations, Visual Discrimination

Mentor(s):

Alexander Chubykin (Science); Sanghamitra Nareddula (Science); Michael Zimmerman (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 170
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

A modular sensing platform for adaptive in-vivo health monitoring

Author(s):

David Flores† (University of New Mexico)

Abstract:

Animal agriculture faces significant challenges in improving productivity while ensuring sustainability and welfare for individual animals to meet the food security goals of 2050. A critical issue in this domain is the high greenhouse gas (GHG) emissions, with livestock responsible for over 26% of global GHG output. Ruminant animals, including cows and sheep, generate methane, a potent greenhouse gas, through the fermentation of ingested feed in their rumen. However, monitoring and measuring rumen methane output are currently complex and costly processes. To address this, we have developed a modularized power-scavenging sensing platform for real-time continuous measurement of rumen methane. The innovative platform recirculates rumen gases to measure methane concentration, while also providing the flexibility to incorporate additional sensors for parameters such as temperature and pH. Moreover, to alleviate the burdens of constantly replacing batteries, we include power scavenging from natural sources such as solar and kinetic energy. The novel scale-invariant design easily adapts across a range of ruminants, from goats to dairy cattle, providing valuable insights into rumen function and contributing to animal welfare. Through this research, we aim to advance knowledge of rumen dynamics while addressing the challenges of sustainable animal agriculture.

Keyword(s):

Adaptive Sensing, Ag-Tech, IoT, CPS, In-Vivo Sensing

Mentor(s):

Richard Voyles (Polytechnic Institute); Upinder Kaur (Polytechnic Institute)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 171
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Sorbent Materials and Their Interaction with Chemical Spills

Author(s):

Madeline Frasure-Lauth† (Engineering, JMHC)

Abstract:

Norfolk Southern's train derailment in East Palestine, Ohio caused havoc as almost a third of the cars were carrying hazardous chemicals which were spilled into the nearby water sources, affecting everyday use of the water. Some compounds that raised concern and were analyzed were 2-butoxyethanol, 2-ethylhexyl acrylate, 2-ethylhexanol, and butyl acrylate. At the derailment site, sorbent pads were placed in the creeks to absorb the chemicals before they would continue downstream. The investigation of the effectiveness of the sorbent pad was executed, beginning with confirming the methodology. Three different types of sorbent pads were spiked with a known concentration of the four compounds listed above as well as naphthalene for 24 hours. Using gas chromatography and mass spectrometry, the samples were extracted and analyzed to determine the absorption capabilities of the sorbent pads. With the confirmed methodology, the pad that was used by the cleanup task force in Ohio was tested to confirm the effectiveness of the sorbent pad.

Keyword(s):

Chemical Spill, Sorbent Pads, Ohio Train Derailment

Mentor(s):

Paula Coelho (Engineering); Gracie Fitzgerald (Engineering); Paula Belmont (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 172
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

"Thermoregulatory Dynamics: Decoding the Sex-Based Temperature Preferences in Bd-Infected Frogs"

Author(s):

Paula Galindo Moreno† (Science)

Abstract:

Amphibians are crucial for assessing aquatic ecosystem quality and providing biological control against mosquitoes that affect humans. However, amphibians worldwide are declining at an alarming rate with 50% of species threatened with extinction. Chytridiomycosis, a disease caused by the fungus Batrachochytrium dendrobatidis (Bd), is one of the primary threats to amphibians. Bd can cause epidermis afflictions and alter frog behavior, especially in environments where the temperatures are at 17-25°C. As a response to infections, cold blood organisms, such as amphibians, increase body temperature through the selection of warm microclimates ("behavioral fever"). Despite the understanding that thermal preferences play a vital role in amphibians ability to combat diseases, as higher temperatures enhance immune system effectiveness, the influence of sex on these preferences is not thoroughly known. This study aims to investigate the differences in thermal preferences between male and female frogs through field observations of multiple species in response to Bd infection. It is expected that female frogs may be more sensitive to the temperature in their environment due to their higher metabolic needs associated with energetically expensive reproduction. Therefore, female frogs in nature will exhibit a preference for higher temperatures that increase metabolism, and when infected with Bd, their preference for higher temperature ranges will be more pronounced compared to uninfected frogs and males. Studying the behavioral changes due to infection with chytridiomycosis in frogs is vital for the understanding and conservation of amphibians.

Keyword(s):

Chytridiomycosis, Batrachochytrium Dendrobatidis, Temperature Preferences, Disease Ecology, Amphibians

Mentor(s):

Catherine Searle (Science); Jonathan Lopez (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 173
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Population Study of Supernovae and their Host Galaxy Environments using Amortized Posterior Inference

Author(s):

Braden Garretson† (Science)

Abstract:

Upcoming all sky surveys, such as the Vera Rubin Observatory, will produce terabytes of data per night and provide the unique opportunity to conduct population scale studies of supernovae and their host galaxy environments. However, this large influx of data also presents numerous technical challenges. Namely, that estimating model posteriors on this scale using traditional sampling techniques, such as Approximate Bayesian Computation (ABC), is infeasible. By replacing traditional ABC methods with amortized posterior inference we are able to train a neural network to estimate accurate posteriors of supernova model parameters at a fraction of the computational cost, and apply this to over 10,000 supernova-like light curves. Using this, we will conduct the largest supernova host galaxy population study to date by empirically measuring whether or not the distribution functions of the supernova model parameters have any dependence on their host galaxy properties. This approach of adapting physical models to neural networks will be essential to rapidly estimate the posterior of model parameters and conduct population scale studies of supernovae and their host galaxy environments in future all-sky surveys.

Keyword(s):

Supernovae, Machine Learning, Astronomy, Physics

Mentor(s):

Dan Milisavljevic (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 174
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Setting a Limit on the Cross-Section of the Toponium Bound State Production at a Center of Mass Energy of 13 TeV

Author(s):

Mason Giacchetti† (Science, JMHC); Sean Flanary* (Science); Karrick McGinty* (Engineering)

Abstract:

The Standard Model (SM) of particle physics provides a description of the fundamental particles and interactions which make up our reality. In the SM, the toponium bound state describes a top quark-antiquark pair interacting via the strong force. The large mass of the top quark makes toponium significant for testing the SM and SM approximate models in extreme regimes. Given the instability of toponium, it is quite rare and statistical analysis of its cross-section must be done in order to observe it with any confidence. Such an analysis will provide information about the cross-section itself, along with the associated uncertainties. To obtain a limit on the toponium cross-section, this analysis uses a deep neural network (DNN) to try and classify toponium in Monte Carlo data from the Large Hadron Collider (LHC), and the DNN score is then used to produce differential plots for toponium and its backgrounds. These plots can then be used to perform a shape based analysis using the Combine data analysis tool. In Combine, model data sets will be produced, known as toys, which can be used to form the distributions for our test statistic, in this case profile likelihood ratios, from which a limit can be extracted. The profile likelihood limits are produced to provide information about what values of our parameter describe the observed data and its fluctuations the best. Conclusions on the observability of toponium can then be drawn from this analysis on the cross-section for future use.

Keyword(s):

Toponium, Cross-Section, Deep Neural Network, Shape Based Analysis

Mentor(s):

Andreas Jung (Science); Andrew Wildridge (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 175
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Understanding the Thermal Noise Signature of Quantum \\Spin Liquids with SQUID Magnetometry

Author(s):

Gabriel Goodwin† (Engineering, Science, JMHC); Lauren Bell* (Science)

Abstract:

Quantum Spin Liquids (QSLs), which have variable spin ordering resulting from geometric frustration, are a promising candidate for topological quantum computing, as they give rise to exotic quantum effects such as fractionalization and zero-point motion. The topological frustration of QSLs introduces inherent spin fluctuations even at absolute zero, and at higher temperatures acts with Johnson-Nyquist thermal noise to further decohere spin order. Understanding the fluctuations in spin order as thermal noise is present in QSLs will thus be extremely beneficial to the development of topological quantum computing technologies. To measure the spin order and thermal noise signature of QSLs subject to various temperatures and magnetic field strengths, we used an Oxford Instruments Proteox Dilution Refrigerator modified with a DC Superconducting Quantum Interference Device (SQUID) Magnetometer. When a magnetic field of up to 14 T is applied to a sample material, the responding magnetic flux through a pickup loop inducts with the SQUID Magnetometer producing a voltage reading whose noise signature reveals the nature and strength of thermal noise which decoheres spin alignment. Varying the temperature at which these measurements occur from several Kelvin to several millikelvin reveal how this noise signature changes as a function of temperature, which quantifies inherent quantum noise in the material.

Keyword(s):

Quantum Spin Liquids, SQUID Magnetometry, Dilution Refrigeration, Thermometry, Spin Ordering

Mentor(s):

Arnab Banerjee (Science); Jhinkyu Choi (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 176
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Behavior of Steel-Concrete Composite (SC) L-Joint Connections Under Blast Loading Conditions

Author(s):

Peter Hays† (Engineering)

Abstract:

Steel-Concrete Composite (SC) has demonstrated significantly improved performance over standard reinforced concrete (RC) in terms of strength, construction cost and time and ductility. For these reasons, SC design is becoming increasingly employed in the Containment Internal Structures (CIS) of nuclear reactors. However, due to the more recent appearance of SC design in these applications and others, certain behaviors of SC structures have not been fully analyzed. In particular, there exists an incomplete understanding of SC L-joint connections under blast loading conditions. The purpose of this research is to further characterize the effect of SC reinforcement in the joint region of SC L-joint connections on joint strength during a blast event. To do so, large-scale testing of L-joint specimens subjected to a bending moment was conducted. The specimens experienced stresses and strains due to loading, which were recorded at different areas along with the maximum yield strength of the specimen and its failure mode. Finite element modeling was conducted along with a mechanical analysis to validate the results of the experiment. It was found that the inclusion of steel-plate reinforcement in the joint region of an SC structure can prevent joint shear failure before inelastic deformation of the wall connections occurs through the formation of plastic hinges. These results show that SC L-joint connections can endure conditions typical of blast loading within a CIS. This experiment is part of an ongoing project at Bowen Laboratory to study the behavior of SC design and document its performance for use in nuclear facilities.

Keyword(s):

Steel-Concrete Composite, L-Joint Connections, Containment Internal Structure, Joint Shear

Mentor(s):

Lance Parson (Engineering); Morgan Broberg (Engineering); Lisa Choe (Purdue University); Amit Varma (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 177
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Unraveling VirE2 Trafficking: Insights into Agrobacterium Infection and Interactions of VirE2 with PDLP5 and SYTA1 in Plant Cells

Author(s):

Elizabeth Hernandez Perez† (Science)

Abstract:

Agrobacterium tumefaciens is a soil bacterium capable of infecting cells by transferring and integrating its DNA (T-DNA) into the plant genome. This DNA transfer process has sparked interest in its use in plant biotechnology. Agrobacterium also transfers virulence proteins, including VirE2, which facilitates T-DNA transfer to the plant nucleus. This study analyzes the intracellular trafficking of VirE2 protein and evaluates its interaction with PDLP5 (Plasmodesmata located protein 5) and SYTA1 (Synaptotagmin 1) proteins. PDLP5 is essential for cell-cell communication and SYTA1 regulates protein transport at the plasma membrane. The interactions of VirE2 with plant proteins during VirE2 intracellular trafficking are poorly understood despite its importance in Agrobacterium infection. Clarifying these interactions will inform us about how infections work and how hosts and pathogens interact. Fluorescence techniques including a split GFP (Green Fluorescent Protein) system and BiFC (Bimolecular Fluorescence Complementation) will be used to monitor VirE2 during Agrobacterium infection and investigate protein interactions. The GFP system will allow us to determine what happens to VirE2 within the plant cell upon T-DNA transfer. BiFC will allow the detection of fluorescent signals that examine the interaction of VirE2 protein with PDLP5 and SYTA1. This study will provide more information about the infection process of Agrobacterium tumefaciens and the behavior of VirE2, one of its most important virulence proteins.

Keyword(s):

Agrobacterium, Vire2 Trafficking, Intracellular Localization, Protein-Protein Interactions

Mentor(s):

Stanton Gelvin (Science); Nana Liu (Science); Lan-Ying Lee (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 178
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Post-Weld Heat Treatment Normalization Effects on Electron Beam Welded SA508 Steel

Author(s):

Jack Herrema† (Engineering)

Abstract:

The reactor pressure vessel (RPV) is an integral component of any nuclear reactor, but the current primary method of production, heavy forging, is limited to only a few facilities worldwide. This inherently causes long lead-times and high costs for forging an RPV, thus limiting the growth of nuclear energy globally. An alternative production method being considered is to forge the RPV in smaller parts, then electron beam (EB) weld them together. This process, however, comes with its own issues, primarily material inhomogeneities around the weld line which can negatively impact strength and susceptibility to radiation damage in-service. A potential solution to this problem is the incorporation of a post-weld heat treatment (PWHT) into the production process, where the welded steel is heated above the austenitization temperature for long enough that the entire sample can transition back to austenite, followed by slow cooling to minimize the formation of brittle martensite structures and encourage a homogeneous microstructure. This study simulates the effects of a PWHT on samples of SA508 steel, then performs the heat treatment to determine both accuracy of the simulation and efficacy of the heat treatment. This study will provide conclusions on and observations of PWHTs to normalize SA508 steel, and will make recommendations for proper heat treatment of larger scale RPV steel samples.

Keyword(s):

Materials Modeling & Simulation, Materials Processing & Characterization, SA508 Reactor Pressure Vessel Steel, Electron Beam Welding, Post Weld Heat Treatment

Mentor(s):

Janelle Wharry (Engineering); Grayson Nemets (Engineering); Elliot Marrero Jackson (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 179
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Derivatization of amino acids, sterols, and lipids for applications in mass spectrometry imaging

Author(s):

Emma Hoffman† (Engineering)

Abstract:

Mass spectrometry imaging (MSI) is a powerful analytical technique used to visualize the distribution of biomolecules in tissue samples. However, detecting certain classes of molecules, such as amino acids, sterols, fatty acids, and peptides, poses a challenge due to their low ionization efficiency, resulting in weak signals that are hard to distinguish from noise. To overcome this limitation, chemical derivatization techniques are employed, where specific functional groups within these molecules react with reagents to enhance their ionization properties. In this study, we focus on improving the detection of amino acids, sterols, and lipids for their application in nanoDESI (nanospray desorption electrospray ionization) imaging, which requires a quick reaction with few intermediates. 9-Fluorenylmethoxycarbonyl chloride (Fmoc-Cl) and 2-picolylamine were utilized for amino acid derivatization, while betaine aldehyde was employed for sterol and lipid derivatization. Dansyl chloride was used for all three molecule classes. Analysis of the samples was conducted using a linear ion trap mass spectrometer (LTQ) and trapped ion mobility time-of-flight spectrometer (timsTOF). Through mass spectrometry experimental analysis, we were able to prove that Fmoc-Cl, betaine aldehyde, and dansyl chloride are all effective derivatization agents for their respective classes of biomolecules and might be employed for future uses in MSI.

Keyword(s):

Mass Spectrometry, Chemical Derivatization, Bioanalysis, NanoDESI Imaging

Mentor(s):

Julia Laskin (Science); Syeda Nazifa Wali (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 180
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Molecular Markers of Thermal Oil Refinery Effluent Exposure in Fish

Author(s):

Sophia Horn† (Science)

Abstract:

A small stream in Illinois is home to the endangered Bigeye Chub (Hybobpsis amblops), but also receives thermal effluents from a large gas refinery. A recent survey suggested that fish exposed to thermal effluents may exhibit deformities, erosions, lesions, and tumors (DELTs), raising concerns about habitat suitability for the endangered species. The combination of gas refinery effluent and thermal stress may cause DELTS and affect fish health, possibly imperiling habitat for an endangered fish. In this portion of the larger study, we will focus on molecular markers of health in fish and will test the hypothesis that effluent, heat, and their interaction alter expression of genes associated with oxidative stress and altered hepatic metabolism. This study exposed a common fish model, the fathead minnow Pimephales promelas, to effluents released from the gas refinery at two different temperatures. Molecular markers were measured using relative gene expression: quantitative polymerase chain reactions (qPCR) were performed on complementary DNA (cDNA) synthesized from RNA extracted from livers. The genes targeted are expressed in response to oxidative stress (catalase) and abnormal hepatic metabolism (cytochrome P450). Deviations in gene expression relative to controls reflect molecular responses to exposure. The sensitivity of these molecular endpoints allows resulting data to indicate if sublethal stress is occurring. Potential alterations in gene expression will be considered along with multiple other health metrics spanning molecular to organismal and population-level responses to determine the sustainability of this habitat for fish.

Keyword(s):

Aquatic, Toxicology, Environment, Sustainability, Genetics

Mentor(s):

Maria Sepúlveda (Agriculture); Anna Bushong (Agriculture); Tyler Hoskins (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 181
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Intent Classification-based Interactive Chatbot for Weed Management

Author(s):

Jungeun Hwang† (Science); Son Ha† (Science)

Abstract:

Chatbots have recently gained traction due to advancements in artificial intelligence, natural language processing, and computational resources. Chatbots are being developed and integrated with messaging platforms for multiple applications, including education, customer service, healthcare, etc. However, their application in agriculture for helping farmers manage crops and improve yield is limited. Therefore, this study focuses on developing a chatbot to assist farmers in managing weeds to improve crop yield. The proposed method enables farmers to ask questions and receive relevant responses for easier and faster decision-making corresponding to their fields. The user interface for the chatbot was developed using React Native, enabling deployment on both iOS and Android platforms. Pinecone was used to store the agriculture-related extension articles and corresponding vectors. Natural language processing (NLP) was used to vectorize and interpret user queries matched against a vectorized pinecone dataset to find the relevant results. Additionally, a large language model (ChatGPT-turbo-3.5) and an intent classification model were utilized to provide decision support for weed management. The intent classification was implemented through Bidirectional Encoder Representations from Transformers (BERT). The chatbot also included the ability to provide a task summary service to help farmers track real-time weather data. Overall, the proposed chatbot will aid farmers in obtaining answers to queries corresponding to weed management.

Keyword(s):

Natural Language Processing (NLP), Large Language Model (LLM), Query Dataset, Weed Management, BERT

Mentor(s):

Dharmendra Saraswat (Agriculture); Varun Aggarwal (Engineering); Aanis Ahmad (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 182

Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Investigation of hemodynamic and morphologic characteristics in stable and growing intracranial aneurysms using computational fluid dynamics

Author(s):

Jonathan Ibinson† (The Ohio State University)

Abstract:

Intracranial aneurysms (IAs) are present in an estimated 2-5% of adult humans. Medical imaging advances have increased incidental IA detection. Interventions are associated with significant complication risks but are necessary in preventing rupture. Most IAs remain stable, so treatment should be reserved for growing aneurysms. Traditional risk stratification of unruptured IAs relies on patient characteristics, aneurysm size, and aneurysm location. However, hemodynamic characterization of IAs could provide quantitative measures associated with aneurysm progression and improve risk assessment. In this study, image-based computational fluids dynamics (CFD) modeling was conducted to determine IA hemodynamic metrics, including wall shear stress (WSS), which influences endothelial modeling pathways. Both stable and growing patient-specific vascular geometries were obtained from MRI data with the open-source software ITK-snap. The inlet boundary conditions correspond to patient-specific flow, if available, or generalized vessel-specific flow. The outlet boundary conditions were set as a lumped parameter RCR model. The simulation was run in the open-source modeling platform SimVascular and post-processed in the open-source visualization software ParaView. The reported hemodynamics parameters include time-averaged WSS, velocity, and oscillatory shear index. Additionally, morphological characteristics were considered, including aneurysm and neck depth and area, aspect ratio, non-sphericity index, size ratio, and bottle neck factor. This investigation considers potential associations between morphologic and hemodynamic variables in both stable and growing IAs. It will be used as the groundwork for a longitudinal study connecting IA characteristics to aneurysm stability over a one-year period. This can elucidate key variables that may improve IA rupture risk in a clinical setting.

Keyword(s):

Intracranial Aneurysm, Hemodynamics, Morphological Characteristics, Computational Fluid Dynamics, SimVascular

Mentor(s):

Vitaliy Rayz (Engineering); Mohammadreza Balouchestani Asl (Engineering); Neal Patel (Engineering); Kostiantyn Kondratiuk (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 183
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Are We a Team?: Identifying Potential Barriers to Driver's Perception of Teaming with a Semi-Autonomous Vehicle

Author(s):

Ambrosia Ingoglia† (Engineering)

Abstract:

Human-autonomy teaming (HAT) is a rapidly emerging research field that seeks to combine human and artificial intelligence (AI) agent capabilities to enhance performance, efficiency, and safety of mutual tasks across various domains. In the driving context, the idea of a driver 'teaming' with a semi-autonomous vehicle (AV) is a fairly

novel concept. However, this framing could significantly help to shape the design of highly autonomous vehicles, thereby promote safety in surface transportation systems. To date, there have been no investigations of whether drivers of semi-AVs perceive their vehicles to be teammates or simply intelligent tools. To address this research

gap, in this study, we develop and deploy an online survey via a crowdsourcing platform to identify potential barriers preventing current owners of SAE Levels 2 and 3 (conditionally automated vehicles) from seeing themselves as teammates with their semi-AVs. The survey will present questions pertaining to general driving

experiences and behaviors, perceptions of driver roles when using semi-AVs, and current and desired in-vehicle communication formats and interface designs. Findings from this survey can provide valuable insights into the psychology of drivers of semi-AVs, which can ultimately support the development of collaborative strategies in

driving.

Keyword(s):

Human-Autonomy Teaming, Semi-Autonomous Vehicles, Transparent Communication

Mentor(s):

Brandon Pitts (Engineering); Maya Luster (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 184
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Authorship Attribution From Decompiled Binaries

Author(s):

Shreya Ompreeti Ippili† (Science)

Abstract:

Code authorship attribution can be a groundbreaking step in Computer Science with numerous applications, ranging from solving plagiarism and authorship disputes to malware analysis and apprehension of those responsible. It also poses a threat to the privacy of programmers, necessitating the study of the “fingerprint” one leaves when they write code. Previous work has explored both source code and compiled binary attribution. While the results for source code are quite substantial, the attribution of compiled binary executables appears to be a lot more complex yet practical in the real world. Therefore, our study aims to leverage machine learning techniques for authorship attribution on compiled binary executables. Initially, we investigated whether pre-trained code language models such as CodeT5, when provided with source code from disassembled and decompiled binary executables, learn functionality over coding style. Training the model on datasets of different kinds with varying degrees of overlap in control flow and author contribution, we observed the test accuracies for each. Next, we plan on utilizing contrastive learning to attribute decompiled binary executables to authors by training the model to provide embeddings for the decompiled code, resulting in code from the same authors being closer in the embedding space. By comparing results from these different techniques, our work aims to determine the most effective approach for authorship attribution for decompiled binary executables and make progress based on the prior work that has been completed in this area.

Keyword(s):

Machine Learning, Security, Contrastive Learning

Mentor(s):

Lin Tan (Science); Jiang (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 185
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

The effect of equivalence ratio on resonance of a Micro Gas Turbine engine using hydrogen as fuel

Author(s):

Smit Kapadia† (Engineering); Nikolai Baranov* (Engineering)

Abstract:

Vibrations in an engine can cause structural damage if the operating frequency coincides with the natural frequency of individual components, or the frequency amplitude is too high for the engine to handle. Researchers have analyzed critical frequencies and modes of industrial turbomachinery, but little literature exists for microscale engines. This study aims to characterize resonance in a Micro Gas Turbine engine, which has an expected rotational speed of 98,000 RPM, turbine inlet temperature of 1520 °F, and 24 lbs of thrust. Hydrogen is used with compressed heated air to perform the combustion cycle. We investigate the effect of varying the equivalence ratio, by controlling heated air mass flow rate, on engine frequencies during startup, shutdown, and steady-state sequences. Piezoelectric accelerometers are attached to the engine casing, clocked around the turbomachinery. Data from the accelerometers is converted from the time domain to the frequency domain using a Fast Fourier Transform (FFT) to obtain the engine's frequency spectrum. Principal modes of resonance are identified by amplitude peaks in the frequency data and are compared to natural frequency predictions from Finite Element Models (FEMs). A relationship between equivalence ratio and resonant frequencies is derived, which can be leveraged to select an optimal equivalence ratio for avoiding structural damage.

Keyword(s):

Micro Gas Turbine, Equivalence Ratio, Resonance, Accelerometers, Finite Element Model

Mentor(s):

Li Qiao (Engineering); Holman Lau (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 186
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Investigating functional domains of the Rip6 Ralstonia type-III effector protein

Author(s):

Ethan Kaser† (Agriculture)

Abstract:

Ralstonia solanacearum is a pathogen that causes bacterial wilt disease across numerous families. In order to induce disease, R. solanacearum uses a type-III secretion system to inject virulence proteins, also known as effectors, into the cytoplasm of the host cells. R. solanacearum injected protein 6 (Rip6) is one of over 50 effectors encoded in the R. solanacearum genome. Transient expression assays in the model plant species Nicotiana benthamiana, indicate that Rip6 localizes to the cytoskeleton and suppresses plant immune responses, including production of reactive oxygen species (ROS). The Rip6 protein does not resemble known proteins and does not have conserved protein domains. Understanding the functional domains of this effector will provide a better understanding for how this effector is able to target the cytoskeleton and suppress host immune responses. To identify the functional domains of this effector, seven truncations of the effector were generated and fused to a green fluorescent protein (GFP) tag. Using confocal microscopy, we visualized where these smaller sections are localized within the plant cell. Our results reveal that different regions of the Rip6 protein localize to distinct subcellular locations. Additionally, Rip6 truncations were tested for their immune suppression activities. Together our data suggest that different functional regions exist within the Rip6 protein.

Keyword(s):

Protein Characterization, Confocal Microscopy, Effectors, Ralstonia Bacteria, Molecular Plant Pathology

Mentor(s):

Anjali Iyer-Pascuzzi (Agriculture); Abbie Rogers (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 187
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Investigating the Influence of Nitrogen Isotopes on Air Pollution Using Machine Learning Techniques

Author(s):

Faarza Khan† (GIK Institute)

Abstract:

In recent decades, air pollution levels have increased to alarming levels. In order to tackle this problem, it is important to understand the dynamics of air pollution and invent better models to understand the complex chemistry of air pollution to adopt science-based mitigation strategies and improve air quality. This study aims to incorporate stable isotopes into air quality models to enable us to better understand the causes of air pollution and provide meaningful solutions. It is believed that human activities are the primary cause of air pollution. However, a change in the chemistry of compounds present naturally in the atmosphere is also a possible cause of the increase in air pollution. The MusicBox simulator shall be used to study the behaviors of the chemical species in the atmosphere. The data from the simulator shall enable us to predict the isotope variation of N species in air pollutants and compare it to observations. We shall use Machine Learning models in addition to Monte Carlo techniques to study how changes in chemistry lead to the partitioning of 14N and 15N into products and reactants. By the end of the study, we shall be able to use the Machine Learning models to learn how 15N affects the NOx compounds and contributes to air pollution. This study shall contribute significantly to understanding the dynamics of air pollution which shall prove beneficial in developing mechanisms to bring down air pollution levels and hence, improve air quality.

Keyword(s):

Machine Learning, Mitigation Strategies, Simulation, Air Pollution

Mentor(s):

Greg Michalski (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 188
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Origami-Inspired Multi-type Locomotive Planetary Exploration Robot

Author(s):

Sumaira Khan† (Engineering); Aditya Arjun Anibha‡ (Engineering)

Abstract:

As humans endeavor to advance their presence beyond Earth, there is an imperative need for advanced systems that can facilitate long-term and efficient exploration of alien planetary bodies.Conventional rover designs have inherent constraints that impede their ability to navigate diverse landscapes and environments effectively. To overcome these limitations, our project endeavors to develop a sustainable, efficient, and economical planetary exploration robot that can traverse many terrains and can switch between different locomotive modes. Our robot utilizes a 3D printed cylindrical bellow Yoshimura origami structure to create a compressible, lightweight, and portable body. The robot actuation is based on string tension which is controlled by small motors. It can switch between multiple locomotive modes (crawling, rolling, and jumping) by compressing and decompressing its body through the use of battery-powered servos (or dc motors). To enhance its navigational capabilities, autonomous obstacle navigation algorithms were integrated, allowing the robot to autonomously navigate around obstacles during its operation. Our final product will showcase multiple locomotive modes and demonstrate that the robot is resilient and suitable enough to be used for space exploration. This work will illustrate the feasibility of using autonomous origami robots for multimodal locomotion in the context of space exploration. This project's design approach establishes a paradigm shift in developing versatile robotic exploration systems, creating a new standard for future methodologies in the field.

Keyword(s):

Origami-Inspired Robotics, Autonomous Robots, Space Exploration, Circuit Design, Extraterrestrial Robots

Mentor(s):

Ran Dai (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 189
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Testing NEMOs, a New Genetically Encoded Calcium Indicator in Zebrafish Embryos

Author(s):

Carolina Kim† (Pharmacy)

Abstract:

Calcium ions play an essential role in cellular and physiological functions such as stimulus-response reactions and homeostasis by serving as a second messenger in many signaling pathways. Researchers have been using genetically encoded calcium indicators (GECIs) to monitor their activities in vivo to facilitate studying the functions of calcium. Along this direction, GCaMP series GECIs have been extensively developed and successfully applied to many cell types, especially neurons. Recently a new group of calcium sensors, NEMO, were reported to have a superior dynamic range compared to the most recently developed GCaMP8. However, more research and trials are still needed to obtain a holistic view of NEMO's full potential in monitoring calcium activity in different model organisms. In this study, we aim to create a NEMOs transgenic zebrafish line by Tol2 transgenesis. First, we codon-optimized NEMOs for zebrafish, synthesized an open reading frame, and cloned it into the Gateway middle entry vector. Then, we created a final plasmid construct with Tol2 minimum sequences by LR gateway recombination. Lastly, we microinjected this final Tol2 construct with NEMOs into the 1-cell stage zebrafish embryos. Green fluorescent signals were able to be detected. These results suggested that we have created a functional zebrafish codon-optimized NEMOs, which could be used for generating a stable transgenic zebrafish line. In the future, NEMOs fish lines can be compared to GCaMP indicators and be used for exploring other embryonic and physiological questions, such as adult fin regeneration.

Keyword(s):

Biological Characterization & Imaging, Cellular Biology, Genetics

Mentor(s):

GuangJun Zhang (Veterinary Medicine); Ziyu Dong (Veterinary Medicine)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 190
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Binary Code Authorship Identification with Code Language Model

Author(s):

Kyung Min Ko† (Science)

Abstract:

Extracting necessary source code authorship attributes is crucial for successful identification. However, extracting such attributes presents significant challenges in real-world scenarios primarily due to various syntax rules in diverse programming languages, average code line availability, and a limited number of code samples per author. Initially, a common approach was to utilize source code to detect the author by extracting various features from source code such as design patterns and the name of the variables. Even though source code includes valuable features, often malware programs are only left with binary executables. Therefore, it is common to apply feature extraction for binary executables. Even though previous researchers developed solid solutions to solve the code authorship tasks, to the best of our knowledge, there are currently no work-related code language models. In our research, we are using the Code T5 model, which is capable of handling code-specific semantics. Common code language models have limitations on input token length, so instead of using the entire code, we leveraged functions present in the code. We used functions as input for the model, then combined the result to predict the author with majority votes. Furthermore, we applied contrastive learning, which learns useful representation from comparing similar and dissimilar dataset pairs to not only improve the accuracy but also deal with code with anonymous authors. We initially tested on 10 authors' datasets from Google Code Jam. Furthermore, we tested on the real-world malware dataset to expand our results. Our result demonstrates that predicting at the file level is also not robust and unstable, since we found the model mostly relies on functionality. Thus, we propose to predict at the function level and use majority voting.

Keyword(s):

Natural Language Processing, Machine Learning, Artificial Intelligence, Security

Mentor(s):

Lin Tan (Science); Jiang (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 191
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Comparison of multiple platforms for estimating agronomic optimum nitrogen (N) rate of corn at early growth stages

Author(s):

Breana Lavallee† (North Carolina State University)

Abstract:

Traditional methods require manual soil or plant sampling for identifying fertilizer nitrogen (N) needs for corn. New technologies are being developed as alternatives to manual sampling. Operational efficiency is a key factor that farmers consider when adopting a new technology. The objective of this study was to evaluate information from three platforms (satellite, drone, and a handheld device) for estimating agronomic optimum nitrogen rates (AONR) for corn during their vegetative period. The specific objectives were to 1) calculate the actual AONR based on corn grain yield, 2) estimate AONR using data from satellite, drone, and handheld device at growth stage V8, 3) identify which platform provided the best estimation, and 4) summarize their advantages and disadvantages in terms of operational efficiency. In order to accomplish this, data from an ongoing Purdue N study conducted in Indiana was used. The field evaluated (60 acres) was composed of 6 N treatments applied immediately after planting and replicated three times. Data collection was completed in 2022 and focused on grain yield, chlorophyll data, multispectral satellite imagery (3m spatial resolution), and drone imagery (0.05m). Data was processed in Rstudio for estimating AONR based on vegetation indices (from satellite and drone platforms) and chlorophyll data (handheld sensor) using Rstudio. Results will be presented at the symposium.

Keyword(s):

Nitrogen, Corn, Agronomic Optimum Nitrogen Rates, RStudio, Agronomy

Mentor(s):

Melba Crawford (Engineering); Ana Morales Ona (Agriculture); Daniel Quinn (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 192
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Role of VP0/VP4 in Enterovirus Structure and Dynamics

Author(s):

Edwin Legall† (Science, JMHC)

Abstract:

Human Enterovirus D68 (EV-D68) is a respiratory virus that infects young children, causing a range of mild to severe respiratory illness and has been implicated in Acute Flaccid Myelitis (AFM), a neurologic condition that causes polio-like paralysis. Mature EV-D68 capsids are comprised of 60 units called protomers, each of which contain 3 external structural proteins, VP1-VP3, and an internal structural protein, VP4. VP4 is dynamic and highly conserved across enterovirus species and has been found to be critical in all stages of the viral life cycle. Current studies on VP4 highlight its role in the EV-D68 life cycle, necessary modifications that are required for infection, and its necessity for viral breathing. However, analysis of specific residues that contribute to particle stability and successful infection remains unclear. In this study, VP4 residue phenylalanine 32 (F32) was mutated to introduce amino acid substitutions in VP4 to ala, trp, and tyr (VP4 F32A, F32W, and F32Y respectively). We hypothesize that mutations within this conserved residue will disrupt interactions within the capsid and will decrease capsid stability and therefore impair host cell entry. Further analysis will be done by performing plaque assays, viral growth curves, thermostability assays, and entry assays. Results will be compared to WT EV-D68 to evaluate the significance of this residue on particle stability and virus entry. Understanding the importance of this residue can provide valuable insight about capsid dynamics and potentially lead to the development of a pan-enterovirus vaccine or anti-viral therapeutic.

Keyword(s):

EV-D68, VP4, VP0, Structure, Mutagenesis

Mentor(s):

richard kuhn (Science); Jacqueline Anderson (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 193
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Nanoencapsulation of Bone Metastatic Prostate Cancer Therapeutics for Oral and Intravenous Delivery

Author(s):

Andy Liu† (University of Texas at Austin)

Abstract:

Each year, 1.3 million new cases of prostate cancer are reported across the globe. Bone metastases are the predominant prostate cancer complication in over 90% of severe patients, and castration-resistant cases elude a cure. Cabozantinib (cabo) and bemcentinib (BCT) are small molecule chemotherapeutics which target cellular receptors critical for prostate cancer tumor growth. However, both cabo and BCT are hydrophobic and have low oral bioavailability, limiting their effectiveness. The goal of this work was to encapsulate cabo or BCT into nanoparticles to develop intravenous and oral formulations with improved dissolution kinetics and efficacy. Flash NanoPrecipitation, an established antisolvent precipitation technique, was used to encapsulate Cabo or BCT into nanoparticles stabilized by an amphiphilic polymer shell. The size-stability of the resultant particles was monitored, and small and stable formulations were dialyzed against water to remove organic solvent and delay Ostwald ripening. After dialysis, all attempted cabo formulations were not stable below 400 nm in size. BCT formulations which incorporated vitamin E acetate remained stable at 50-70 nm for at least one-week post-dialysis, likely due to extremely hydrophobic vitamin E acetate providing favorable core nucleation sites. These BCT formulations were freeze-dried into powders and evaluated relative to unencapsulated BCT for in vitro dissolution kinetics and effective dosage. Based on these findings, the delivery and efficacy of BCT nanoparticles will be investigated in an animal model of bone metastatic prostate cancer.

Keyword(s):

Flash Nano-Precipitation (FNP), Nanoencapsulation, Nanoformulation, Nanotechnology, Drug Delivery

Mentor(s):

Kurt Ristroph (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 194
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Coupling an Olfaction Chamber with Proton Transfer Reaction Mass Spectrometry for Evaluating Human Response to Scented Product Emissions

Author(s):

Rashmika Manipati† (Engineering)

Abstract:

Commonly used household and personal care products, which are categorized as volatile chemical products (VCPs), contain and release volatile organic compounds (VOCs) that contribute significantly to indoor air pollution. Extensive research has already been conducted on the physical effects of VOCs on human beings. However, the effects of VOCs on human emotional and physiological responses have received less attention and remain less explored, with no definitive conclusions regarding their specific impacts. The objective of this study is to investigate the effects of volatile organic compounds (VOCs) emitted by scented volatile chemical products (sVCPs) on the emotional and physiological responses of humans and to characterize and identify VOCs. This study aims to achieve this by developing and using a controlled olfaction chamber in combination with a high-resolution proton transfer reaction time-of-flight mass spectrometer (PTR-TOF-MS). The scented volatile chemical products (sVCPs) are placed inside the olfaction chamber in order to fully isolate the product emissions from outside contaminants. Additionally, the PTR-TOF-MS is utilized to monitor and measure the type and quantity of VOCs released by the sVCPs. Simultaneously, participants are directed to inhale the emissions from the chamber through a specifically designed sniffing port. At various linear intervals, the participant's heart rate and blood-oxygen saturation levels are monitored using a smartwatch. Concurrently, the participant's odor assessment is conducted using the Geneva Emotion and Odor Scale (GEOS), allowing for the subjective evaluation of the perceived odors. By combining objective physiological measurements with subjective odor assessments, researchers can gain insights into the potential physiological and emotional effects. Overall, the findings from this research will contribute valuable knowledge that can facilitate informed decision-making when it comes to purchasing and using household products.

Keyword(s):

Volatile Organic Compounds (VOCs), Indoor Air Pollution, Volatile Chemical Products (VCPs), Olfaction Chamber, Odor Assessment

Mentor(s):

Nusrat Jung (Engineering); Brandon Boor (Engineering); Jordan Cross (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 195
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Understanding the spectral changes of space weathered pentlandite

Author(s):

Manuel Francisco Martinez Motta† (Science)

Abstract:

The surfaces of airless bodies (e.g., the Moon, Mercury, asteroids) are altered by high velocity dust impacts and ions from the solar wind (i.e., H+ and He+) in a process known as space weathering. Space weathering alters the optical properties of mineral surfaces by modifying their chemistry and microstructure, posing challenges in accurately interpreting regolith mineralogy using remote sensing datasets. However, most space weathering studies have centered on silicate minerals (i.e., SiO2-bearing) found in lunar samples which display reddening and darkening in their spectra. As a result, the exploration of the impact of space weathering on non-silicate minerals, including sulfides (i.e., S-rich), is still in its early stages. One important sulfide mineral is pentlandite (Ni,Fe)9S8 that has been identified in returned samples from asteroids, but little is known about how this mineral is altered under interplanetary space conditions. In order to understand how pentlandite responds to space weathering we used simulated space weathering through H+ ions, He+ ions, and pulsed-laser irradiation and analyzed their spectral properties from 0.3 to 2.5μm wavelengths in the visible to near-infrared (VNIR) region. The spectral measurements show darkening for samples irradiated with He+, while the spectra of H+ ion irradiated pentlandite show a brightening. Pulsed-laser irradiated pellet spectra show a brightening after 5 pulses. These results will help us to understand the spectral characteristics of airless bodies and to perform an accurate characterization of the returned space weathered pentlandite-bearing grains from asteroids Ryugu and Bennu.

Keyword(s):

Space Weathering, Pentlandite, Spectroscopy, Micrometeoroid, Solar Wind

Mentor(s):

Michelle Thompson (Science); Laura Chaves (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 196
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Semantic Feature Category's Impact on Early Word Learning

Author(s):

Kathryn McGregor† (Science)

Abstract:

Children are introduced to millions of words in their first few years of life, and as they become toddlers, their vocabulary growth rate significantly increases. Although we have information on the normative properties of this growth, the language acquisition timeline can vary between children. This study explores how children build on their existing vocabulary knowledge to learn new words. We use a graph theoretic approach to model children's vocabulary knowledge where the words they say are connected by their shared features to form a semantic network. These shared features, or semantic feature norms (McRae, Cree, Seidenberg, & Mcnorgan, 2005; Borovsky, Peters, Cox, & McRae, in revision), can be grouped into categories like perceptual (e.g. has four legs) and functional (e.g. is used by children). To understand the impact of perceptual versus functional features, we first measure each child's existing vocabulary knowledge, then model their semantic network and produce an individually-tailored list of novel words related to the child's network via perceptual or functional features. Parents are given these words to teach their child, then assess whether their child learned them after two weeks and how this impacted vocabulary growth one month later. Prior research has shown perceptual features are most strongly correlated with normative age of acquisition (Peters & Borovsky, 2019), so we expect the novel words related by perceptual features to be learned better and improve vocabulary growth above the normative rate for the month. We anticipate this effect will not be seen in words related by functional features.

Keyword(s):

Semantic Networks, Language Acquisition

Mentor(s):

Arielle Borovsky (HHS); Amanda Yuile (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 197
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

A Simple Method for Peripheral Delivery of Human Microglia Progenitor cells into the CNS.

Author(s):

Jenna McLean† (Engineering)

Abstract:

Microglia replacement is a promising new therapeutic for the treatment of multiple neurodegenerative diseases and brain tumors. Previous methods for microglia replacement require radiation or chemotherapy before microglia engraftment, leading to substantial adverse effects on patients. This study presents a simple and minimally invasive method to increase the success of microglia replacement and minimize adverse effects. We hypothesize that using an FDA approved microglia depletion drug PLX3397 before and after peripheral microglia transplantation will result in an empty niche in the central nervous system (CNS) that allows human-induced pluripotent stem cell-derived microglia progenitor cells to infiltrate into the CNS from the peripheral system and replace original microglia. Mice receive a first round of PLX administration through food consumption for 10 days. On the 10th day, mice receive a peripheral injection of progenitor cells. Mice then receive another 7 days of a lower concentration dose of PLX through oral gavage. Mice then undergo perfusion and samples are collected, stained, and analyzed. Results are processed through the sectioning and staining of the mouse brain. Mice who received PLX3397 and an injection of progenitor cells are compared with controls who did not receive PLX3397 or a progenitor cell injection. This comparison will provide insight into the efficacy of using a second round of PLX treatment and peripheral engraftment using human microglia progenitor cells for the intent of therapeutic techniques. Successful completion of this project will lead to a simple method for microglia-based cell therapy for the treatment of neurological disorders and brain tumors.

Keyword(s):

Microglia Replacement, Regenerative Medicine, Microglia, Neurodegenerative Therapeutics, Cellular Biology

Mentor(s):

Ranjie Xu (Veterinary Medicine); Yanru Ji (Veterinary Medicine)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 198
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Gold-polystyrene nanoparticles developed for the detection of Cyclospora cayetanensis using paper-based µ-pads

Author(s):

Alexander McQuade† (Pharmacy, JMHC)

Abstract:

The foodborne pathogen Cyclospora cayetanensis poses a substantial public health risk, especially for immunocompromised individuals. Existing detection methods require sophisticated lab facilities, trained personnel, and substantial time commitment, involving techniques such as Polymerase Chain Reactions (PCR) and sequencing. This underscores the need for a rapid, user-friendly testing methodology. Traditional approaches require antibodies, yet no such antibodies are available for C. cayetanensis. Therefore, our research focuses on the synthesis of aptamers, also known as "chemical antibodies", which consist of short-stranded DNA. In Dr. Lia Stanciu's laboratory, we've developed an economical, colorimetric paper-based analytical device (µ-PAD), fabricated using wax ink and incorporating a test spot coated with gold nanoparticles conjugated to aptamers. This device also includes a control. The fabrication of these µ-PADs involves the conjugation of gold nanoparticles to aptamers selected via the Systematic Evolution of Ligands by Exponential Enrichment (SELEX) method, accompanied by a meticulous determination of the number of particles to drop cast onto the paper. When the specific C. cayetanensis protein TA4 interacts with the aptamer, we anticipate a color shift from red to blue, observable using a 3D- printed colorimetric reader. Given the high infectiousness of the pathogen, we've employed proteins produced via bacterial transformation for our experiments. After generating an aptamer specific to this protein (TA4) and successfully conjugating it to our nanoparticles, we plan to test our µ-PADs on actual C. cayetanensis parasites. In partnership with the FDA, we'll employ our optimized device within their labs for further validation.

Keyword(s):

Gold Nanoparticles, Paper-Based Microfluidics, Disease Diagnostics, Sensors & Microsystems, Nanotechnology

Mentor(s):

Lia Stanciu (Engineering); Amit Barui (Engineering); Sunil Vasu (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 199
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Characterizing Losses of Topological Insulator Transmon Qubits with Superconducting 3D Cavity

Author(s):

Zach Miles† (Science)

Abstract:

Superconducting quantum circuits are one of the leading realizations of qubit. Among these qubits there exists a special type known as a topological insulator (TI) transmon qubit. This lab is working to craft an effective TI transmon with a Copper 3D resonant cavity. We need to understand where the microwave losses come from in this recently made prototype. An Aluminum 3D resonant cavity was used, which is superconducting at low temperatures, offering a higher quality (Q) factor of the resonator than Copper. In this Aluminum 3D qubit architecture, we used the scientific method to find out which fabrication step or material causes the most loss. In a cryogenic environment of ~10 mK, the Q factor and full width at half maximum (FWHM) were measured of each variation of the 3D cavity. The Q factor and FWHM were compared in each configuration experiment. We have identified sources of microwave losses in these specific qubit materials used. The materials used may not be perfect for qubits and other materials should be explored. Otherwise, efforts can be made to reduce the losses in these materials in any way possible. Another prospect is using a superconducting cavity to study the lossiness of materials. The results from this experiment are meant to provide insight into the fabrication of the 3D TI transmon.

Keyword(s):

Transmon, Cavity, Qubit, Lossy

Mentor(s):

Ruichao Ma (Science); Sheng-Wen Huang (Science); Ramya Suresh (Science); Kevin Barrow (Science); Jian Liao (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 200
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Increasing the Carbon Intake of 3D Printed Concrete via Superabsorbent Polymers

Author(s):

Angus Moore† (Engineering, JMHC)

Abstract:

Ever-growing urbanization has increased the demand for resilient concrete structures around the globe. However, concrete’s main binder, Portland cement, is responsible for 8% of the global carbon emissions, which puts the construction industry in dire need of a more environmentally sustainable alternative. Reactive magnesia cement (RMC) is one possible alternative binder but requires carbonation to achieve required mechanical strength. Since atmospheric carbonation is an external process, cast RMC concrete cannot achieve viable strength. 3D printing offers some remedy by increasing the exposed surface area increasing carbon intake. This investigation introduces secondary agents via superabsorbent polymers (SAPs) to maximize hydration and carbonation. The compressive strength of cubes with differing curing durations and filament width-to-depth ratios were investigated with mixtures containing SAPs, others without. Four samples of each group with a .7, .85, or 1 width-to-depth ratio. Specimens sit for a 20–28-hour period before entering carbon incubation for 3, 7, 14, or 28 days. Additional samples with an intermediatory 1-day moist curing were introduced for 7 days, as well as samples with a day of drying at 230 degrees Fahrenheit prior to 7-day incubation. Current results have shown greater compressive strength for mixes containing SAPs with filaments of w/d = .7 to their non-SAP counterparts. Further testing is on-going to explore the effects of printing paths as well as investigating the microstructure.

Keyword(s):

Reactive Magnesium Cement (RMC), Superabsorbent Polymers (SAPs), Carbonation, 3D Printing

Mentor(s):

Ala Eddin Douba (Engineering); Kendra Erk (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 201
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Inferring Clinical Information from Large-Scale Transcriptomic Data Using Machine Learning

Author(s):

Kyle Mundy† (Engineering, JMHC)

Abstract:

New genome sequencing technologies have greatly increased the number of transcriptomic datasets available for research. With this, machine learning (ML) models have been used to predict clinical information, including age, smoking/drinking history, and BMI. However, a notable limitation is that the majority of these samples lack proper annotation, so large datasets cannot be easily constructed to increase the accuracy of ML models. This project addresses these issues by attempting to build an ML model to predict clinical information from large-scale sequencing data across multiple databases. There are 2 major components: 1. Collect all human RNA-seq data from public databases to establish a comprehensive and large-scale dataset, 2. train ML models for predicting clinical traits. The human RNA-seq samples with annotated traits are collected from public datasets, and the matching processed data is taken from existing transcriptomic project portals, providing a potential dataset of > 1.7 million samples. Then, separate ML models are trained, tested, and optimized for predictions from information across all matched RNA-seq samples. The resulting dataset is larger than any previous studies, with hundreds of thousands of samples collected. Additionally, the Receiver Operating Characteristic (ROC) curve and related results matrix are compared against current standards for transcriptomic ML models, with increased accuracy showing the benefits of growing datasets and clear annotations by researchers. These findings will serve as a valuable asset for researchers, enabling more simple and accurate extraction of pertinent clinical information from transcriptomic data.

Keyword(s):

Machine Learning - Big Data, Genetics, Genomics, Transcriptomics, Data Mining

Mentor(s):

Majid Kazemian (Agriculture); Luopin Wang (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 202
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Revealing cellular electric activity in the Danio rerio (zebrafish) caudal fin folds via Voltron, a genetically encoded voltage indicator

Author(s):

Erbol Nishanov† (Florida International University)

Abstract:

Growing evidence suggests that bioelectricity modulates embryonic development, tissue regeneration, and congenital diseases. Recent invention of genetically encoded voltage indicators (GEVIs) surmounted the challenge of non-invasive in vivo assessment of cellular electric potential. Voltron, a novel genetically encoded voltage indicator, implements the HaloTag protein complex to bind to the bright and photostable synthetic fluorophore ligand dyes. The functional versatility of these dyes makes Voltron a superior indicator, allowing for brighter, high-resolution, prolonged imaging. The goal of our research is to investigate regeneration biology of the zebrafish caudal fin. A previously established transgenic Voltron zebrafish line with UAS promoter was bred with Tg(and1: Gal4FF) to image the bioelectric activities of zebrafish larva caudal fins. The embryos at the early development stage were incubated in the working solution of the selected ligand dye and then paralyzed and mounted in low-melting agarose for imaging. Movies of various duration were obtained to document the change of the fluorescence intensity in the fish's caudal fin. The fluorescence data were quantified using Image J and analyzed via MATLAB and Minitab. Resulting data will be used to assess the behavior of the electric potential in the embryos. Upon successful application of the Voltron GEVI, the imaging technique can be used to reveal the role of bioelectricity in the fin development and regeneration and its relationship with calcium signaling.

Keyword(s):

Biological Imaging, Embryo Development, Bioelectricity, GEVI

Mentor(s):

GuangJun Zhang (Veterinary Medicine)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 203
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Classifying Human Trust Levels via Ensemble Learning for Enhanced Adaptive Transparency in Autonomous Recommendations

Author(s):

Douglas Nyberg† (University of Montana); Matthew Beecher‡ (New Mexico Tech)

Abstract:

Technological advances in autonomous agents are demonstrating their capabilities as effective decision aids in humans' daily activities. For decision aids to be fully effective, issues of human overtrust and undertrust in autonomous recommendations must be addressed. It has been shown that user interface (UI) transparency in autonomous agent recommendations affect human trust. Ideally, each individual would have a tailored trust model, but this is currently unrealistic due to the required computational resources and the practicality of obtaining individualized data. Therefore, an optimal comprise is to group individuals into defined trust groups in order to balance model efficiency and computational requirements. Previous research has identified two distinct groups for optimal trust balancing using Partially Observable Markov Decision Process (POMDP) Models. In this work, we utilize an ensemble learning method comprised of logistic regression, a random forest classifier, and a support vector machine to determine into which group individuals should be sorted. By implementing recursive feature elimination methods, features generally highlighted for training the classifier were the humans' compliance, responses, trial times, and response times to the decision aid’s recommendations. With trust groups predicted, transparency can now be altered according to a control policy that has been designed based on that individual's dominant trusting behavior, or trust group. Finally, a closed-loop human user study is conducted to determine if the classification method is effective for determining optimal UI transparency, thereby improving the calibration of users' trust and their reliance behavior with respect to the intelligent decision aid.

Keyword(s):

Machine Learning, Trust, Partially Observable Markov Decision Processes, Decision Aids, Classification

Mentor(s):

Neera Jain (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 204
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

The Applications of NIOSH Lifting Equation In Preventing Musculoskeletal Injuries

Author(s):

Gerald Obuseh† (Truman State University)

Abstract:

Musculoskeletal injuries, such as strains, sprains, and back pain, pose significant challenges to workers' health and well-being. This study explores the application of the NIOSH (National Institute for Occupational Safety and Health) Lifting Equation as an effective tool for preventing musculoskeletal injuries in various occupational settings. The objective was to examine lifting practices and their impact on injury risk among 120 external participants. Four lifting tasks involving boxes weighing 1 pound, 5 pounds, 10 pounds, and 15 pounds were completed, and participants rated their self-perceived exertion using the standardized Borg scale. The study implemented an ergonomic redesign, including lifting tasks in ascending order of weight and bringing the table closer to the participants to minimize lifting distance and twisting. The results showed that the lifting index indicated a safer condition (<1.0) and low lifting risk for the healthy population. The study also highlights the economic implications of adopting the NIOSH Lifting Equation, emphasizing the potential for substantial cost savings through optimized lifting practices. This research underscores the importance of applying the NIOSH Lifting Equation as a preventive measure to reduce musculoskeletal injuries, improve worker health, and enhance organizational productivity.

Keyword(s):

NIOSH Lifting Equation, Musculoskeletal Injuries, Occupational Safety, Ergonomics, Risk Assessment and Prevention Measures

Mentor(s):

Denny Yu (Engineering); Guoyang Zhou (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 205
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Characterizing Binding and Stabilization of Indenoisoquinolines to the MYC G-quadruplex using Circular Dichroism Spectroscopy

Author(s):

Rio Ohtake† (Pharmacy, JMHC)

Abstract:

MYC gene is responsible for producing transcription factor that stimulates various cellular processes and its deregulation contributes to the causes of many cancers. G-quadruplexes are non-canonical, globular intramolecular secondary structures of DNA that form in guanine-rich regions. Within the MYC promoter region, the formation of G-quadruplex results in repression of MYC expression and suppression of cancer cells. Thereby the stabilization of the MYC promoter G-quadruplex is an attractive drug target for the development of anti-cancer research. However, clinically available drugs have not been found yet. In our previous studies, a class of compounds, Indenoisoquinolines, that bind and stabilize G-quadruplexes, were discovered. This research project aimed to determine which Indenoisoquinolines stabilize the MYC G-quadruplex. Circular Dichroism spectroscopy (CD) is a commonly used technique to characterize the topology and thermal stability of G-quadruplexes. In this study, CD was used to measure the spectra curve and thermal denaturing curve of the MYC promoter DNA G-quadruplex in the presence and absence of Indenoisoquinolines to analyze how the compounds affect the topology and thermal stability of MYC G-quadruplex. This study was able to compare the melting temperature difference between the drug-free DNA and the drug-present DNA to observe the effectiveness of Indenoisoquinolines to stabilize the MYC G-quadruplex. Data from this study will be used in combination with cellular studies to understand the effectiveness of these drugs in cancer cells at repressing MYC expression.

Keyword(s):

Cancer Research, MYC, G-Quadruplex, Indenoisoquinolines, Circular Dichroism Spectroscopy (CD)

Mentor(s):

Danzhou Yang (Pharmacy); Sarah Dagher (Pharmacy); Yichen Han (Pharmacy)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 206
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Synthesizing Avenolide-Type Hormone Inducers of Cryptic BGC's

Author(s):

Noor Owayni† (Pharmacy)

Abstract:

Redacted.

Keyword(s):

Natural Product, Signaling Molecule, Avenolide, Biosynthetic Gene Cluster, AvaR1

Mentor(s):

Betsy Parkinson (Science); Namuunzul Otgontseren (Science); Christina Martinez-Brokaw (Purdue University)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 207
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Computational investigation of neurite outgrowth

Author(s):

Laurel Patterson† (Western Kentucky University)

Abstract:

The outgrowth of neurites, projections from the cell body of a neuron, plays a fundamental role in shaping the intricate neural circuits of the brain. Neurite outgrowth is driven by mechanical forces generated by interactions between proteins. Previous experimental studies have identified key factors involved in neurite outgrowth, including a microtubule motor protein called dynein. However, it remains elusive how each factor affects neurite outgrowth due to the intrinsic complexity of biological growth systems and the limitations of experiments. In our study, we employed a computational model consisting of minimal components to explore the mechanism of neurite outgrowth. The model successfully reproduces the neurite outgrowth process against resistant forces. By systematically altering various biophysical factors, we studied how neurite outgrowth is enhanced or suppressed. We observed that increases in the concentration, length, and rigidity of microtubules, cross-linking dissociation rate, and motor density led to a faster outgrowth rate. In addition, a decrease in the resistant force resulted in faster neurite outgrowth. In future studies, we will investigate the impact of microtubule dynamics on neurite outgrowth.

Keyword(s):

Neurite Outgrowth, Computational Model, Neuron, Dendrite, Microtubule

Mentor(s):

Tae Yoon Kim (Engineering); Jeffery Coulter (Engineering); Donghyun Yim (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 208
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Use of CNN to predict heatwaves in the US

Author(s):

Henry Peng† (Science); Ahn Nhu‡ (Science); Yuke Zhang‡ (Science)

Abstract:

Heat waves can have devastating effects on crop growth, infrastructure, and human life. Therefore, understanding and predicting heat waves are integral to a wide variety of industries. Machine learning techniques including convolutional neural networks (CNN) have seen widespread use in many aspects of atmospheric science, and this study aims to evaluate if those techniques can be applied to predict heat waves considering that large-scale atmospheric circulation may be conductive to the occurrence and persistence of heat waves. To do so, a CNN is trained on geopotential height at 500 hPa data obtained from a large scale simulation dataset (LENS) before transfer learning is applied using the same variable from an observed reanalysis dataset (ERA5). This study will look at the results of the CNN and determine the relation of heat waves and atmospheric variables along with application of CNN in heat wave prediction. Using this model, this study will provide conclusions on the viability of CNN in heat wave prediction and identifying large-scale atmospheric circulation patterns preceding heat waves.

Keyword(s):

Machine Learning, Atmospheric Modeling, Extreme Weather

Mentor(s):

Lei Wang (Science); Valentina Castañeda (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 209
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

The Evolution of Protoclusters in the Distant Universe

Author(s):

Ethan Pinarski† (Science)

Abstract:

Protoclusters are young, forming galaxy clusters in the distant Universe observed well before they fully collapse into a dynamically relaxed system. The details and mechanisms behind protoclusters evolving into larger galaxy clusters remain uncertain. The One-hundred-deg2 DECam Narrow-Band (ODIN) survey is designed to enable the detection of the large-scale structure (LSS), the locations of protoclusters, and to trace the evolution of protolcusters over cosmic time. The ODIN survey is sampling three redshift slices, $z \sim 2.4$, 3.1, and 4.5 corresponding to 2.7, 2.0, and 1.3 billion years after the Big Bang), and gathering multi-band photometric and spectroscopic data from seven widely separated regions in the night sky. Spectroscopic observations have the potential to uncover the differences in chemical composition and cosmic ages in galaxies residing in protocluster environments. By combining the datasets from ODIN and the Dark Energy Spectroscopic Instrument (DESI), our project is aimed at i) confirming the targeted galaxies at these cosmic slices selected by ODIN; and ii) investigating the physical properties of the galaxies as a function of large-scale environment. By confirming these galaxies with spectroscopy we can not only detect the sites of protoclusters and detect the large-scale structure, but also better understand the evolution of protoclusters in the early Universe.

Keyword(s):

Galaxies, Lyman-Alpha Emitters, ODIN, Large-Scale Structure

Mentor(s):

Kyoung-Soo Lee (Science); Vandana Ramakrishnan (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 210
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

AutoCrop: A User-friendly and Efficient Technique for Subregion Cropping in SMLM Image Reconstruction

Author(s):

Heiner A. Quintero† (Engineering)

Abstract:

Single-Molecule Localization Microscopy (SMLM) is a super-resolution imaging technique that achieves nanometer resolution by localizing individual molecules. This process is based on the principle that within a certain time frame, only a portion of fluorescent molecules emit light and are sufficiently distanced to enable accurate position determination with a precision far exceeding traditional optical resolution limits. One critical step in SMLM is segmentation: cropping sub-regions from camera frames containing emission pattern of single molecules. Conventional methods necessitate an empirical threshold to separate sub-regions containing a single molecule and ones that do not –an error prone step leading to sub-regions without molecule, regions containing multiple molecules, or missing regions containing a single molecule. To this end, we developed an innovative method that eliminates the need for manual threshold input and reduces the error rates. This novel approach centers on identifying the maxima of the similarity map—the normalized correlation between the raw image and a Point Spread Function (PSF) pattern. Implementing this refined segmentation method in SMLM reconstruction not only minimizes the artifacts in the reconstructed super-resolution image but also enhances the overall computational efficiency of image reconstruction and speed. Importantly, our approach negates the need for users, often cell biologists, to enter potentially confusing parameters through trial and error. We expect that our novel single molecule segmentation algorithm provides a user-friendly and robust tool for high-accuracy SMLM image reconstruction and analysis.

Keyword(s):

Biological Characterization & Imaging, Fluorescence Microscopy, Super-Resolution Images, Image Processing

Mentor(s):

Fang Huang (Engineering); Yilun Li (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 211
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Characterizing Immune Cell Populations in Blood and Spleens from Wildtype Mice after Joint Injury

Author(s):

Graham Ragland† (Engineering)

Abstract:

Post-traumatic osteoarthritis (PTOA) is a degenerative joint disease that commonly develops after anterior cruciate ligament (ACL) injury. We have implemented a non-invasive model of ACL rupture (ACLR) by single tibial compression which initiates the onset and progression of PTOA in mice. Although this model has provided insights into PTOA, the mice selected have not been skeletally mature at the time of injury, which may limit the model's representation of the young adult human population that is most vulnerable to joint injury.

The complex interactions between synovial inflammation, circulatory immune cell response, and structural changes in the joint following non-invasive joint injury are not well understood. The quantification of shifts in lymphocytes, highly mobile adaptive immune cells, in response to joint injury could provide insight into the mechanisms by which immune response contributes to OA development.

This study aims to utilize histological staining to visualize and grade cartilage degradation by scoring sections according to OARSI guidelines for PTOA. Flow cytometry will be employed to quantify changes in lymphocyte populations in blood and spleens after ACLR.

This study also aims to compare the progression of PTOA in skeletally mature mice to previously reported results in 10-week-old mice at 1 week after injury to evaluate how age contributes to differences in early joint remodeling and inflammation that contributes to PTOA. T cell populations will also be quantified and compared between sham and injured mice to evaluate how immune cells and systemic inflammation contribute to PTOA after ACLR. Findings from this study can be used to achieve a more comprehensive understanding of joint remodeling and associated immune responses following injury.

Keyword(s):

Osteoarthritis, Joint Disease, Flow Cytometry, Histology, Systemic Inflammation

Mentor(s):

Deva Chan (Engineering); Rahaf Salim (Education); Cameron Villarreal (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 212
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Evaluation of electrolyte salts paired with Bi doped LLZO garnet material for improved ionic conductivity in composite polymer electrolytes

Author(s):

Yaisa Ramirez† (Engineering); Javier Castillo‡ (Engineering)

Abstract:

With the success of electric-powered vehicles, the aviation industry aims to start a new era of electric powered aircraft to reduce environmental impact and to improve aircraft economy, specifically on electrical vertical takeoff and landing type aircrafts. Lithium-sulfur (Li-S) batteries paired with solid state electrolytes are a viable option to fulfill the mentioned objective since they characterize for having high specific energy and capacity, high thermal stability, mechanical strength, and non-flammability. However, this type of batteries present challenges due to Li-dendrite and long chain polysulfide formation, which result on reduced long-term electrochemical performance. This study analyzes the optimal composition for a composite polymer electrolyte with high ionic conductivity and effective anion solvation, that can be applied in Li-S batteries. To this aim, an evaluation of composite polymer electrolytes comprising different electrolyte salts together with garnet material nanoparticles will be conducted. Characterization of the electrolyte's ionic conductivity and microstructure will allow the selection of the most suitable composition for further tests on sulfur cathode compatibility and Li-S cell cyclability.

Keyword(s):

Composite Polymer Electrolyte, Electrolyte Salts, Ionic Conductivity, Li-S Batteries

Mentor(s):

Ernesto Marinero (Engineering); Juan Carlos Verduzco (Engineering); Sebastian Calderon (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 213
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Exploring Ethics in Biomedical Engineering

Author(s):

Tyler Ramsey† (Engineering)

Abstract:

Within the field of Biomedical Engineering (BME), numerous concerns have risen over the last decade regarding the teaching of ethics. Many scholars believe that ethics are either taught poorly or not at all to students in engineering, especially at the undergraduate level. To better understand and gain perspective, approximately 20 scholars were interviewed, including BME professors and advisors. From the wide array of backgrounds and experiences, the research team utilized the Critical Incident Technique (CIT) to discover key incidents and experiences where ethical/unethical actions and choices were made by or experienced by BME faculty during their careers. From the undergoing study, one key theme that has emerged so far is approximately two-thirds of the interviewees did not have any exposure to ethics while they were undergraduate students. Using this data, we hope to understand why a majority of engineers are not taught or exposed to ethics while in undergrad, while also trying to have ethical engineering research inform more effective educational heuristics for preparing ethical engineering researchers. Additionally, we will be trying figure out the best ways to incorporate the teaching of ethics into the Biomedical Engineering undergraduate curriculum.

Keyword(s):

Biomedical Engineering, Research Ethics, Qualitative, Teaching Ethics

Mentor(s):

Justin Hess (Engineering); Andrew Gray (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 214
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Investigation of the Direct Shear Mechanism in Steel-Plate Composites with a Shear Span-to-Depth Ratio less than 1.0

Author(s):

Lainie Rapp† (Engineering)

Abstract:

This research aims to understand the out-of-plane shear strength and direct shear mechanism of steel-plate composite (SC) members through static experiments. SC structures comprise two steel faceplates enclosing a concrete core, connected by steel tie bars, and potentially reinforced with shear studs. Direct shear failure in reinforced concrete structures refers to the abrupt shearing of a concrete member at its supported ends under severe blast loading conditions. Previous studies have not investigated the direct shear mechanism in SC or with shear span-to-depth ratios less than 1.0. A large-scale SC member with a shear span-to-depth ratio of 0.8 was tested statically to failure to confirm that the AISC N690-18 design guide shear strength equations are not representative of out-of-plane shear strength with ratios less than 1.0. The tested specimen included an SC beam with tie bars and part of a slab-to-wall connection on each end of the specimen which introduces a geometric discontinuity in the concrete. The AISC N690-18 out-of-plane shear strength capacity was calculated and compared to the experimental out-of-plane shear strength based on the maximum applied load. These results revealed that the AISC N690-18 design guide equations do not account for the actual out-of-plane shear strength of SC specimens with shear span-to-depth ratios less than 1.0, as the experimental values obtained drastically exceeded predicted values.

Keyword(s):

Steel-Plate Composites (SC), Direct Shear, Out-Of-Plane Shear

Mentor(s):

Maggie Perlman (Engineering); Joshua Harmon (Engineering); Lisa Choe (Engineering); Amit Varma (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 215
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Characterization of calcium-sensing receptor (CaSR) in embryonic zebrafish wound repair

Author(s):

Karlianie Rivera† (University of Puerto Rico - Mayaguez)

Abstract:

Calcium is a key participant in a variety of signaling pathways that preserve homeostasis after injury. Previous research has demonstrated that extracellular calcium is responsible for tissue contraction following tissue damage, implicating the calcium sensing receptor (CaSR), which senses extracellular calcium levels, as a prime research target. Given that there is limited knowledge of the involvement of CaSR in wound healing, the objective of our study is to characterize its role during the embryonic zebrafish wound response. Based on results with chelators, extracellular calcium is required for wound contraction. Furthermore, treatment with NPS-2143, a CaSR inhibitor, causes sustained contraction and tissue death. To verify these results, embryos homozygous for a CaSR knockout were wounded and observed using light microscopy. Preliminary results show that the knockout demonstrates the same phenotypic results as treatment with a CaSR inhibitor, most notably sustained contraction during the wound response. Further genotyping will confirm that the modified phenotype truly results from the CaSR mutation. Ultimately, studying the potential role of the molecules involved in calcium signaling pathways in response to injury will provide insight into the multi-level tissue scale phenomenon of wound response.

Keyword(s):

Calcium-Sensing Receptor (CaSR), NPS-2143, Extracellular Calcium, Wound Response, Embryonic Zebrafish

Mentor(s):

Qing Deng (Science); Shelly Tan (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 216
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Arp2/3 complex's role in plant's immune response

Author(s):

Cristian D. Rosario-Marcano† (University of Puerto Rico at Mayaguez)

Abstract:

Plants have developed defense mechanisms to fight against potential pathogens, mainly involving cytoskeletal rearrangement. Actin filament nucleators are key players in cytoskeletal array construction, as nucleators initiate the formation of new actin filaments. One of these nucleators is the Actin-Related Protein 2/3 complex (Arp 2/3). Studies have shown the Arp2/3 to be one of the nucleators responsible for penetration resistance regulation to powdery mildew since actin patch-like structures have been observed at fungal penetration sites, but the penetration mechanism of powdery mildew is mainly mechanical. If Arp 2/3 is a nucleator responsible for nucleation in response to chemical stimuli remains to be observed. To test this, five-day old Arabidopsis thaliana hypocotyl cells were treated with a MAMP to induce a chemical stimuli and images were acquired on a TIRF microscope to observe single filament growth events. Three types of growth events were described: side branches, de novo and end growths. ImageJ software was utilized for filament analysis on each acquired image, and single filament measurements taken on each one, including filament lifetime, elongation and severing rate. The results of this experiment would help determine Arp2/3 complex's role in a plant cell's response to pathogen invasion and help identify other potential molecular players in plant's immune response.

Keyword(s):

Cellular Biology, Plant Biology, Plant Immunity, Actin Cytoskeleton, Biological Characterization & Imaging

Mentor(s):

Chris Staiger (Agriculture); Weiwei Zhang (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 217
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Probing the Free Energy landscape of Protein L

Author(s):

Ryan Rushing† (Science); Bianca Caminada‡ (Science, JMHC); Eleazar Gonzalez* (Science)

Abstract:

Proteins are large molecules that perform both structural and functional roles in live cells. Key to their abilities, most of these long polymeric molecules spontaneously fold into specific 3-dimensional structures. Because of this, much work has been done to study the mechanics and thermodynamics of the 3-dimensional, folded structure of proteins. Using laboratory-built magnetic tweezers, we found previously that the difference in free energy between the folded and unfolded forms of Protein L held under tension is 6.5 kBT, in media with 150 mM NaCl, pH 7.4, and R.T. To further probe the folding-unfolding transition of Protein L, here we extend the previous study to observe the effect of varying environmental conditions on these transitions under tension. Specifically, we have preliminary data that suggests that an increase in environmental monovalent salt concentration does not significantly affect the free energy difference between the folded and unfolded form of protein L but does allow for more frequent hops between the two states implying a lowering of the energy of an intermediate, transition state along the unfolding pathway. This current study continues and extends this work to probe modifications to the free energy landscape along the tension-induced unfolding pathway due to an increase in environmental salts.

Keyword(s):

Biophysics, Single-Molecule Mechanics

Mentor(s):

Ken Ritchie (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 218
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Rapid characterization of surface oxidation in refractory alloys

Author(s):

Claire Russell† (Engineering)

Abstract:

Refractory Complex Concentrated Alloys (RCCAs) are high temperature-capable metal alloys that typically do not contain one majority element and contain four or more metal elements in high concentrations. These alloys may serve as a potential replacement of state-of-the-art Ni-based superalloys and conventional refractory alloys due to their enhanced mechanical properties at high temperatures. However, many refractory alloys do not exhibit satisfactory high temperature oxidation and environmental resistance, and literature studies suggests that oxidation resistance can be improved via the formation of an external Al_2O_3, Cr_2O_3, or SiO_2 layer in the oxidizing environments. For this study, we selected RCCAs from (1) existing literature and (2) new compositions predicted from machine learning models that exhibit superior oxidation resistance and fabricated them using the arc melting process. We performed oxidation testing at approximately 1000 ºC (recoding mass changes) and identified surface oxide phases using Raman spectroscopy. The results from Raman spectroscopy will be compared to direct electron microscopy observations from the literature. Finally, we show that this technique can be used as a fast, and high-throughput experimental method to identify oxides phases and the results will be used in future machine learning models to predict oxidation-resistant high temperature RCCAs.

Keyword(s):

Materials Processing & Characterization, Composite Materials & Alloys

Mentor(s):

Michael Titus (Engineering); Kenneth Sandhage (Engineering); Akhil Bejjipurapu (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 219
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Trajectory Planning with Aerodynamics for Multi-Rotor in CasADi

Author(s):

Jefte Santiago† (Engineering)

Abstract:

Autonomous robots have existed for decades now, they can be programmed to do multiple things by today's standards. One of those things is trajectory planning with quadcopters. This project is focused on Unmanned Aerial Systems trajectory planning with aerodynamics. To be able to properly plan the trajectory of a multirotor, it is necessary to consider aerodynamic forces in the algorithm. What J. Goppert et al. have done is create a framework to make the multirotor flight, but it puts aerodynamics aside. The problem with doing so is that aerodynamics changes flight characteristics and the quadcopter could end up out of the projected trajectory. To solve this problem, it is necessary to plan a trajectory that considers aerodynamics. When aerodynamic forces are considered, a multirotor should follow a traced path and combat aerodynamic forces mid-flight. With the use of polynomial trajectory planning, it gets harder to consider aerodynamical forces in the project because of the nature of the "snap" derivative method with polynomial trajectory planning. For that reason, this project is focused on including a method that can consider aerodynamic forces in the current framework

Keyword(s):

Multirotor, Polynomial Trajectory Planning, Unmanned Aerial Systems

Mentor(s):

James Goppert (Engineering); Worawis Sribunma (Engineering); Jaehyeok Kim (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 220
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Identification of Biomarkers of Aging by Proteomic Analysis

Author(s):

Faith Scott† (Science)

Abstract:

The risk of many chronic diseases increases with age. With the rapidly growing elderly population, better understanding the biology of aging is critical. Advances in proteomics now allows for the assessment of thousands of proteins in biological matrices, which can be translated into clinical biomarkers. This project aims to investigate the biology of aging and identify potential biomarkers of aging utilizing proteomics techniques. We will perform both untargeted and targeted proteomic analyses of liver tissues collected from young and old mice to identify specific proteins that are differentially regulated with age. We will first generate a protein library using comparative proteomics to identify differentially regulated liver proteins. We will use this library to develop Multiple-Reaction-Monitoring-Mass Spectrometry (MRM-MS) assays which facilitate the accurate quantification of proteins within different samples. For MRM assays, we will select several previously reported tumor suppressor proteins as well as several newly identified proteins from our study to quantify and assess differences in the specific peptides corresponding to the proteins of interest. MRM-quantification of target peptides allows for the precise determination of which proteins are up- or down-regulated in old mice relative to young counterparts. These protein level changes will highlight which biomarkers are most significant to further explore in later mechanistic studies. Identification of proteins that are differentially regulated during biological aging will facilitate the development of a method to identify age-related biomarkers in a tissue-specific manner. This information is necessary for the future development of therapies to prevent age-associated diseases and promote proper tissue repair in older individuals.

Keyword(s):

Aging, Proteomics, Biomarker Discovery, Multiple-Reaction-Monitoring, Mass Spectrometry

Mentor(s):

Uma Aryal (Veterinary Medicine); Rodrigo Mohallem (Veterinary Medicine)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 221
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

The bootstrap method: a survey of correlation functions and recursion relations to model and analyze systems in classical and quantum mechanical realms using convex optimization and semi-definite programming

Author(s):

Stuti Shah† (University of Rochester)

Abstract:

‘Turbulence’ is a characterization of fluid flow by the occurrence of irregular flow patterns and unpredictable fluid behavior - random fluctuations in the velocity of the fluid at a given time and position, for instance. A turbulent flow is said to be ‘homogenous’ when all its statistical properties (such as the time average of the velocity of the fluid) are invariant with respect to the position in the fluid, ‘incompressible’ when the density of the fluid remains constant, and ‘isotropic’ when the properties associated with a turbulent flow are independent of the direction of progression of the fluid. Turbulence is a phenomenon that occurs abundantly around us, for example, the motion of air around aircraft wingtips and in the oceans. However, it lacks a satisfactory mathematically rigorous description. Studying the idealized concept of homogenous, incompressible, isotropic turbulence is a step toward understanding it. While investigating homogenous, incompressible, isotropic turbulence, we determined that the governing equations (established from the incompressibility condition and the Navier-Stokes equation) involving the velocity of a fluid, its density, and the coefficient of viscosity were correlated and obeyed specific recursion relations. Hence, we solved a simpler dynamical system consisting of coupled differential equations known as the Bogdanov system using a numeric computing environment as our first approach to understanding 'the bootstrap method,' i.e., computing recursive correlation functions. The solutions to the said system could be constructed in the form of what is referred to as a positive semi-definite matrix, which with the aid of Convex Optimization Theory and numerical computation, could let us resolve the unique aspects of its behavior. Following this, an attempt was made to model homogenous, incompressible, isotropic turbulence with the governing system of equations aligning with the Bogdanov system. However, we found an exponential growth in the parameters, and therefore devising a method to condense these infinite variables to a workable number poses our next challenge. Subsequently, we looked at the quantum anharmonic oscillator and how the same approach of obtaining recursion relations between the Hamiltonian and an operator symmetric with respect to the Hamiltonian could be taken to understand this system and, further, a quantum spin system.

Keyword(s):

Bootstrap, Recursion Relations, Correlation Functions, Bogdanov System, Convex Optimization & Semi-Definite Programming

Mentor(s):

Martin Kruczenski (Science); Derek Ping (Science); Syeda Neha Zaidi (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 222
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Chemical Leaching on Epoxy-based Drinking Water Pipe Repair

Author(s):

Samuel Spears† (Engineering)

Abstract:

As municipal drinking water infrastructure within the United States becomes older, cured-in-place-pipe (CIPP) technology has emerged as an efficient and inexpensive pipe repair method. However, chemical components used and created during the installation process are not well documented and some have been shown to pose a risk to workers and bystanders. A better understanding of these chemicals and their ability to transfer into water is critical. In the present study, epoxy-based drinking water CIPP resin composites were manufactured in an oven and immediately transferred into water to document chemical leaching. This process was repeated four additional times with flushing procedures between stagnations. Water was analyzed for total organic carbon (TOC) concentration and also using gas chromatography (GC) and mass spectrometry (MS). Due to the paucity of data available, results are expected to help inform future post-installation water testing approaches when CIPPs are used for drinking water applications.

Keyword(s):

Drinking Water, Leaching, Epoxy Resin, Composites

Mentor(s):

Pritee Pahari (Engineering); Pritee Pahari (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 223
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

An Imaging Approach to Study the Developmental Growth of Nepenthes

Author(s):

Grace Stanton† (Science)

Abstract:

Although many studies have been conducted on Nepenthes—also known as pitcher plants—the method of determining the pitchers' direction of growth is still unknown. Nepenthes may be utilizing chemotropism, gravitropism, phototropism, thigmotropism, or a combination of tropisms. In order to formulate an effective approach in studying their growth, a Nepenthes alata (N. alata) plant was placed in a growth chamber with cameras focused on various positions of interest. The recorded videos from the cameras were fed into a deep learning framework called SLEAP in order to track the movement of any plant parts of interest. RNA sequencing analysis will be conducted on the transcriptomics data of the leaf tendrils; this will reveal which genes in the genome are key to influencing the direction of growth. The described approach involves tracking of plant movement through imaging and analysis of omics data can be utilized in determining the method of growth in N. alata or it can be adapted for other plant species. Since N. alata's growth patterns are unknown, this data will be able to fill a gap in the scientific knowledge, and the data may explain how N. alata's growth method has been perplexing the scientific community.

Keyword(s):

Nepenthes Alata, Imagery, Plant Development, SLEAP Software, Tropism

Mentor(s):

David Porterfield (Engineering); Manisha Dagar (Engineering); Alexander Baena (Engineering); Marshall Tabetah (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 224
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Machine Learning-Based Vibration Suppression in Mobile Applications of Particle Diffusometry

Author(s):

Priyadarshini Subramaniam† (Engineering); Shayak Chatterjee* (Engineering)

Abstract:

Diffusion coefficient measurement has the potential to become important in many of today's medical diagnostic devices. With the advent of at-home, accessible testing, it becomes necessary to optimize existing particle-based techniques of diffusion coefficient measurement, specifically particle diffusometry (PD) methods. PD utilizes pictures of particles taken at varying time points to measure the diffusion coefficient, with the potential for disease diagnosis. Yet, the performance of existing PD methods degrades drastically in the presence of vibrations, a common occurrence during in-field applications. Although physical vibrational suppression methods (such as an optical table) and software-based vibration suppression methods (using fiduciary marks and subsequent frame-by-frame shifting) is available, the high-cost barrier of optical tables and absence of available fiduciary marks in micro-PD systems makes these methods ineffective. This work attempts to use single particle tracking and deep learning algorithms to suppress in-field vibration of PD tools. This technique utilizes various vibrations to create image datasets of particles through time and uses a convolutional neural network to predict the underlying diffusion coefficient. The results are expected to show how to account for long-term consistent vibrational motion of a PD device using existing and new deep learning models. It is expected that deep learning models can be trained to account for the vibrational motion of the particles. Based on the findings of this study, long-term consistent vibrational noise is expected to be filtered out using deep learning models.

Keyword(s):

Vibration Suppression, Particle Diffusometry, Particle-Based Measurements, Neural Networks, Microfluidics

Mentor(s):

Steve Wereley (Engineering); Pranshul Sardana (Engineering); Hui Ma (Engineering); Zhengwei Chen (Engineering); Jacqueline Linnes (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 225

Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Characterization of polymer blend nanocomposites using Cellulose Nanocrystals (CNCs) across different size scales

Author(s):

Kiran Sultana† (Engineering, JMHC)

Abstract:

Cellulose Nanocrystals (CNCs) are widely studied as fillers to reinforce polymers due to their high aspect ratio and stiffness. Thermoplastic matrices like poly (lactic acid), polyvinyl alcohol, polyethylene glycol, polyvinyl pyrrolidone, etc. reinforced with cellulose fibers have garnered significant attention as high performance sustainable materials with outstanding mechanical, thermal, and barrier properties. A typical production method involves using polymer-CNC solutions or emulsions with the CNCs in suspension, followed by film casting. This method is favoured due to excellent stability of cellulose nanoparticles in water, however, the resulting materials from solution-based processes are difficult to scale up to larger product dimensions and potentially create more waste during manufacturing in contract to solventless processing. Thus, the focus of this research is to fabricate solventless polymer blend nanocomposites using CNCs with thickness ranging from the nanoscale to millimetres, while observing the morphology and mechanical properties with resulting properties compared to solution-based analogs. For solution casting, multiple samples of 2.5 wt% and 5 wt% of homopolymers: PVA and PVP along with their blends and varying ratios of CNCs (2.5 and 5 wt%) were prepared in deionized water. Thicker samples were prepared by solution casting and preliminary works on fabricating the thickest samples (millimetres) were done using micro compounder in a solutionless process. Morphological study was performed using optical and polarized light microscope. Quartz crystal microbalance and tensile tester were used for mechanical characterization. We found the polymer blend microstucture, including dispersion of CNCs, was altered by changing the weight ratios of PVP/PVA and CNCs which greatly affected the material properties of the final composite specimen.

Keyword(s):

Polyvinyl Alcohol (Pva), Cellulose Nanocrystal (CNCs), Polyvinyl Pyrrolidone (PVP), Characterization, Micro Compounder

Mentor(s):

John Howarter (Engineering); Jeffrey Youngblood (Engineering); Geeta Pokhel (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 226
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Modeling of the Chemical Fate and Transport Post Norfolk Southern Train Derailment

Author(s):

Stefanie Surdyka† (Engineering)

Abstract:

The February 2023 Norfolk Southern train derailment in East Palestine, Ohio released large amounts of chemicals into the environment. Chemicals entered at least five states, killed tens of thousands of fish and prompted numerous illness reports from the population and workers. Illnesses continued to be reported by workers and residents after the evacuation order was lifted. To better understand chemical exposures, we applied USEPA EPI Suite software alongside the CompTox Chemicals Dashboard and compared results to field observations. The fate of 7 volatile organic compounds (VOC) released from the derailment in the environment (air, water, sediment) was examined. The models considered 3 factors; water depth, current velocity, and wind velocity. Results indicate that depending on the chemical, 6.19% to 32.7% was present in the air, while 66.6% to 90.5% of the chemical was primarily present in the water. Mechanical aerators and diffusers were installed in heavily contaminated creeks, therefore the mass of the given chemical emitted into the air is likely greater than estimated by the model. Additionally, it was found that chemical levels inside concrete stormwater culverts likely allowed for contaminant accumulation in air beneath homes. As these contaminants entered through the open drain pipes in the culverts, the indoor air of the building was contaminated. The half-life of the chemicals ranged from 0.05348 to 47.51 hours and was dependent upon the three factors that were altered by the user. The State of Ohio claims that chemical concentration decreases in creeks were due to biodegradation caused by aeration, which was not supported by USEPA's software outputs. Evidence suggests chemicals were removed from the creeks through transfer into the air. These calculations, along with further research and sampling can lead to a more accurate determination of the chemical fate, which in turn, can help with the future development of more effective disaster relief strategies.

Keyword(s):

Disaster Relief, Chemical Fate, Energy & Environment, Chemical Spill, Environmental Effects Post Disaster

Mentor(s):

Paula Coelho (Engineering); Paula Coelho (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 227
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Development and application of Atomic Force Microscopy (AFM) and imaging tools towards the measurement of oocyte mechanical behavior

Author(s):

Amani Talbert† (Morehouse College)

Abstract:

The mechanical properties of cells contribute to several different aspects of cell physiology, including cell shape, cellular morphogenesis, orientation for cell division, and the sensing and transducing of signals associated with mechanical forces. Additionally, measurement of cortical tension of cells is a readout of acto-myosin-mediated contractility. Previous studies assessing cortical tension in mammalian oocytes using micropipette aspiration revealed changes with progression through meiosis and the egg-to-embryo transition. This work aims to develop and apply atomic force microscopy (AFM) and imaging tools towards the measurement of mammalian egg mechanical behavior, to elucidate how calcium signaling and cytoskeletal dynamics interact during the egg-to-embryo transition to modify the egg plasma membrane to a state that is unreceptive to sperm, resulting in a block to fertilization by additional sperm (known as polyspermy). This project will involve collection and culture of egg cells from mice, development of methods for immobilizing these cells for AFM measurements (e.g., anchoring on coverslips or embedding in agarose), and testing a spherical indenter for these analysis of unfertilized eggs. With these experimental parameters in place, our goal is to perform these measurements to compare unfertilized and fertilized eggs, and then fertilized eggs that have been experimentally manipulated in ways that are known to alter calcium signaling, actomyosin dynamics, and events of the egg-to-embryo transition such as the membrane block to polyspermy.

Keyword(s):

Cellular Mechanics, Meiois, Atomic Force Microscopy, Mechanobiology, Signaling Pathways

Mentor(s):

Deva Chan (Engineering); Janice Evans (Science); Aritra Chatterjee (Engineering); Dhulika Ravinuthala (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 228
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Calcium-dependent Signaling of CaMKII and its Regulation of Actin in Dendritic Spines

Author(s):

Hareem Tariq† (Engineering)

Abstract:

Alzheimer's disease (AD) is a neurodegenerative disorder associated with memory loss and cognitive decline, primarily attributed to calcium signalling dysfunction. Canonical Ca2+ signalling activates Calcium-Calmodulin Kinase II (CaMKII), the most abundant protein in excitatory synapses and central to synaptic plasticity (SP), which further modulates actin-driven morphological changes in dendritic spines at excitatory synapses. The underlying mechanisms of CaMKII-dependent actin regulation are complex given that the extent to which spine membranes, and in particular the spine neck, expand due to these protein signals remain unresolved. The aim of this study is to explore the interactions of CaMKII and actin in rat hippocampal neurons, utilizing a proximity ligation assay (PLA). PLA is a powerful tool that allows in situ detection of protein interactions with high specificity and sensitivity. The proteins CaMKII and actin are detected with primary antibodies, after which a pair of secondary antibodies (PLA probes) bind. Hybridization of connector DNA oligonucleotides join the probes within proximity and a ligase closes the circular DNA template rolling-circle amplification (RCA). The incorporation of fluorescently labelled nucleotides within the template generates fluorescent dots, indicative of interaction, which can be detected using confocal microscopy fluorescence imaging techniques. Our results show detection and visualization of the close proximity of these proteins and shed light on CaMKII and actin colocalization throughout the dendritic spine. Thus, the interplay between Ca2+ signalling, CaMKII and actin offers insights into dendritic spines organization, determining synaptic strength, and influencing SP, with potential therapeutic implications for synaptic dysfunction in neurodegenerative disorders like AD.

Keyword(s):

CaMKII, Ca2+ Signaling, Actin Regulation, PLA, Dendritic Spines

Mentor(s):

Tamara Kinzer-Ursem (Engineering); Agnes Doszpoly (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 229
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Microbial Growth in Hydroponic Systems Influenced by Water Quality

Author(s):

William Townsend† (Engineering); Madelyn Whitaker‡ (Engineering); Alex Mate‡ (Engineering)

Abstract:

Redacted.

Keyword(s):

Hydroponics, Microbiome, Kratky Method, Bacterial Growth, Water Quality

Mentor(s):

Caitlin Proctor (Agriculture); Emily Spicuzza (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 230
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Sensor-based methods for assessing elements of non-technical skills in surgeries

Author(s):

Ryan Toy† (Engineering)

Abstract:

Non-Technical Skills (NTS) in surgeries like leadership, communication, decision making, and situation awareness are critical for safe procedures. The current standard for assessing NTS are behavioral markers like the Non-Technical Skills for Surgeons (NOTSS) system. The NOTSS system uses expert human raters to qualitatively measure performance across all elements of NTS. The cost of human raters and potential for bias necessitates more efficient and objective measurements for elements of NTS. In this work, over 30 laparoscopic or robotic assisted surgeries were observed. Microphones and cameras captured audio and video recordings. Surgeons' eye tracking and operating room (OR) staff position data was also captured. The audio data is particularly useful in analyzing communication in the OR. Computer programs provide transcripts of the audio recordings. The transcripts were then annotated for closed loop communication (CLC), a standard communication strategy in the medical field. These transcript annotations of CLC give objective measurements of frequency and forms of CLC throughout the operation. Eye tracking data is also especially useful for measuring surgeon's situation awareness. Information about the surgeon's pupil dilation and gaze focus can be used as a metric for cognitive activity during specific parts of the procedure. This study is a work-in-progress and developing better metrics for assessing NTS elements in surgeries will help improve the performance of surgeons and lead to better patient outcomes.

Keyword(s):

Non-Technical Skill, Closed-Loop Communication, Surgical Communication, Sensor-Based Metrics

Mentor(s):

Denny Yu (Engineering); Marian Obuseh (Engineering); Nicholas Anton (Indiana University)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 231
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Intended Impact, Unintended Domain: Revolutionary Innovations Gain Momentum Elsewhere

Author(s):

Corin Tuinstra† (DSB)

Abstract:

Prosperous societies are built upon major innovations that drastically change how we live. These innovations, termed enabling innovations, have broad impact and cascading benefit for society. However, the trajectory to discovering an enabling innovation is not simple. Previous studies have discovered two paths for achieving the vision of an enabling innovation. The first, called a “moonshot” strategy, uses small tests and incremental advances to reach a goal within a single application context. The second, called a “lily pad” path, pursues multiple applications and contexts to retain interest, gather resources, advance performance, and generate impact. This study used patent citation analysis to demonstrate that using the “lily pad” path generates more impact, quicker than the “moonshot” approach. We hypothesized high-impact patents had a shorter path from vision to impact, if not limited to a single application context. Analysis of backward and forward patent citations suggests that high-impact innovations are benefited from an evolution across multiple application contexts. These findings suggest innovators should use novel application spaces to shorten the time from vision to application. As societies pursue major innovations, they should consider a “lily pad” approach to realize quicker positive impact.

Keyword(s):

Innovation, Adoption Strategy, Business History

Mentor(s):

Joe Sinfield (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 232
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Creating Hybrid LoRaWAN Topologies for Energy Constrained Environments

Author(s):

Hector Valenzuela† (University of New Mexico)

Abstract:

In resource-constrained austere environments, such as animal agriculture, the utilization of reactive hybrid topologies proves effective in addressing the challenges associated with long-range, low-power connectivity. While LoRaWAN technology offers extended coverage, it consumes considerable power, particularly with routing nodes requiring additional energy. Additionally, the ad-hoc approach commonly employed results in collisions and packet losses. To overcome these obstacles, our research introduces a novel two-way synchronized slotted approach utilizing a star-like topology. Each node is allocated a dedicated slot time, guaranteeing collision-free communication, and allowing for dynamic adaptation to varying packet sizes and sampling rates, particularly in dense clusters. In emergencies, a switch to a broadcast strategy using higher spreading factors is triggered, enabling a longer range when required. The effectiveness of our proposed approach is validated through a comprehensive evaluation encompassing various scenarios inspired by real-world conditions prevalent in animal agriculture. Both simulation and hardware testbeds are utilized to validate the performance and practicality of our solution. This research serves to adapt long-range communication to meet the unique challenges encountered in austere environments, fostering enhanced connectivity and reliability in resource-limited settings.

Keyword(s):

LoRaWAN, Hybrid Topology, Animal Agriculture, Slotted Aloha, Energy Constrained

Mentor(s):

Richard Voyles (Polytechnic Institute); Upinder Kaur (Polytechnic Institute)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 233
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Discovery of Inflammatory Bowel Disease Biomarkers Trough Multi-Omics Data Analysis

Author(s):

Nicolas Vivas Rincon† (Engineering)

Abstract:

Inflammatory bowel disease (IBD) is a non-curable condition that affects millions of people around the world. IBD is characterized by chronic relapsing and remitting inflammation of the gastrointestinal tract, resulting in debilitating physical and psychosocial symptoms for patients including diarrhea, abdominal pain, fatigue, depression, and anxiety. To date, the causes, and reasons for progression of IBD are unknown, which impedes the accurate diagnosis, and the development of efficient treatments. Our goal in this study is to identify key biomarkers of IBD through the analysis of multi-omics data. For this purpose, we will use the IBDM Database which contains data for 27 non-IBD subjects and 105 IBD subjects. Each subject has records of different microbially focused profiles, or omics data: metagenomes, transcriptomes, metaproteomes, and metabolomes. We will use two different methods available in the literature. The Joint and Individual variation explained (JIVE) method, which combines multi-omics data and captures the joint and individual structure of each type of data; and the Sparse Generalized Canonical Correlation Analysis (SGCCA), which identifies key multi-omics features by estimating the directions in the data that maximize correlation. By discovering the key biomarkers of IBD, we will enable the development of a theragnostic (diagnosis and therapeutic) system, able to help patients to control their symptoms.

Keyword(s):

Inflammatory Bowel Disease, Multi-Omics Data, Machine Learning: High Dimensional Data, Medical Science, Technology

Mentor(s):

Ana Estrada Gomez (Engineering); Manni Zhang (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 234
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Operation and Characterization of the SPT-100 Hall-effect Thruster

Author(s):

Liam West† (Engineering); Nicholas Babusis‡ (Engineering)

Abstract:

Hall-effect thrusters are a popular choice for in-space propulsion systems due to their high efficiency and wide range of applications. Development of improved thrusters is a major area of research, as improvements in these thrusters would allow for a larger number and variety of space missions. The characterization and refinement of these thrusters can aid in creating methods for designing and manufacturing more advanced thrusters. This study aims to characterize and improve the performance of an SPT-100 hall-effect thruster running on krypton to allow for stable and repeatable use. Electrical measurements were taken of the electronic system powering the SPT-100 hall-effect thruster and photographic observations were made of the thruster plume across various operating modes and electrical setups, generating V-I curves and identifying plume shape characteristics and areas of stability. This study identifies key improvements made to the power and control circuitry as well as to the operating procedures which improved operational stability and control. Recommendations for future research with this SPT-100 thruster setup are also provided.

Keyword(s):

Electric Propulsion, Space Propulsion, Plasma Physics, Ion Engines, Hall Effect Thruster

Mentor(s):

Alexey Shashurin (Engineering); Lee Organski (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 235
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Sustainable Quench Oil Replacements for Austempering Salt Quenchants

Author(s):

Yichu Xu† (Engineering); Sydney Belk* (Engineering, JMHC); Jackson Truitt* (Engineering)

Abstract:

Austempering is an isothermal transformation widely employed in the industry to enhance the ductility, corrosion resistance, and hydrogen embrittlement resistance of alloys by achieving a lower bainitic organization. The choice of an appropriate quenchant with high-temperature resistance and suitable properties holds significant importance in the austempering process. Conducting a comparative analysis and characterizing different quenchants can provide valuable insights for optimizing plant and production efficiency. This study examines more than 50 quenchants, encompassing molten salts, fluorinated oils, phosphate ester oils, natural oils, and silicon-based polymers. While considering the cost-effectiveness and solvent blend composition, the investigation focuses on understanding their degradation patterns and boiling points by thermodynamic analysis in both air and nitrogen circunstances, as well as flashpoints and other factors. The results indicate that higher viscosity polydimethylsiloxane (trimethyl siloxane terminated) and high oleic natural oils have elevated degradation points, rendering them more suitable for austempering than conventional industrial oils. Moreover, refining the specific compounded natural oils further increases their flashpoints. Consequently, oils and polymers are being explored as potential alternatives to quench salts in order to enhance the austempering process.

Keyword(s):

Oils, Polymers, Austempering, Materials Processing & Characterization, TGA

Mentor(s):

Jeffrey Youngblood (Engineering); Michael Titus (Engineering); David Johnson (Engineering); Rodrigo Orta Guerra (Engineering); Lipi Roy (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 236
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Action Detection in Occupational Safety Using IMU Sensors and Advanced Data Analysis

Author(s):

Tongwei Zhang† (Science)

Abstract:

The field of occupational health and safety has continually sought innovative strategies to mitigate workplace risks, particularly in high-demand environments such as warehouses. Tasks in these settings often entail a high level of physical intensity, leading to an increased incidence of musculoskeletal injuries. This situation has given rise to an urgent need for effective preventive measures. As we explore potential solutions, Artificial Intelligence (AI) and Machine Learning (ML) have emerged as promising tools with the potential to deliver transformative opportunities to prevent physical injuries in warehouses using 2D cameras. This research capitalizes on the integration of numerous mocap cameras, 8 GoPro Cameras, IMU sensors, and pressure-sensing gloves to gather data from participants simulating the role of a warehouse worker. The data collected serves to train an AI model capable of predicting potential injuries based on 2D images. As part of this research team, my role primarily involves leveraging IMU sensor data to detect actions that might lead to injuries, as well as determine the start and end of pulling, lifting, and pushing tasks at frame intervals.

Keyword(s):

Proposal-Based Action Detection, Inertial Measurement Unit, MoCap Camera, Risk Factor Detection, 3D Spatial Information

Mentor(s):

Denny yu (Engineering); Guoyang Zhou (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 237
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Encapsulation of Delamanid into Nanoparticles to Enhance Bioavailability for Oral Tuberculosis Treatment

Author(s):

Rachel Zheng† (Agriculture, Engineering)

Abstract:

Delamanid, a moderately hydrophobic basic molecule, has shown promise in treating drug-resistant tuberculosis. However, its hydrophobic nature presents challenges for effective drug delivery by limiting its oral efficacy. This research explores the use of nanoparticle encapsulation to improve the bioavailability of delamanid by improving its dissolution kinetics. To achieve the encapsulation of DLM within polymer-stabilized nanoparticles, Flash NanoPrecipitation (FNP), a technique for controlled antisolvent precipitation, was employed. Through FNP, stable DLM nanoparticles ranging in size from 100 to 300 nm were successfully formed and exhibited stability over multiple days. Previous attempts to nanoencapsulate DLM were unsuccessful and predicted to be due to the presence of trifluoromethyl and nitro functional groups. To overcome these challenges, co-encapsulation with vitamin E acetate and PS-b-PEG as the stabilizer were implemented. The co-encapsulation strategy involved incorporating DLM with a strongly hydrophobic co-core, such as vitamin E acetate. It is hypothesized that this approach increases the overall hydrophobicity of the nanoparticle (NP) core, creating nucleation sites that space out the trifluoromethyl and nitro functional groups, thereby facilitating stabilizer attachment. Consequently, the resulting nanoparticles are expected to exhibit increased specific surface area and amorphous drug forms, thereby promoting dissolution and augmenting drug bioavailability. Future work will focus on processing the nanoparticle suspension into a dry powder and testing the drug dissolution kinetics in a simulated intestinal fluid. The outcomes of this study have significant implications for advancing treatment options in drug-resistant TB, potentially leading to enhanced therapeutic outcomes, and combating this global health menace more effectively.

Keyword(s):

Delamanid, Drug Resistant Tuberculosis, Nanoencapsulation, Nanoparticles, Flash NanoPrecipitation

Mentor(s):

Kurt Ristroph (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 238
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF

Molecular Cages as Artificial Antibodies and Artificial Enzymes

Author(s):

Daniel Zou† (Science)

Abstract:

Abstract Redacted.

Keyword(s):

Supramolecular, Hydrazone-Linked, Hydrolysis

Mentor(s):

Severin T. Schneebeli (Pharmacy); Olav Vestrheim (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 239
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF,CISTAR

Investigation of Periodic Trends Between Platinum Alloyed Nanoparticles as Catalysts for Ethane Dehydrogenation

Author(s):

McKenna Clinch† (University of Kentucky)

Abstract:

The conversion of alkanes to alkenes provides the petrochemical industry with its most significant precursors. Steam cracking, a commonly used method for ethylene and propylene production, requires excessive input of energy and high reaction temperatures. Catalytic alkane dehydrogenation provides a more energy-efficient alternative to steam cracking, but improvements in catalyst stability at high temperatures are still needed. Platinum (Pt) alloy nanoparticles are efficient catalysts for alkane dehydrogenation reactions, allowing for improved alkene selectivity while decreasing the required reaction temperature. In this work, two complementary strategies are utilized to improve catalyst stability under ethane dehydrogenation conditions: 1) variation of the promoter metal identity in the bimetallic Pt alloy and 2) addition of calcium dopants into the supported alloy catalyst. Preliminary results indicated that Pt alloys with first-row transition metals (vanadium, manganese, cobalt) showed much lower activity for ethane dehydrogenation (EDH) compared to propane dehydrogenation (PDH) whereas post-transition metals (gallium, indium, tin) showed more comparable reactivity in EDH and PDH. This leads to the hypothesis that early transition metals experience a potential electronic effect that results in higher activation energies for EDH causing significantly lower conversions. Platinum alloys of vanadium, manganese, cobalt, and tin were synthesized and used in EDH reactions to determine ethane conversion and ethylene selectivity. Kinetics experiments were performed at different temperatures to determine activation energy. Trends seen from these catalysts can be used to probe differences of varying alloy nanoparticle catalysts between ethane dehydrogenation and propane dehydrogenation, providing more insight into catalysts and their abilities in these reactions.

Keyword(s):

Ethane Dehydrogenation, Catalysts, Platinum, Alloy, Conversion

Mentor(s):

Christina Li (Science); Joanna Rosenberger (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 240
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF,SCALE

Micro-Precision Testing on Lead-Free Bi-Based Solder Joints

Author(s):

Brendan Duffy† (Engineering, JMHC); Rongkai Yu* (Engineering)

Abstract:

Solder joint reliability is a critical contributor to the longevity of electronic assemblies. With the ban on lead-based solder alloys, there exists a critical need to characterize alternatives. Furthermore, with the increasing use of large-area advanced electronic packages, there is a need for newer, Bi-based lead-free solder alloys that may be assembled at temperatures less than 180 degrees Celsius. However, the stress-strain profiles of these alloys vary significantly with strain rates and operating temperature. To provide a standardized process of lead-free solder joint material characterization, a custom micro-precision tester is used to apply double shear loading to solder joint samples. The tester leverages closed-loop feedback control and uniformly designed samples to mitigate measurement errors and enable repeatable experimentation. Monotonic and creep tests were conducted with aged and unaged solder joint samples of three Sn-Bi (tin bismuth) alloys with different microalloying elements. In addition, different sample-holding designs were modeled and fabricated. Component models were developed through Fusion360, a computer-aided design software. Fusion360's computer-aided manufacturing functionality was then leveraged to elicit code for a programmable milling machine. Monotonic experimental results evidenced that the saturation stress of tested alloys increased with aging. Moreover, creep test data outlined that all aged alloys exhibited lower strain rates and, therefore, more creep resistance than their unaged counterparts.

Keyword(s):

Micro-Precision Tester, Solder Joints, Material Characterization, Lead-Free Alloys, Computer-Aided Manufacturing

Mentor(s):

Ganesh Subbarayan (Engineering); Sean Lai (Engineering); Sukshitha Achar (Engineering); Carol Handwerker (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 241
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF,SCALE

SCALE Smart capsule for targeted gastrointestinal microbiota sampling

Author(s):

Samuel Hyde† (Engineering)

Abstract:

Understanding the gastrointestinal microbiome has become a frontier in understanding gut health and is being utilized for diagnostics and therapy. Current research has found many environmental factors which influence the microbiome including sleep, stress, diet, smoking, exercise, and age. And it has also been correlated with many diseases such as IBD, cardiovascular diseases, type 2 diabetes, and other diseases. Many methods have been used to analyze the microbiome such as fecal analysis, endoscopy, colonoscopy, and capsule endoscopy. The gastrointestinal microbiome is complex and has temporal as well as spatial variances. We review the advantages and limitations of various technologies and techniques while also encouraging more research to be done to collect samples while reducing cost and invasiveness but increasing spatial and temporal information.

Keyword(s):

Sampling Capsule, Passive Sampling, Ph-Sensitive Polymers, Gastrointestinal Microbiota, Targeted Sampling

Mentor(s):

Rahim Rahimi (Engineering); Sina Nejati (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 242
Presentation Time: 7/27, Session 1: 10am-11:30am

SURF,SCALE

Material Composition Impact on Low Temperature Solder Alloys

Author(s):

Rongkai Yu† (Engineering); Brendan Duffy* (Engineering, JMHC)

Abstract:

The strength of solder materials can vary widely depending on the material composition of the alloys. Knowing how different solder alloys behave at different temperatures and aging conditions is critical to understanding the long-term reliability of electronic products assembled with these solder alloys. However, understanding the machines and programs involved in conducting experiments is also essential to improving the efficiency and quality of data collection. This study serves to develop an understanding of the mechanical characteristics and software programs related to the experimentation of three SnBi (tin- bismuth) solder alloys with microalloying elements. Additionally, relevant functions and legacy MATLAB scripts are analyzed to prepare for the decommission of the current tester and the commission of a revamped tester. Flowcharts are created for the core scripts to illustrate their logic and all related code are thoroughly reviewed for obsolete code. During the experiments, solder material specimens are mounted on specialized precision testers with closed loop control and undergo experiments to determine their mechanical behavior under creep, fatigue, and monotonic loading. Test data regarding mechanical strength was collected on-site and analyzed, and the samples were then sent to for microstructural analysis. It was observed that the solder materials often have higher saturation stress at lower temperatures and at unaged conditions. Both data about saturation stress acquired from monotonic tests and data about creep resistance from creep tests suggest that all three materials are more resistant to stress and strain deformation when aged.

Keyword(s):

Material Modeling & Simulation, Solder Alloys, Heterogeneous Integration & Advanced Packaging, Mechanical Characterization, Tin-Bismuth

Mentor(s):

Ganesh Subbarayan (Engineering); Carol Handwerker (Engineering); Sean Lai (Engineering); Sukshitha Achar (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 243

Presentation Time: 7/27, Session 1: 10am-11:30am

VIP

Earth History Visualization: TimeScale Creator

Author(s):

Siya Sharma† (Engineering)

Abstract:

The TimeScale Creator, an innovative and freely available JAVA package, has transformed the way we explore and visualize the geologic time scale. This user-friendly tool makes it easy to study Earth's history by allowing researchers and enthusiasts alike to navigate through an extensive geological database easily.

Understanding the increasing need for accessibility and convenience, the team has been working to develop a user-friendly web application. They have developed a website that aims to make the TimeScale Creator more readily accessible to a wider audience.

The primary objective of the Earth History Visualization team this summer is to further improve the TimeScale Creator's functionality on the web platform. The aim is to create a more user-friendly and streamlined website, ensuring accessibility for a wider audience. The team plans to focus on enhancing user-friendliness, refining the user interface, and providing clearer settings.

By continuing to work on the web application, the goal is to make the TimeScale Creator accessible to researchers and individuals with a general interest in geology. The online version eliminates the need for users to download the software, offering convenience and ease of use.

Keyword(s):

Timescale Creator, Geological Data Visualization, Web-Based Tool, User-Experience/User-Interface, Accessibility

Mentor(s):

Jim Ogg (Purdue University); Aarom Ault (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 300

Presentation Time: 7/27, Session 2: 1pm-2:30pm

Investigating Potential Causes of Flip-Over and Scarring Events in Pekin Ducks

Author(s):

Emma Bartley† (Agriculture); Dylan Seets† (Science); Andrew Keck† (Science)

Abstract:

Indiana is the number one producer of duck products in the United States. The industry has noticed an increasing occurrence of individuals suffering from flip-over. Flip-over is a welfare concern where a duck falls onto their back and struggles to return to its feet, which can lead to scars on the shoulders/hips. Little information is known about how these events result in scarring or what hinders the ducks' ability to right themselves; however, the tail may play a role in the body righting reflex. The objectives of this study were to investigate the relationship between tail flexion and likelihood of flip-over and determine if presence of scaring was influenced by the number of flip-over events. Pictures of 1200 Pekin hens were taken at 23 and 30 days of age. Ducks were held by their legs with their dorsal side facing the camera. Images were graded concerning tail flexion and flip-over scar presence. Counts of each time an individual duck was found flipped over were also utilized. R Studio was used to run odds ratio analysis. No significant difference in the presence of scarring was found between the group experiencing one versus multiple flip-over events (P = 0.85). Individuals not flexing their tail tended to be 1.28 times more likely to experience a flip-over event (P = 0.09). These results highlight potential importance of the tail reflex in body righting and that the number of flip-over events a duck experiences may not influence an individuals' odds of scarring.

Keyword(s):

Flip Over, Motor Incoordination, Image Analysis, Waterfowl, Body Righting

Mentor(s):

Darrin Karcher (Agriculture); Carl Kroger (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 301
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Optimal Machining Parameters for Additively Carbon Fiber-Reinforced Thermoplastic Composites

Author(s):

Min Yong Chun† (Polytechnic Institute); Harry K. Lee‡ (Engineering)

Abstract:

Additive manufacturing technology for fiber-reinforced thermoplastic composites is widely used in tooling applications, where the quality of the tool surface finish is of utmost importance. However, due to the heterogeneous nature of composites, improper machining parameters can result in more severe surface defects, such as fiber pull-out, fiber breakage, and melted polymer, compared to traditional metal tool machining processes. The primary objective of this research is to investigate the relationship between machining parameters, specifically surface speed (SFM) and feed rate (IPT), and the surface finish quality of additively manufactured fiber-reinforced thermoplastic composites. By studying these relationships, this research aims to identify optimal machining parameters for different composite materials. To assess each machining parameter, a thermal camera was used to measure temperatures of the part, tool, and chip during the machining process using various parameter settings. By optimizing cutting parameters, tool selection, and tool paths, manufacturers can minimize tool wear, reduce the frequency of tool changes, and improve overall tool life.Additionally, visual inspection and surface roughness testing were conducted to evaluate the surface finish quality of each test specimen. Two different carbon fiber-reinforced composites with distinct glass transition temperatures, namely Acrylonitrile Butadiene Styrene (ABS) and Polyethersulfone (PESU), were used as test specimens. This study serves as a valuable contribution and guide for operators seeking to effectively machine fiber-reinforced thermoplastic composites. The findings provide insights into optimizing the machining process and achieving desirable surface finish quality, thereby enhancing the overall efficacy of manufacturing composite tools.

Keyword(s):

Advanced Composite, Subtractive Manufacturing, Additive Manufacturing, Machining Parameter

Mentor(s):

Garam Kim (Polytechnic Institute)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 302

Presentation Time: 7/27, Session 2: 1pm-2:30pm

The Effect of High Fat Diet and Circadian Disruption on Diurnal Feed Intake, Fecal Output and Fecal Corticosterone Levels of Pregnant and Lactating Mice

Author(s):

Michayla Dinn† (Agriculture); James MacKinnon* (Agriculture)

Abstract:

Circadian rhythms are 24-h cycles that regulate physiology and behavior like sleep-wake patterns and cortisol levels and are highly integrated with metabolism. Chronic circadian rhythm disruption, such as shift work, is associated with development of diseases like type II diabetes. The objective was to determine the effect of chronic circadian disruption imposed by light-dark phase shifts (PS) and high fat (HF) diet on diurnal feeding behavior, fecal output, and fecal corticosterone content in ICR mice during pregnancy and lactation. We hypothesized that feed intake, fecal output and fecal corticosterone levels would be altered by HF diet and PS, remaining relatively constant across day and night. A 2X2 factorial study was conducted and virgin mice were placed on control (CON; 10% fat) or high fat (HF; 60% fat) diets and fed ad libitum for 4 weeks. Mice were mated and assigned to light-dark (LD; n=17) or phase shift (PS; n=16). LD were exposed to 12h of light (0600-1800) and 12h of dark (1800-0600). PS were exposed to a jet-lag paradigm, by shifting the light phase forward 6h every 3d. Mice delivered naturally. Dam and litter were euthanized on lactation d12. Feed intake and fecal output were measured twice daily at 0600 and 1800 to gather day and night data. Corticosterone was extracted from fecal matter and measured using an ELISA. Analysis is ongoing, but preliminary graphs suggest feed intake and fecal output increased from pregnancy to lactation, and early pregnancy showed diurnal differences in both.

Keyword(s):

Circadian Rhythms, Corticosterone, Circadian Disruption

Mentor(s):

Theresa Casey (Agriculture); Linda Beckett (Agriculture); Kelsey Teeple (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 303
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Effect of Sorghum Arabinoxylan (SAX) on the growth of human gut microorganisms

Author(s):

Denisse Victoria Gutierrez† (Agriculture)

Abstract:

Human gut microbiota plays a significant role in overall health, impacting disease conditions such as cardiovascular disease, high cholesterol levels and obesity. The gut microbial composition and function can be influenced by factors such as environment, genetics, and diet. Among these factors, diet offers a feasible way to effectively modify the gut microbiota. Dietary fiber, which cannot be absorbed by the human body, serves as a substrate for fermentation by bacteria, resulting in the production of beneficial metabolites. Arabinoxylan (AX) is a common dietary fiber that widely found in cereal crops, which is a complex substrate primarily composed of arabinose and xylose. Recently, AX has emerged as an impactful regulator of gut microflora, which is attributed to its intricate polysaccharide structures, including diverse linkage patterns and branching units. We aimed to analyze the effect of sorghum AX (SAX), a naturally heavily branched AX, on the growth of different human gut isolated microorganisms. Bacteria from phylum Bacteroidetes, Firmicutes, Proteobacteria and Actinobacteria were incubated under anaerobic condition for 24 hours at 37ºC with shaking at 150 RPM. The growth with 0.2% SAX and gut mineral media were evaluated through optical density (OD 600 nm) for 30 hours. The goal is to identify and screen for rapid-growing microorganisms that can thrive on the specific AX substrates, which underlies the fundamental knowledge of how a complex dietary fiber, like AX, governs gut microbial competition. It is expected that SAX can enhance the growth of beneficial strains while suppress the proliferation of pathogenic organisms.

Keyword(s):

Dietary Fiber, Gut Microbiota, Cell Growth

Mentor(s):

Steve Lindemann (Agriculture); Tianming Yao (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 304
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Exploring Neurite Complexity in Cortical Neurons Carrying an Epilepsy-Linked SCN2A Mutation: A Human-Induced Pluripotent Stem Cell Study

Author(s):

Hope Harlow† (Pharmacy); Muhan Wang* (Pharmacy); Conrad Otterbacher* (Science)

Abstract:

Epilepsy is a neurological disorder that causes misfiring of neurons, leading to random, oftentimes unprovoked, episodes of seizures. In lab, we study the SCN2A gene, which encodes the sodium ion channel protein type 2 subunit alpha protein, Nav1.2 and is known to cause severe seizures and epileptic episodes in infancy/younger adolescence. A specific mutation that affects the SCN2A gene is the L1342P variant. There are only 6 known cases of epilepsy with the L1342P mutation in the world, so little information is known about how the mutation will affect neuronal development. Therefore, in order to study it, our lab uses hiPSC-derived cortical neurons that have been CRISPR/Cas9 edited to contain the Nav1.2-L1342P mutation.

The objective of this project was to assess and quantify the changes in neuronal morphology of hiPSC-derived cortical neurons carrying the Nav1.2-L1342P mutation. Our primary hypothesis was that this mutation would induce alterations in neurite complexity and shape. To achieve this, we employed the advanced software tool Neurolucida360 for comprehensive structural analysis, encompassing soma size and perimeter, number of dendrites, as well as mean and total process length. By comparing the data collected from neurons containing the L1342P mutation with that from neurons without the mutation, we aimed to discern significant differences. Our initial findings suggest that neurons carrying the L1342P variant exhibit diminished neurite complexity in comparison to the control group. These results strongly indicate a potential role of the L1342P mutation in influencing neuronal development.

Keyword(s):

Neurons, Epilepsy, Neuronal Morphology, Control Vs Mutation

Mentor(s):

Yang Yang (Pharmacy); Maria Olivero-Acosta (Pharmacy)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 305
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Protein Purification for Structural and Functional Analysis: An Undergraduate Perspective

Author(s):

Camille Higgins† (Science, JMHC)

Abstract:

Proteins are essential biomolecules that play a vital role in all living organisms. They are responsible for various functions, including catalyzing biological reactions, transporting molecules, and providing structural support.

As an undergraduate student, I was fascinated by the complexity and diversity of proteins, particularly in learning how proteins are purified and characterized. I challenged myself to understand these topics by conducting an independent research project in the structural biology lab.

I was responsible for purifying proteins from recombinant bacterial cultures. This involved several steps, including cell lysis and chromatography to purify the proteins, SDS-PAGE, and Western blot to check for heterogeneity, which will assess the expression and purity of the protein. Further purification is accomplished using affinity chromatography, size exclusion, or ion exchange chromatography.

Structural analysis can be achieved using X-ray crystallography or cryo-electron microscopy. Both methods will reveal the three-dimensional structure of the pure protein. The finalized structure will include functional regions, active sites, and the conformation determining their function.

I have purified protein involved in Sialic acid and Rhamnose biosynthesis metabolism. Pathogenic bacteria use these metabolic products to evade the host immune system. I have learned a great deal about the structure and function of proteins and gained valuable laboratory skills. I am excited about the future research I will accomplish with this knowledge.

Keyword(s):

Protein Purification, Structural Analysis, Functional Analysis

Mentor(s):

Ramaswamy Subramanian (Science); Vijayan Dhanabalan (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 306
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Expression and Purification of Nucleolin Proteins for X-ray Crystallographic Study

Author(s):

Carson Huber† (Science, JMHC)

Abstract:

c-Myc is one of the most important oncogenes that is deregulated in about 80% of cancers. G-quadruplex is a globular DNA secondary structure. G-quadruplex formed in the c-Myc promoter region (MycG4) functions as a transcription silencer and is an attractive anticancer drug target. Nucleolin was discovered as a major MycG4 binding protein. It shows a remarkably high binding affinity for MycG4 and can repress the activity of the c-Myc promoter. Nucleolin's central RBD domain containing four RNA binding domains (NCL1234) is shown to be the high affinity minimal binding domain with MycG4. Fab is widely used to facilitate crystallization and we have discovered Fabs that specifically bind the NCL1234-MycG4 complex using a phage display screening. For my SURF research, I am working on the expression and purification of wildtype NCL1234 and its various mutants, as well as multiple Fab proteins. I expressed these proteins in E.coli bacteria cells. The NCL1234 proteins were purified by FPLC using Histrap affinity column, Q-seph ion-exchange column and size exclusion column. Fabs were purified by FPLC using protein L affinity column. I am able to obtain the proteins with large quantities and high purity, which are critical for structure study. I will use the purified NCL1234 and Fab proteins for NCL1234-MycG4-Fab ternary complex which will be used to set up crystallization trays for X-ray crystallographic structural study. Molecular level details of nucleolin protein recognition of MycG4 is important to understand MycG4 and nucleolin functions and help develop MycG4-targeted cancer therapeutics.

Keyword(s):

c-Myc, Promoter G-Quadruplex, Nucleolin Protein, Structure, Drug Target

Mentor(s):

Danzhou Danzhou (Pharmacy); Luying Chen (Pharmacy)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 307
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Sustainable Adhesives derived from Plant Polymers

Author(s):

Logan Kitts† (Science); William Lock Falcon‡ (Science); Emma Jeffries‡ (Science); Maren Gingrich‡ (Science)

Abstract:

Zein protein is a polymer found in corn and when mixed with plant phenolic compounds such as lignin and tannic acid, create an adhesive replacement for synthetic adhesives that can perform on par with said synthetic adhesives in a variety of environments. These plant-based adhesives can be more cost effective, environmentally sustainable, biodegradable, and non-toxic.

In this project, the zein protein-based adhesives are evaluated at different pHs. Each pH sample is tested through lap shear testing, and each sample is kept in a variety of environments such as at room temperature, underwater, and oven cured prior to testing. The adhesion data from resulting lap shear testing can be related to composition, strength, color, pH, and age of the sample. Fourier-transform infrared spectroscopy (FTIR) is also used analyze samples from a molecular view to find and create further correlations between composition, strength, color, pH, and age of the samples.

The results of the testing showed promising results for use of the zein protein-based adhesives in oven cured and room temperature environments for increased strength. Results also showed that underwater samples containing lignin seemed to decrease in strength over various samples.

Further testing on similarly correlated formulations could open a future path forward in providing plant-based adhesives as an environmentally safe and non-toxic alternative to synthetic adhesives with little to no loss in strength.

Keyword(s):

Zein Protein, Lignin, Tannic Acid, Adhesives, Sustainable

Mentor(s):

Gudrun Schmidt (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 308
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Stereotyping and Intersectionality in Media Coverage of Confirmations to the United States Supreme Court

Author(s):

Bryn Kozuch† (HHS, Liberal Arts)

Abstract:

I examine media coverage of the US Supreme Court confirmation progress. My work continues a previous study which notes that Justice Sonia Sotomayor's coverage differed from that of the other justices confirmed since Justice Sandra Day O'Connor. The coverage about Sotomayor is more negative than her counterparts and more frequently mentioned her race and gender, leading the original study to conclude that journalists were influenced by her status as both an ethnic minority and a woman. I analyze the coverage of the four justices confirmed after Justice Elena Kagan: Neil Gorsuch, Brett Kavanaugh, Amy Coney Barrett, and Ketanji Brown Jackson. Using content analysis, I examine news coverage by the Washington Post, Associated Press, New York Times, and USA Today. Following the results of the previous study, We expect coverage of Ketanji Brown Jackson to be similar to that of Sotomayor due to journalists relying on stereotypes and biases as a reaction to her own intersectionality.

Keyword(s):

Intersectionality, Supreme Court, Media Coverage, Stereotypes

Mentor(s):

Rosalee Clawson (Liberal Arts); Terri Towner (Oakland University)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 309
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Factors affecting bacterial growth in home hydroponics systems

Author(s):

Alex Mate† (Engineering); Madelyn Whitaker‡ (Engineering); William Townsend‡ (Engineering); Emily Spicuzza‡ (Agriculture)

Abstract:

Redacted.

Keyword(s):

Hydroponics, Microbiome, Kratky Method

Mentor(s):

Caitlin Proctor (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 310
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Design of portable device for fluorescent/colorimetric scanning image analysis applied to point-of-care lateral-flow diagnostics

Author(s):

Jhon Brandol Munoz Romero† (Engineering)

Abstract:

Redacted.

Keyword(s):

Point-Of-Care, Diagnostics, Image-Analysis, Portable

Mentor(s):

Gabriel Aguirre Cruz (Engineering); Lia Stanciu (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 311

Presentation Time: 7/27, Session 2: 1pm-2:30pm

Validation of a Canine C-Reactive Protein Immunoassay

Author(s):

Lorraine Prevost† (HHS, JMHC)

Abstract:

C-reactive protein (CRP) is an acute phase protein produced in the liver in response to systemic inflammation. As a more sensitive marker of inflammation in dogs than traditionally used leukograms, CRP is a desirable addition to diagnostic profiles. This study aimed to confirm the validity of the Gentian canine C-reactive protein (cCRP) immunoassay on the PVM Clinical Pathology Lab's Vitros 4600 chemistry analyzer. Serum from 108 dogs was used for a correlation study with the previously validated assay on Cornell University Animal Health Diagnostic Center's Roche Cobas C510 chemistry analyzer. Precision, linearity, and interference studies were also performed. Data obtained from the Vitros 4600 correlated strongly with the Cobas C501 (R2 = 0.9922); however, a negative systemic bias (5.5 mg/dl) was observed and Bland-Altman plots revealed proportional bias. Precision was very good with inter-assay CVs of 2.82 & 2.01 and intra-assay CVs of 2.39 & 3.43 for low and high values, respectively. Linearity was excellent at low and high limits with all R2 >0.998. Interference from lipemia, icterus and hemolysis was negligible at the concentrations tested. Correlation with the previously validated cCRP assay and the observed performance metrics (precision, linearity, interference) support the use of this cCRP assay in the Purdue Clinical Pathology Lab. However, the observed bias on the Vitros 4600 necessitates the establishment of an independent reference interval, currently in development. Once complete, clinicians and researchers can utilize this sensitive diagnostic and monitoring tool for canine inflammatory disease.

Keyword(s):

C-Reactive Protein, Validation, Canine, Inflammation

Mentor(s):

John Christian (Veterinary Medicine); Amanda Bettag (Veterinary Medicine)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 312
Presentation Time: 7/27, Session 2: 1pm-2:30pm

An Interdisciplinary Evaluation of HPV Self-sampling as a Modality to Increase Screening Uptake Among Hispanic Women in Indiana

Author(s):

Sathveka Sembian† (Engineering)

Abstract:

Cervical cancer remains the fourth most leading cancer in women on a global scale. At least 95% of cervical cancer develops from human papillomavirus (HPV) infection. HPV DNA tests are used as routine screening for the early detection of high-risk HPV (hrHPV) strains (eg, HPV16). Despite recent advances in screening, Hispanic women present with a 40% higher rate of cervical cancer diagnosis compared to non-Hispanic whites. Such disparities continue at the state-level, as Indiana ranks second in the nation for the highest cervical cancer incidence rate for Hispanic women (12.2 per 100,000 women), as compared to 9.7 for the U.S (as of 2019). Such disproportionate burden may correlate with lack of transportation, limited knowledge and awareness, and several other sociocultural barriers. The development of a rapid and accurate in-clinic HPV self-sampling test may alleviate such barriers and improve screening uptake. To explore stakeholders' perspectives, interview and survey data were collected from Indiana community members and clinicians in late 2021-22. Preliminary results reveal that lack of self-efficacy emerged as a barrier, whereas "increased comfort" and "saves time" emerged as facilitators in the context of HPV self-sampling at the clinic. Additionally, a variety of self-collection methods (including brushes, swabs, and cell lysis reagents) will be evaluated in their ability to reliably collect samples for DNA detection. Thus far, saponin and TritonX100 are demonstrating efficacy in lysing cells to free the virus DNA, without interfering with downstream DNA detection.

Keyword(s):

HPV Testing, Cervical Cancer Screening, Self-Sampling, Women's Health Promotion, Under-Screened Population

Mentor(s):

Natalia Rodriguez (HHS); Jacqueline Linnes (Engineering); Luke Brennan (Engineering); Layla Claure (HHS); Lara Balian (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 313
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Sexual dimorphism in early developmental stages of a non-human biting mosquito, Uranotaenia lowii

Author(s):

Krisha Shah† (Science)

Abstract:

Sexual dimorphism is widespread throughout the animal kingdom, and mosquitoes provide an important avenue for exploring the biological basis of this phenomenon. These insects display sexually dimorphic traits that play a key role in disease dynamics, making them an ideal subject for studying morphological differences between the sexes. In mosquitoes, understanding sexually dimorphic traits during developmental stages such as the pupae is particularly relevant as it can provide new targets for efficient vector control strategies. However, our current knowledge of sexually dimorphism in non-human biting mosquitoes is limited, as most research has concentrated on anthropophilic mosquitoes. To address this knowledge gap, we investigated Uranotaenia lowii, a small mosquito species that is specialized on feeding on frogs. By using morphometric analyses, focusing on cephalothorax length at the pupal stage as a key indicator of size for differentiating between the sexes, we examined pupae sorting to evaluate sex identification success upon reaching adulthood. Given that female and male adult Ur. lowii exhibit differences in abdomen shape, this trait was also examined to identify the sex of individuals as pupae. In addition to broadening our understanding of the ontogeny of sexual differences, being able to separate individuals by sex will contribute to future investigations involving focusing on female behavior as they determine disease prevalence.

Keyword(s):

Mosquito Species, Sexual Dimorphism, Pupal Stage, Sex Identification, Morphology

Mentor(s):

Ximena Bernal (Science); Richa Singh (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 314
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Dual Protection Use Among Sub-Saharan African Adolescents and Youth to Prevent STI/HIV and Unintended Pregnancy

Author(s):

Alexandra Wildridge† (HHS, Science, JMHC)

Abstract:

Introduction: Within Sub-Saharan Africa, adolescents are disproportionately affected by HIV infection and unintended pregnancy. This review examines commonalities amongst interventions to better understand dual protection strategies' used to address this complex issue.

Objectives: The purpose was to conduct a systematic review of studies examining intervention outcomes on condom and dual protection use within Sub-Saharan adolescents and youth.

Methods: Included study criteria: a) published between 2000 and 2023; b) report quantitative data on dual protection interventions with the goal to enhance prevention of unintended pregnancy and sexually transmitted infections including HIV; c) located in Sub-Saharan Africa; d) consider dual protection a single method that provides protection against STI/HIV and unintended pregnancy, or a combination of methods. Overviews of treatment models, case studies, and qualitative studies were excluded. Utilized studies focused on adolescents and youth. The review included 23 peer-reviewed journal articles.

Results: A majority (61%) of studies examined effects of intervention by comparing baseline and post-intervention self-reports regarding condom self-efficacy and/or condom use. Intervention curriculum often discussed attitudes regarding condom use and HIV prevention. Studies often reported change in attitudes and knowledge but none or little in behavior. Limited reporting regarding impact of demographics on findings.

Conclusions: As most studies focused primarily on condom use as dual protection, a majority of the studies reported an increase in self-reported condom self-efficacy but limited change in risky behaviors for pregnancy and/or HIV infection. Due to self-reporting and small populations, generalizability is limited, prompting for further research to examine possible methods of intervention.

Keyword(s):

Dual Protection Intervention, HIV Prevention Intervention, Sub-Saharan Africa, Adolescents

Mentor(s):

Jennifer Brown (HHS); Stephen Beegle (HHS); Dylanne Twitty (University of Cincinnati)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 315
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Oxalic Acid Production through Aspergillus Niger Fermentation of Corn Stover Slurry

Author(s):

Zhujin Xia† (Agriculture, Engineering)

Abstract:

Increasing the value of agricultural products has become a pressing problem nowadays, and much focus has been shifted to the agricultural residues. Corn stover as a biomass is rich in lignocellulose and has the potential to be used as a feedstock for production of biofuels and biochemicals. In this research, liquefaction of the corn stover was applied to generate a special slurry for liquid phase fermentation to oxalic acid, which is widely employed in the metal industry. Oxalic acid is currently produced from petroleum. This work demonstrates manufacture of this di-acid from a renewable resource, i.e. cellulose in corn stover, by using an enzyme to create a low viscosity slurry. The liquefied slurry was then fermented with a strain of Aspergillus niger able to produce oxalic acid. Quantification of oxalic acid from the fermentation broth was done using liquid chromatography (HPLC). The research demonstrates the proof of concept that a corn stover slurry, inoculated with A. niger fungi, is able to generate 14 g/L oxalic acid after 12 days, and that liquified corn stover is a great substrate for organic acid production thereby giving a practical example of adding value to lignocellulosic, agricultural residue.

Keyword(s):

Biomass, Oxalic Acid, Fermentation, Liquefaction

Mentor(s):

Mike Ladisch (Engineering); Fernanda da Cunha (Engineering); Diana Ramirez Gutierrez (Engineering); Xueli Chen (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 316
Presentation Time: 7/27, Session 2: 1pm-2:30pm

The Role of ALDH2 in Aldehyde-Mediated Pathology in Spinal Cord Injury

Author(s):

David Yin†

Abstract:

Oxidative stress plays a significant role in functional loss after spinal cord injury(SCI). As a factor of oxidative stress, lipid-peroxidation releases acrolein, one of the most destructive aldehydes, which damages proteins, lipids, and DNA. Mitochondrial aldehyde dehydrogenase 2(ALDH2) is a critical enzyme that detoxifies acrolein endogenously. However, around 600 million people have mutations, primarily known as "Asian flush," that lower the enzymatic activity of ALDH2. In spinal cord injury, individuals that carry this mutation could lead to the accumulation of acrolein and other toxic aldehydes, worsening the pathological damage associated with the secondary injury and recovery. The first aim of this study is to determine ALDH2*2 mutants' susceptibility to acrolein accumulation and poor recovery after SCI. The ultimate goal of this study is to validate the acrolein-clearing and neuroprotective role of ALDH2 in SCI. By using the transgenic (TG) ALDH2*2 deficiency mouse model that recapitulates the real genetic condition that exists in humans, we observed a more exaggerated acrolein build-up, inflammatory response in the spinal cord, and behavioral dysfunctions when compared to the wild type (WT) after SCI. We also planned to implement an ALDH2 enzyme agonist to alleviate such dysfunctions by rescuing the ALDH2 activity and reducing the level of acrolein.

Keyword(s):

Spinal Cord Injury (SCI), Oxidative Stress, Lipid-Peroxidation, Aldehyde Dehydrogenase 2 (ALDH2)

Mentor(s):

Riyi Shi (Veterinary Medicine); Siyuan Sun (Veterinary Medicine)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 317
Presentation Time: 7/27, Session 2: 1pm-2:30pm

CILMAR

Empathy and Teamwork: Perspectives of Nursing and Science Undergraduates

Author(s):

Nathan Bitner† (Engineering, JMHC)

Abstract:

With increasing globalization, employers expect fresh graduates to showcase intercultural competence and cross-cultural communication abilities. Research has identified that developing empathy can help young graduates to become mindful of cultural differences and behave appropriately to mitigate them. In this study, we intend to compare perspectives of empathy between science (N=1762) and nursing (N=187) undergraduates. The students in both groups completed an online self-paced module on intercultural collaboration and empathy. At the end of the module, students were required to complete a capstone reflection assignment. The responses of the students were analyzed using the Latent Dirichlet Allocation (LDA) topic modeling technique and prominent themes present in their responses were identified. Topic modeling is an unsupervised machine learning algorithm that identifies clusters known as topics based on the frequency co-occurrence of words in the documents of the textual collection. Each topic generated by the LDA model was qualitatively analyzed by researchers to identify emerging themes for science and nursing students. Moreover, Empatico's empathy framework, which categorizes empathy into behavioral, cognitive, and emotional areas was used to identify the associated empathy area with each theme that emerged. The results of the analysis revealed that science students' responses primarily contained instances of behavioral and cognitive empathy whereas nursing students mainly showed instances of emotional empathy along with cognitive and behavioral empathy. Overall, the results of the study indicate that nursing students express empathy in a more emotional manner than science students.

Keyword(s):

Empathy, Intercultural Teamwork, Qualitative Analysis, Topic Modelling, Latent Dirichlet Allocation

Mentor(s):

Aparajita Jaiswal (Ofc of Corp and Glbl Partnersh); Gaurav Nanda (Polytechnic Institute)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 318
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Colombian Research Scholars Program

Systematically Detecting Packet Validation Vulnerabilities in Embedded Network Stacks

Author(s):

Ricardo Andrés Calvo Méndez† (Universidad Nacional de Colombia); Parth Doshi* (Engineering); Kyle Alexander Robinson* (Engineering)

Abstract:

Embedded Network Stacks (ENS) enable communication with cyber-physical systems. Many defects in ENS are high-severity cybersecurity vulnerabilities: they are remotely triggerable and can impact the physical world. The most common automated approach to detecting ENS defects is feedback-driven random dynamic analysis (“fuzzing”), a costly and unpredictable technique. While prior research has shed light on the characteristics of defects in many classes of software systems, no study has described the properties of known ENS defects nor identified a systematic technique for exposing them.

This paper provides the first systematic characterization of vulnerabilities in ENS (61 defects across 6 ENS). Most ENS defects are concentrated in two layers of the network stack, occur in different states in the network protocol, and are triggered by only 1-2 modifications to a single packet. We therefore propose a novel systematic testing framework that focuses on the transport and network layers, uses seeds that cover a network protocol, and systematically modifies packet fields. We evaluate this framework on 4 ENS and find it replicates 12 of the 14 reported IP/TCP/UDP vulnerabilities. On recent versions of these ENSs, it discovered 7 novel defects during a bounded systematic test that covered all protocol states and made up to 3 modifications per packet. We found defects in 3 of the 4 ENS we tested that had not been found by prior fuzzing research. Our results suggest that fuzzing should be deferred until after systematic testing is employed.

Keyword(s):

Testing, Cybersecurity, Embedded Systems, IoT, Networking

Mentor(s):

James Davis (Engineering); Paschal Chukwuebuk Amusuo (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 319
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Colombian Research Scholars Program

Insights into gut microbial interactions: mathematical modeling of inulin consumption as carbon source

Author(s):

Mariana Guzman Sanchez† (Science)

Abstract:

Gut microbial interactions are influenced by the variety of dietary substrates available, as different microbes show variations in substrate preferences. By understanding these preferences, it is possible to selectively stimulate growth and activity of beneficial gut microbes. Inulin-type fructans and fructooligosaccharides are nondigestible, highly fermentable carbohydrates that can be hydrolyzed by a multitude of microorganisms. To explore the competition mechanisms related to complex polysaccharide degradation, a modeling approach is proposed. This research aims to study the consumption of inulins as carbon sources by Klebsiella pneunomiae, Escherichia coli and Bifidobacterium dentium to build a mathematical model that predicts and simulates microbial interactions. Monoculture batch fermentations were conducted under aerobic and anaerobic conditions using FB and M9 buffer supplemented with glucose, fructose, sucrose, kestose, and CLR at 0.4% concentration. Cultures were incubated for 8 hours at 37ºC, and samples were collected at 1-hour intervals. Bacterial growth was assessed by measuring optical density at 600 nm, microbial biomass was determined by dry weight through oven drying, and substrate concentration was analyzed using High-Performance Liquid Chromatography. Results revealed significant differences in maximum growth rates and yields among the various substrates investigated, as well as among the bacteria tested. Notably, the utilization of sucrose led to higher growth rates and yields, outperforming glucose and fructose. These differences are linked to substrate preferences, which are based upon degradation capabilities, metabolic pathways, and enzyme expression patterns. By comprehending the individual growth kinetics of bacteria, it is possible to forecast the outcomes of competition in future experiments.

Keyword(s):

Gut Microbial Interactions, Mathematical Modelling, Inulin-Type Fructans, Substrate Preferences

Mentor(s):

Steve Lindemann (Agriculture); Rubesh Raja (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 320
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Colombian Research Scholars Program

Solution-Processed BaZrS3 with low-cost molecular precursors

Author(s):

Alison Mesa† (Engineering)

Abstract:

Chalcogenide perovskites have garnered significant attention as promising materials for semiconductor applications, primarily due to their favorable optoelectronic characteristics and stability. Among these materials, BaZrS3 has emerged as a highly prospective candidate for implementation as a top layer in multi-junction photovoltaic devices. Various synthetic approaches have been proposed to produce BaZrS3, encompassing solid processing, colloidal nanoparticles, and solution deposition using inks. However, the existing approaches have encountered significant hurdles, including the requirement for high temperatures and the utilization of expensive organometallic molecular precursors. Herein, we present the successful synthesis of BaZrS3 via solution processing, employing cost-effective molecular precursors, namely barium acetylacetonate and zirconium acetylacetonate, dissolved in an organic solvent. The synthesis was conducted at 575°C for one hour. The successful fabrication of BaZrS3 using this method underscores its potential as an economical approach for producing this semiconductor material.

Keyword(s):

Chalcogenide Perovskites, Solution Deposition, BaZrS3, Low-Temperature, Semiconductor

Mentor(s):

Rakesh Agrawal (Engineering); Shubhanshu Agarwal (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 321

Presentation Time: 7/27, Session 2: 1pm-2:30pm

Colombian Research Scholars Program

Verification of an Extracellular Vesicle Isolation Protocol from Blood Plasma

Author(s):

Ricardo Pardo† (HHS)

Abstract:

Verification of an Extracellular Vesicle Isolation Protocol from Blood Plasma

Objective: Assessment of the Functionality of a Protocol for Isolating Extracellular Vesicles from Blood plasma

Introduction

Extracellular vesicles (EVs) are particles originating from cells, related to a wide range of physiological or pathological roles. Investigating EVs isolated from blood holds significant importance since blood participate in many physiological processes and EVs transport biological information.

Methods:

Firstly, arterial and venous punctures were performed to obtain blood samples. Subsequently, a two-step centrifugation process was employed to separate the EVs from other components of the blood. To further purify the EVs, size exclusion chromatography was conducted using qEV columns (qEVORIGINAL LEGACY, Izon Science Ltda. New Zealand) and 26 fractions were obtained. To determine the concentration of proteins, a BCA assay was performed, and nano sight was used to calculate the EV´s concentration. This comprehensive methodology ensures the efficient isolation and purification of EVs from blood, providing valuable samples for further analysis and investigation.

Results:

The equation $y = 0.0003x + 0.6103$ was obtained, resulting in a value of R was 0.9919. The protein concentration in arterial blood was 493.2203 μg/mL, while in venous blood it was 410.2203 μg/mL, indicating that the extracellular vesicles were collected in the expected fractions of their respective columns. In arterial blood the nano sight showed 1840012 particles/mL (30-130 nm), and 885494.8 particles/mL (>130 nm), showing the presence of EV`s.

Conclusions:

The essay confirmed the effectiveness of the employed protocol for isolating extracellular vesicles (EVs) from blood samples.

Keyword(s):

Vesicles, Extracellular, Blood, Chromatography, Absorbance

Mentor(s):

Tim Gavin (HHS); Ivan Alonso (HHS); Linda Adeyemo (HHS); Lundon Burton (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 322
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Colombian Research Scholars Program

Synthesis and Evaluation of Protein N-terminal Acetyltransferase D Inhibitors

Author(s):

Juan Raffaeli† (Pharmacy)

Abstract:

N-terminal acetylation is an essential protein modification, and it is involved in protein-protein interactions, protein complex formation, cellular apoptosis, rDNA transcriptional regulation, and protein subcellular localization. This modification is catalyzed by Protein N-terminal acetyltransferases (NATs). NatD is a highly selective NAT because its only known substrates are histones H2A and H4. Inhibition of NatD has appeared as a new therapeutic target due to its oncogenic activity in primary human lung and colorectal cancer. This study aims to discover potent and selective small NatD inhibitors. Previously, we established a ThioGlo4 fluorescence assay to conduct high throughput screening and identified a hit compound YH086 with IC50 of 150 μM. To understand the structural relationship activity of YH086 and optimize the inhibitory activities, we applied a medicinal chemistry approach and synthesized more than 40 analogs using Curtius rearrangement reaction. We have improved the IC50 from 150 μM to a single-digit micromolar in biochemical Thioglo4 fluorescence assay. Our ongoing work will validate our inhibitors with thermal shift assay, cellular thermal shift assay, and cellular inhibitory activities against lung and colorectal cancer cells. We anticipate that discovering inhibitors can help us further understand the biological roles of NatD.

Keyword(s):

NatD, Colorectal Cancer, Lung Cancer, Inhibitors, Epigenetics

Mentor(s):

Rong Huang (Pharmacy); Yi-Hsun Ho (Pharmacy)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 323
Presentation Time: 7/27, Session 2: 1pm-2:30pm

DUIRI

Scanning Electron Microscopy Analysis of Renal, Aortic, and Cardiac Tissue

Author(s):

Sarah Grev† (Engineering); Claudia Albrecht* (Liberal Arts, JMHC)

Abstract:

Scanning electron microscopy (SEM) is a powerful tool that provides detailed insight into objects invisible to the human eye. As the name suggests, an electron beam is used to create an image down to the nanometer scale. The beam focuses on the surface of a sample using lenses in the electron column. In this project, SEM is used to study three types of tissue. First, the glomerulus, found in the kidney and primarily responsible for filtering blood, is examined. After an induced left renal vein (LRV) stenosis, SEM was used to observe changes to the glomeruli. Differences in the left and right kidney glomeruli were noted, with right glomeruli appearing intact, while left glomeruli were broken down. These findings are vital for preeclampsia studies, where these glomerular changes are likely a result of renal ischemia induced by the LRV stenosis. Second, cross sections of the descending aorta with a type B aortic dissection are examined under SEM. High magnification images of these cross-sections reveal the morphology of red blood cell types in the false lumen. These findings will be used for future studies in evaluating medical interventions for aortic dissection. Third, tissue from the left ventricle and atrium of the heart is examined. SEM will detect if hypertrophy caused by thoracic aortic constriction causes changes to cells lining the endocardium. This project demonstrates that SEM provides high resolution and magnification images unseen by other imaging modalities, revealing new information that is pivotal to current and future studies.

Keyword(s):

Scanning Electron Microscopy, Glomeruli, Aortic Dissection, Cardiac Hypertrophy

Mentor(s):

Craig Goergen (Engineering); Luke Schepers (Engineering); Jennifer Anderson (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 324
Presentation Time: 7/27, Session 2: 1pm-2:30pm

DUIRI

ISF: Data-driven Discovery of the Nonlinear Schrödinger Equation as a Governing Equation for Extreme Weather Events

Author(s):

William Messman† (Science, JMHC)

Abstract:

The purpose of this project is to provide a data-based approach for determining between multiple competing models for atmospheric blocking via the use of sparse regression methods such as PySINDy and Subsampling Sparse Bayesian Regression (SubTSBR) for identifying the governing equations from the data. This project examined the effectiveness of such methods in correct identification of governing equations through their application to partial differential equations relevant to the current models of atmospheric blocking such as the Burgers equation and the nonlinear Schrodinger equation, both with and without the addition of noise to the system. We then apply the regression methods to both simulation and real atmospheric data for discovery of the underlying governing equation. We have found both the SubTSBR and PySINDy approaches to be effective on identification the Burgers equation for noisy data and have determined that the PySINDy approach is effective on the identification of the nonlinear Schrodinger equation with noisy data, providing confidence in the method's ability to accurately identify a governing equation for atmospheric blocking from noisy real world data. Atmospheric blocking is thought to be involved in extreme weather events such as heat waves, and so a better understanding of the driving equations behind this phenomenon will help to better understand, predict, and plan for such events in the future.

Keyword(s):

Data Science, Applied Math, Atmospheric/Climate Science, Machine Learning, Global Sustainability

Mentor(s):

Lei Wang (Science); Guang Lin (Science); Zhaoyu Liu (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 325
Presentation Time: 7/27, Session 2: 1pm-2:30pm

DUIRI

Life Cycle Assessment of Sustainable Construction Materials

Author(s):

Kah Soon Ngooi† (Engineering)

Abstract:

The construction material industry is recognized as one of the largest and most energy-intensive sectors globally, contributing significantly to carbon emissions. Specifically, the cement and concrete industry alone accounts for approximately 1,500 megatons/year of CO2 emissions, translating to around 0.8 to 1.0 ton of CO2 per ton of cement produced. This makes cement production responsible for approximately 8% of global carbon emissions, making it a significant contributor to climate change. To address these concerns, this project aims to investigate the environmental impact of construction materials through the implementation of a life cycle assessment (LCA) model. LCA is a methodology used to assess the environmental impacts associated with all stages of a commercial product, process, or service's life cycle. By utilizing LCA, we can analyze and compare the environmental friendliness of different construction materials, such as Ordinary Portland Cement (OPC), Portland Limestone Cement (PLC), and other types of cement, during the manufacturing process. Additionally, the project will employ the Life Cycle Impact Assessment (LCIA) process to evaluate the potential consequences of the inventory data obtained from the LCA. LCIA allows decision-makers and professionals to gain a deeper understanding of the environmental harm resulting from resource consumption and emissions, including impacts like global warming, stratospheric ozone depletion, and terrestrial acidification. These potential impacts will be evaluated to determine which construction materials are more sustainable and environmentally favorable. It is important to continue future studies that build upon this model in order to provide compelling results and further insights into sustainable construction practices.

Keyword(s):

Construction Materials, Climate Change, Life Cycle Assessment (LCA), Sustainability, Environmental Impact

Mentor(s):

ChengCheng Tao (Polytechnic Institute); Jan Olek (Polytechnic Institute)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 326
Presentation Time: 7/27, Session 2: 1pm-2:30pm

DUIRI

Harmful Algal Bloom Predictions for Midwestern Waters

Author(s):

Petra Schwaab† (Engineering)

Abstract:

Environmental and anthropogenic activities create increasing pressure on inland water quality in the Midwestern U.S. However, current harmful algal bloom (HAB) monitoring is expensive and labor-intensive. This has led to increasing interest in improving HAB monitoring using remote sensing data products. This study aims at developing a method to monitor the occurrence of HABs in reservoirs of the Wabash watershed: Freeman, Shafer, Mississinewa, and Salamonie. The objectives of this study were to (a) determine the optimal spectral index threshold to identify the cyanobacterial blooms, (b) reveal the spatiotemporal distribution of HAB using spectral indices obtained from UAV and satellite imagery, (c) compare the applicability of various remote sensing products including Landsat 8 & 9, Sentinel 2, PlanetScope and UAVs in inland waters, and (d) analyze the impact of environmental variables on the occurrence of HABs. Samples have been collected from the shore, bridges, and boats to allow for coverage of the different conditions these reservoirs may experience. Our preliminary results show that: (1) the HABs in the Wabash watershed usually bloom during June and July and occur near the inlet from agriculture and residential areas, (2) PlanetScope and UAVs, which have a higher spatial resolution, are more suitable for inland water because data from these sensors are less likely to be affected by mixed pixels, (3) Environmental variables like discharge and temperature have influence on the occurrence of HABs.

Keyword(s):

Water Quality, Harmful Algal Blooms (HABs), Remote Sensing, Unmanned Aerial Vehicles, Prediction Model

Mentor(s):

Melba Crawford (Engineering); Cary Troy (Engineering); Keith Cherkauer (Engineering); Zhi Zhou (Engineering); Sheng Tan (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 327
Presentation Time: 7/27, Session 2: 1pm-2:30pm

DUIRI

Creating Connections to Natural Landscapes in Agroecological Settings

Author(s):

Nellie Walthery† (Science)

Abstract:

Industrial-scale agriculture disconnects people from their food systems while creating isolated pockets of native habitat. When planning for wide scale sustainable transitions, even as the base principles are in discussion, their implementation often runs into cultural and political roadblocks. At the same time, participation in local, small-scale gardens and farms persist, building from past traditions while allowing room for new viewpoints to develop. The everyday actions and motivations of these spaces are often emblematic of grassroots action already in occurrence. Small scale agricultural sites foster environments that bridge greater connections to local ecosystems and demonstrate the reciprocal support systems at work between agriculture, ecology, and a community at large.

My research investigated the connections among people and their environments at three local foods initiatives in Greater Lafayette: Wea Creek Orchard, a local heritage orchard, the Grow Local sharing garden network , in downtown Lafayette, and the Purdue Student Farm. Each exemplifies different aspects of agroecology and agricultural education. I used participant observation, surveys, and walking interviews to examine how (and what) connections to local landscapes are built. I found that hands-on community food initiatives link people with their food systems and their environment, while also contributing to shifts in worldview and value systems.

Keyword(s):

Agroecology, Human-Nature Relationships, Sustainability, Community Gardens, Political Ecology

Mentor(s):

Andrew Flachs (Liberal Arts); Steve Hallett (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 328
Presentation Time: 7/27, Session 2: 1pm-2:30pm

DUIRI

Methods to study activity dependent protein synthesis in autism spectrum disorder

Author(s):

Megan Webb† (Science)

Abstract:

It is estimated by the World Health Organization that 1 in 100 children have autism spectrum disorder (ASD), a condition characterized by neurological differences that may impact a person's learning or behavior. Clinically, ASD symptoms are alleviated with behavioral or pharmacological therapies, however, not all patients respond to these interventions. Deep brain stimulation (DBS) is a promising treatment of Parkinson's disease that could also be effective in treating ASD. SynGAP1 is a protein involved in neuronal action that is crucial in the regulation of synaptic plasticity. Mutations in the SYNGAP1 gene causing haploinsufficiency can result in the manifestation of ASD symptoms. This study aims at gathering information on the potential of using a Syngap1+/- mouse model to determine whether DBS can counter neurological differences between mice with haploinsufficiency and wild type littermates. Histology slides were analyzed for lesioning from previous surgeries performed in which electrodes were placed for DBS. To gain baseline data before DBS, behavioral tests were conducted on both male and female wild type and Syngap1+/- mice to understand differences. To correlate behavioral results with protein synthesis, labeling of newly synthesized proteins was optimized using azidohomoalanine. While still examining behavioral results, inspection of histology slides showed no evidence of brain lesioning in mice that were to have undergone DBS. Additionally, SDS-PAGE analysis of azidohomoalanine injections revealed more injections administered on subsequent days provides optimal proteomic labeling. With this information as a baseline, further research can be conducted where DBS is performed followed by behavioral studies and proteomic analysis.

Keyword(s):

Autism Spectrum Disorder, Deep Brain Stimulation, Syngap1

Mentor(s):

Karin Ejendal (Engineering); Tamara Kinzer-Ursem (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 329
Presentation Time: 7/27, Session 2: 1pm-2:30pm

DUIRI

Pre-differentiation short-chain PFAS exposure induce neurotoxicity via altering ER vulnerability in dopaminergic-like neurons

Author(s):

Xihui Zhao† (Engineering)

Abstract:

Per- and polyfluorinated alkyl substances (PFAS) are a large group of surface-active compounds, which are commonly used in industrial processes and everyday consumer products, affecting the majority of the population. The adverse health effects associated with conventional long-chain PFAS, include increased risks of cancer immune system dysfunction, and neurodegenerative diseases, which collectively led to the replacement of long-chain PFAS such as PFOA and PFOS with short-chain alternatives such as PFBA and PFBS. The health implications of short-chain PFAS, particularly neurotoxicity, however, remains understudied posing long-term health risk in the exposed population. In this study, we exposed progenitor like cells, SH-SY5Y, to 0.4 and 4 μg/L of PFBS or PFBA for four days. We then removed the PFAS upon the onset of differentiation. After 14 day differentiation, we characterized neuronal network and assessed the intensity of tyrosine hydroxylase (TH). Altered TH intensity was observed after prior exposure to short-chain PFBA or PFBS. In addition, chemicals known to target mitochondria (MPP+) and endoplasmic reticulum (ER) (Tunicamycin) were used to test vulnerability after developmental PFBA or PFBS exposure. Our results revealed that cells previously exposed to PFBA exhibited modified sensitivity to ER stimulation. We also assessed changes in epigenetic markers to understand the potential molecular targets contributing to the establishment of a persistent neurotoxic state in DA-like neurons after prior PFBA or PFBS exposure. Collectively, our results identified neurotoxicity of low-dose PFBA or PFBS exposure in human DA-like neurons following a developmental exposure scheme.

Keyword(s):

PFAS Exposure, Neurodegenerative Disease, Epigenome, Dopaminergic Neuron

Mentor(s):

Chongli Yuan (Engineering); Shichen Wu (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 330
Presentation Time: 7/27, Session 2: 1pm-2:30pm

DUIRI

Understanding worker preferences for decarbonized manufacturing jobs

Author(s):

Ellison Zhu† (Engineering); Dongting Cai‡ (Engineering)

Abstract:

The US steel industry contributes 2% of the nation's CO_2 emissions, which can be attributed to using coal for 80% of the industry's primary energy. Our research aims to develop ways to decarbonize the steel industry while accounting for the impacts of the transition on the industry. While a technological transition with economic considerations is crucial, it is also necessary to ensure a transition that is equitable for workers. Therefore, we keep steel-workers at the forefront of this study; the primary objective is to optimize for worker satisfaction while prioritizing decarbonization and achieving manufacturing goals profitably. We are conducting semi-structured interviews with steel-workers to gain insight into their schedules, pay rates, over-time and time-off. Themes from interviews will be transcribed and compared with ground theory code to detect steelworkers' most valued preferences. Interviews conducted thus far have revealed some consistent themes, with workers having a 4-on-4-off schedule; while this works for some, others prefer a schedule closer aligned with family. A redeeming quality is the pay/benefits in this industry, and the ability to advance in rank. A recurring disfavor is the schedule: as workers take time off, there is more overtime for those on shift. The results of our choice-based survey will help better align steel workers' work-life balance with their ideal schedule.

Keyword(s):

Steel-Workers, Interview, Optimize, Transition, Schedule

Mentor(s):

Rebecca Ciez (Engineering); Meenakshi Narayanaswami (Engineering); Ivan Arturo Nunez (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 331
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Growing Entrepreneurially-Minded Researchers REU

Development and Implementation of a Miniaturized, Solar-Powered FPGA-Based Multi-sensor Platform for Farmed Animal Monitoring

Author(s):

Gabriel A Baquero† (University of Houston); Bianca Perez‡ (Polytechnic Institute); Ndongo Njie‡ (Princeton University)

Abstract:

Within the rapid advances in microelectronics, sensor technologies, and animal behavioral studies, there lies the potential for Field Programmable Gate Arrays (FPGAs) to revolutionize the methods used to monitor and understand animal behaviors. These semiconductor devices can be programmed or reprogrammed to the desired application or functionality after the manufacturing process. Backed by their versatility and speed, FPGAs enable a high level of digital computation, making them crucial to dynamic data acquisition and analysis. This research demonstrates the design and implementation of a data acquisition unit controlled with FPGA technology. The solar-powered unit houses several sensors, and measures only 25mm x 30mm x 5 mm. Serving as an advanced tool for real-time data collection of livestock animal behavior analysis. The system integrated FPGA is a Lattice ICE40 Ultra-Light, a suite of sensors including a temperature sensor, a light sensor, and an accelerometer which is all powered by a Gallium Arsenide solar cell. Furthermore, the FPGA coded hardware design has the possibility to enhance the capture and interpretation of real-time environmental and animal behavioral motion data, as well as contributing to continued device iterations, representing a stepping stone in improving animal health monitoring and enriching animal behavior research methodologies. Future research objectives could focus on miniaturizing the device further, integrating additional sensors for detecting gas emissions such as ammonia and methane, and incorporating a gyroscope to refine the precision of collected animal behavior data.

Keyword(s):

FPGA, Sensor Integration, Solar Power, Animal Behavior Analysis, PCB Design

Mentor(s):

Daniel Leon-Salas (Polytechnic Institute); Lisa Bosman (Polytechnic Institute)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 332
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Growing Entrepreneurially-Minded Researchers REU

Measuring the Transformation of SnOx Thin Films During the Annealing Process

Author(s):

Devon Fears† (Houston Christian University)

Abstract:

Synthesizing P-type SnOx (1≤x<2) thin films for their electrical properties is challenging because of the way that Tin atoms and Oxygen atoms in the film interact with each other. Mainly, studies that focus on using an annealing process to engineer the properties of SnOx vary temperature, time, and atmospheric conditions such as the pressure, or concentration of oxygen, and measure the properties before and after the annealing process. For example, a study by Hsu et al. (2013) found that by annealing SnOx with Rapid Thermal Annealing in a Vacuum Environment, the samples could transform from a highly resistive form with a resistivity of ~105 Ω·cm to a form with a resistance of around ~10 Ω·cm, which corresponded to the appearance of SnO crystals in the XRD study. In our work, the electrical resistivity of SnOx thin films have been measured during the annealing process in a vacuum environment with temperatures ranging from 100 to 200°C. For each test, the sample was annealed for at least 24 hours. The strain, and the electrical resistance, were simultaneously measured as well, but in an oxygen-rich, positive pressure environment. The films have not just shown that there is a decrease in resistance, but a sudden change around 1 hour of annealing at 200°C. This change confirms the existence of metastable p-type SnO in the film.

Keyword(s):

Thin Film, SnOx, Strain, Electrical Resistivity, In-Situ

Mentor(s):

Sunghwan Lee (Polytechnic Institute); Dong Hun Lee (Polytechnic Institute)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 333
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Growing Entrepreneurially-Minded Researchers REU

Market Viability and Design Analysis of Hydraulically Powered Bicycles

Author(s):

Quin Howell† (California State University, Chico); Ryder Michael† (Schreiner University); Emanuel Lugo† (University of Puerto Rico - Mayaguez)

Abstract:

The bicycle industry is poised for significant growth in the coming years. This growth is driven by factors such as escalating fuel costs, rising environmental and health awareness, and growing traffic congestion in urban areas. Additionally, the bicycle industry is experiencing increased demand for recreational and sporting activities, urbanization trends, and the rising popularity of electric bicycles (e-bikes).

While electrically assisted pedaling is driving growth in the cycling market, there exists ample opportunity for innovative and environmentally friendly alternatives. Most industry attention has focused on advancing e-bike technology, leaving other means of assisted pedaling relatively unexplored. This study delves into the application and market viability of fluid power technology for human powered vehicles, and specifically, bicycles. To assess consumer perception and market potential, a comprehensive survey is conducted, for validation of a favorable outlook for hydraulically powered bicycles (HPB). Furthermore, a working prototype undergoes a design analysis, providing current data and highlighting design challenges.

Challenges associated with hydraulically powering a bicycle are addressed and potential solutions to enhance practicality and market viability are presented based on the survey results. These findings present opportunities for companies and entrepreneurial individuals to capitalize on innovative, environmentally friendly alternatives to traditional e-bikes. By exploring the potential of fluid power technology in bicycles, this research contributes to the diversification of the bicycle industry and other recreational vehicles and offers a promising avenue for future sustainable transportation solutions.

Keyword(s):

Fluid Power, Bicycles, Market Viability, Design Analysis, Consumer Perception

Mentor(s):

Jose Garcia-Bravo (Polytechnic Institute)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 334
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Growing Entrepreneurially-Minded Researchers REU

Solar Energy and Community Resilience: Overview, Benefits, Challenges, and Opportunities

Author(s):

Amy LeGrande† (Engineering); Brandon Yonnie‡ (Engineering)

Abstract:

Amidst the ongoing climate crisis, the increase in extreme weather phenomena has led to a surge in power outages throughout the world. There is a growing need for improved community resilience within the electrical grids to manage these unforeseen events to sustain productivity, safety, and endeavors impacting the quality of life. Currently, the primary backup power resource is diesel generators, which are not only unreliable for long periods of time, but also release harmful greenhouse gases into the air. This major fault in current systems can cost millions in damages, disrupting the infrastructure that is relied upon so heavily. Given the magnitude of the problem and the gaps with current solutions, the authors propose a shift to integrating solar energy systems into community resilience strategies. This paper reviews the current literature highlighting the benefits, challenges, and opportunities for using solar energy to drive community resilience. This paper concludes by issuing a call to action that establishes a collaborative agenda toward prioritizing a shift from diesel generators to solar energy systems.

Keyword(s):

Climate Change, Community Resilience, Backup Power, Solar Energy, Power Grids

Mentor(s):

Lisa Bosman (Polytechnic Institute); Esteban Soto (Engineering); Gnanaprakash Athmanathan (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 335
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Growing Entrepreneurially-Minded Researchers REU

Design and Implementation of a Dual-Modality Printed Circuit Board for Sensor Data Visualization and Optical Communication in Agriculture

Author(s):

Ndongo Njie† (Princeton University); Bianca Perez‡ (University of Texas San Antonio); Gabriel A Baquero‡ (University of Houston)

Abstract:

This research presents a novel dual-modality printed circuit board (PCB) that combines sensor data visualization for farmers with code generation for optical communication. By integrating a Crystalfontz OLED display and an ATMega328P microcontroller, the PCB achieves these functionalities effectively. The Crystalfontz OLED display module offers a clear visualization of temperature, humidity, ammonia levels, and other measurements, while the ATMega328P microcontroller generates codes for optical communication. Rigorous design methodologies, including schematic design, component selection, and PCB layout optimization, ensure seamless integration of the dual-modality features. Software programming enables real-time visualization of sensor data and efficient code generation for optical communication. The proposed dual-modality PCB offers versatile functionality, empowering farmers to visually monitor sensor data and facilitating reliable optical communication. With a compact design measuring 45mm x 30mm, it seamlessly integrates into existing sensor systems, enhancing data visualization and communication efficiency. The Crystalfontz OLED display and the ATMega328P microcontroller significantly improve system performance and usability. By providing visual feedback on sensor readings and enabling efficient optical communication, the integrated Crystalfontz OLED display and ATMega328P microcontroller create a reliable and user-friendly platform for farmers. This study offers valuable insights into the design of advanced PCBs for multi-functional applications in agricultural settings. Future endeavors may focus on exploring miniaturization techniques to further enhance the board's compactness, facilitating effortless attachment to various farm animals.

Keyword(s):

Dual-Modality Printed Circuit Board, Sensor Data Visualisation, Optical & Communication, Crystalfontz OLED Display, ATMega328P Microcontroller

Mentor(s):

Daniel Leon-Salas (Polytechnic Institute); Lisa B Bosman (Polytechnic Institute)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 336
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Growing Entrepreneurially-Minded Researchers REU

Optimizing Solar Energy Harvesting: A Compact PCB Design for Testing and Evaluating Solar Cells

Author(s):

Bianca Perez† (University of Texas San Antonio); Gabriel Baquero‡ (University of Houston); Ndongo Njie‡ (Princeton University)

Abstract:

This project highlights the importance of integrating energy harvesting technologies at a smaller scale within research environments to test and evaluate different solar cells. The increasing use of solar energy has led to the need for a simple, efficient way of harnessing its power without requiring complex equipment. The solution for this issue lies in a compact printed circuit board (PCB) design incorporating an energy harvesting chip and a buck-boost converter that aims to be user-friendly. It allows users to choose what voltage values to generate and enable according to their needs. This approach provides a platform to test the capabilities of alternative solar cells, such as organic and perovskite solar cells, in a controlled manner. The energy harvesting chip integrated into the PCB efficiently captures ambient energy and converts it into usable electrical power. This allows for targeted testing and optimization of energy conversion efficiency. Complementing the energy harvesting chip, the buck-boost converter plays a crucial role in regulating the harvested energy. It ensures compatibility and efficient energy utilization by stepping up or down the voltage required to power specific devices or systems. This capability enables laboratories to evaluate the effectiveness of different solar cells in delivering the desired power levels and voltage requirements. Researchers can gain valuable insights into their performance by testing and considering various solar cells within laboratory environments. It allows laboratories to explore and compare multiple solar cell technologies, assess their efficiency, and determine their suitability for specific applications.

Keyword(s):

Energy Harvesting, Solar Cells, Compact PCB, Voltage Selection, Energy Conversion Efficiency

Mentor(s):

Daniel Leon-Salas (Polytechnic Institute); Lisa Bosman (Polytechnic Institute)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 337
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Growing Entrepreneurially-Minded Researchers REU

Unveiling Electrode Mysteries: A Tool for Disassembling Li-ion Batteries

Author(s):

Aurora Raygoza† (Polytechnic Institute); Julie Ware† (Polytechnic Institute); Brandon Dickenson† (Polytechnic Institute)

Abstract:

Lithium-ion batteries are widely used in various applications due to their high energy density, long cycle life, and lightweight design. These batteries are commonly found in portable electronic devices, electric vehicles, and energy storage systems. The continual improvement of Li-ion battery technology relies on extensive electrochemical and materials science research. These research activities often involve a series of analytical studies focused on understanding how the electrodes have degraded after cycling the battery under different operational conditions. For Li-ion cells having a metallic outer casing, such as the common 18650 format, dissection for analysis of electrode materials can prove to be problematic. Mishandling or improper disassembly of these batteries can pose safety risks, such as thermal runaway and the release of toxic substances. Safe dissection of a live Li-ion cell should occur in a well-ventilated area using appropriate personal protective equipment while avoiding mechanical damage to the battery. The primary focus for this study is to create a safe dissection mechanism which allows the operator to easily harvest electrode materials from 18650 format cells without damaging or overheating the active materials within the cell.

Keyword(s):

Lithium-Ion Batteries, Battery Cell Dissection, Internal Contents Analysis, Battery Research, Battery Composition

Mentor(s):

Jason Ostanek (Polytechnic Institute)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 338
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Growing Entrepreneurially-Minded Researchers REU

Agrovoltaics: Challenges, Current Approaches, and Opportunities

Author(s):

Brandon Yonnie† (Engineering); Amy LeGrande‡ (Engineering)

Abstract:

Agrovoltaics, a concept that combines agricultural production with photovoltaics (solar electricity generation), leverages the panel's shade and electricity to optimize traditional farming methods. Agrovoltaics have many advantages including land use efficiency, diversification of income, increased crop productivity, improved resilience, and environmental benefits. In addition, agrovoltaics have the potential to promote sustainable land use while responding to challenges including access to electricity and food security. Although agrovoltaic approaches have existed for about forty years, little is known about long-term benefits, compatibility with current agricultural practices, solar panel market uncertainty, and overall benefits. This research reviews the literature highlighting holistic benefits, challenges, current approaches, and opportunities for agrovoltaics, concluding with a call to action for establishing a collaborative agenda toward prioritizing agrovoltaic research and adoption.

Keyword(s):

Agriculture, Photovoltaic, Solar Energy, Crop Production, Energy Resilience

Mentor(s):

Lisa Bosman (Polytechnic Institute); Esteban Soto (Engineering); Gnanaprakash Athmanathan (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 339
Presentation Time: 7/27, Session 2: 1pm-2:30pm

LSAMP

Rescuing FMR1 Protein Function in PV Interneurons to Restore Learning in Fragile X Syndrome Mouse Model.

Author(s):

Violet Saldarriaga† (Science, JMHC)

Abstract:

Autism Spectrum Disorders (ASDs) are characterized by deficits in learning, social behavior, and sensory integration. Fragile X syndrome (FXS), caused by a mutation in the FMR1 gene, is a prominent genetic cause of ASD. Recent research has revealed impaired functioning of parvalbumin (PV) interneurons (INs) in ASD. These INs play a crucial role in regulating inhibitory and excitatory processes in cortical pyramidal neurons, which subsequently impacts behavior, learning, and memory. Learning deficits in Fragile X Knockout (FX) mice compared to wild-type (WT) mice have been studied; however, the role that PV INs play in visual learning processes is still unknown. Here, we investigated whether rescuing FMR1 protein (FMRP) function in PV interneurons can restore the learning impairments observed in FX mice. Using a novel conditional knock-in mouse strain, Fmr1 cON/PV-Cre (CON), we specifically restored FMRP in PV interneurons only. To measure behavior, freely moving mice were placed in touchscreen chambers and learned a visual discrimination go/no-go task. By incorporating a delay between the offset of the stimulus and when the mice perform the task, we could specifically focus on measuring behavior during a delayed working memory period. We assess the performance of FX and CON mice, with WT mice serving as control, by quantifying training scores (Hits and Correct Response Values minus the normalized False Alarms and Misses) across days of training. We found that there is a significant difference in the response time between WT and FX. CON response time is significantly better than FX and equivalent to WT. Furthermore, CON training scores are an intermediate between FX and WT. Results show that restoring FMRP function in PV INs improves performance in visual learning tasks compared to FX. This evidence suggests that PV interneurons play a critical role in visual processing and memory and could underly the learning disability present in ASD.

The results of this project provide more insights into the learning and memory deficits exhibited by FX mice while also working to precisely examine the role of PV INs in network responses to stimuli. The findings work to unveil notable behavioral differences across the three mouse strains and suggest new potential therapies for treating symptoms of ASD.

Keyword(s):

Autism Spectrum Disorder, Fragile X Syndrome, Parvalbumin Interneurons, Visual Discrimination, Operant Conditioning

Mentor(s):

Alexander Chubykin (Science); Sanghamitra Nareddula (Science); Michael Paul Zimmerman (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 340
Presentation Time: 7/27, Session 2: 1pm-2:30pm

NSF REM Program for High School: ASPIRE Youth Engineers in the Sustainability of Electric Vehicles (YES-EV) Program

Addressing the lack of charging stations throughout the U.S and proliferation of land utilization for enhanced electric vehicle infrastructure

Author(s):

Georgia Alexander† (Purdue Polytechnic High School); Aspen Arnold* (Purdue Polytechnic High School); Daniel White* (Purdue Polytechnic High School); Kaydence Hall* (Purdue Polytechnic High School); Francisco Hurtado* (Purdue Polytechnic High School)

Abstract:

Electric vehicles(EV's) have presented many benefits, such as reducing carbon emissions and promoting sustainable transportation. Although these advances can help in addressing climate change and environmental justice concerns, the proliferation of EV's across the US has brought up other challenges, such as lack of charging stations and the sustainability of the land the chargers inhabit. Several studies exist that address sustainable solutions with EVs centered on mobility, but infrastructure remains understudied. Land sustainability is one challenging problem due to relying on public funds, it is very expensive and lacks an understanding on what, if any economic incentives exist. The purpose of this research is to explore electric vehicles potential contribution to the expansion of impervious surfaces and the best way to utilize that land. Data will be collected through surveys and secondary data analysis using google scholar and science directly. Additionally, data will be collected through mock trials with electric motorbikes and go-carts. The research question guiding this study is "How does the widespread adoption of electric vehicles impact land use patterns?"

Keyword(s):

Land Sustainability, EV Charging, Charging Station Accessibility, Land Use, EV Transportation

Mentor(s):

Brandon Allen (Engineering); William Walls

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 341
Presentation Time: 7/27, Session 2: 1pm-2:30pm

NSF REM Program for High School: ASPIRE Youth Engineers in the Sustainability of Electric Vehicles (YES-EV) Program

Navigating Solutions for Electric Vehicle Charging Infrastructure: Overcoming Range Anxiety

Author(s):

Aspen Arnold† (Purdue Polytechnic High School); Georgia Alexander* (Purdue Polytechnic High School); Francisco Hurtado* (Purdue Polytechnic High School); Jarret Harris* (Purdue Polytechnic High School); Daniel White* (Purdue Polytechnic High School); Kaydence Hall* (Purdue polytechnic)

Abstract:

"Range anxiety," or the dread of running out of power, continues to be a persistent worry for prospective EV owners and continues to be one of the leading barriers to EV adoption. Electric cars (EVs) are increasing in popularity, which has led to important developments in battery technology and longer driving distances. Range anxiety can lead people to be misinformed about EVs leading to lack of adoption of electric vehicles. Enhancing the usability and effectiveness of the infrastructure for charging will assist in increasing adoption of EVs. There are several existing solutions aimed to alleviate range anxiety, including, the integration of cutting-edge telematics and navigation systems, which enables drivers to efficiently plan their routes by taking into account real-time data on the availability of charging stations, charging prices, and distances. These technologies offer precise information about charging stations and ways to reduce range anxiety. The aim of this research is to identify and analyze existing solutions to addressing range anxiety and identifying the most promising methods to proliferate into the public.

Keyword(s):

Range, Anxiety, EV, Adoption, Charging

Mentor(s):

Brandon Allen (Engineering); William walls

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 342
Presentation Time: 7/27, Session 2: 1pm-2:30pm

NSF REM Program for High School: ASPIRE Youth Engineers in the Sustainability of Electric Vehicles (YES-EV) Program

Equitability and Accessibility for Electric Vehicles Across Different Political Classes

Author(s):

Kaydence Hall† (Purdue Polytechnic High School)

Abstract:

Equitability and Accessibility for Electric Vehicles

A shift to electric vehicles (EVs) offers exciting promises that can help address climate change and other public health concerns, however affordability across socioeconomic classes remains one barrier in the transition to EVs. Two of the main concerns with electric vehicles continue to be around accessibility (i.e costs). Studies show that EV buyers are often from more wealthy economic classes. Without addressing accessibility issues (i.e charging stations, costs) the transition to EVs can be delayed. Conversely, with the widespread adoption of EVs, costs of EVs could start to reduce for older models making them more affordable for lower socioeconomic groups. The purpose of this research is to Identify the relationships of affordability across socioeconomic classes, and to identify the impact of EVs in different communities and climate change. This study will identify the issues of affordability on low-income populations with EVs, while sharing the impact electric vehicles make on climate change. Data will be collected by doing secondary data analysis. Additionally, data will be collected using surveys; interviewing college students around the campus to get their inputs on electric vehicle accessibility and adoption. The research questions guiding this study were: 1) What are equity considerations in planning for a future of going all electric? 2) How do electric vehicles affect communities and the environment? 3) How is the affordability in electric vehicles cost effective for low income groups?

Keyword(s):

Low-Income, Accessibility, Equitability

Mentor(s):

Brandon Allen (Engineering); William Walls

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 343
Presentation Time: 7/27, Session 2: 1pm-2:30pm

NSF REM Program for High School: ASPIRE Youth Engineers in the Sustainability of Electric Vehicles (YES-EV) Program

Enhancing Electric Vehicle Safety in Low-Income Areas: Mitigating Liability and Promoting Accessibility

Author(s):

Jarrett Harris† (Purdue Polytechnic High School); Francisco Hurtado* (Purdue Polytechnic High School); Kaydence Hall* (Engineering); Aspen Arnold* (Engineering); Daniel White* (Engineering); Georgia Alexander* (Engineering)

Abstract:

The widespread adoption of electric vehicles (EVs) presents numerous benefits, including reducing greenhouse gas emissions and dependence on fossil fuels. However, ensuring EV safety is crucial, particularly in low-income areas where accessibility and liability concerns are pronounced. Addressing liability concerns is vital to foster the adoption and safe usage of EVs in low-income areas. Proactive collaboration between these stakeholders can help delineate liability responsibilities, ensuring that all parties involved are held accountable for negligence or malfunctions. Prioritizing electric vehicle safety in low-income areas necessitates concerted efforts to address liability concerns, enhance safety measures, and promote accessibility. This study will examine participants perceived safety concerns factoring in the ownership of an electric vehicles. Further, this study will seek to identify potential perceived liability concerns that factor into EV ownership. This study will survey participants from low-income communities who have an interest in EV ownership one day to see how factors outside of affordability weigh in EV ownership. The research questions guiding this study include 1.) What safety concerns do aspiring EV owners from low-income communities have in before purchasing an EV? and 2.) What other liability issues exist for aspiring EV owners from low-income areas?

Keyword(s):

EV Safety, EV Liability, Low-Income

Mentor(s):

Brandon Allen (Engineering); William Walls (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 344
Presentation Time: 7/27, Session 2: 1pm-2:30pm

NSF REM Program for High School: ASPIRE Youth Engineers in the Sustainability of Electric Vehicles (YES-EV) Program

The Barriers in the Adoption of Electric Vehicles

Author(s):

Francisco Hurtado† (Purdue Polytechnic High School); Aspen Arnold* (Purdue Polytechnic High School); Jarrett Barkley* (Purdue Polytechnic High School); Daniel White* (Purdue Polytechnic High School); Kaydence Halls* (Purdue Polytechnic High School); Georgia Alexander* (Purdue Polytechnic High School)

Abstract:

Two main barriers with the adoption of electric vehicles(EVs) are price and availability. Unlike gasoline vehicles that are readily available and at a reasonable price, electric vehicles are uncommon and can be several thousand dollars more expensive than a gasoline vehicle. Due to the rapid evolution of the EV field, it is very important that we continue to expand on the production of innovative technology that makes EVs more consumer convenient. This study seeks to conduct a literature review on mechanisms that affect the affordability and availability of electric vehicles. Studies will be identified through the usage of google scholar and other data sources. The information pulled from the literature review will be compared to other studies in an attempt to find a general consensus of how researchers view EV affordability and availability. Additionally, this study will perform a needs-based survey, in order to better understand the public's view on electric vehicles. A survey will be conducted and shared with a wide demographic of people, with the aim of gaining a consensus on the way a person views EV affordability and availability. The research questions guiding this study are "Do most people perceive EVs as both available and affordable enough to purchase them as their vehicle," and "do EV researchers perceive EVs as both available and affordable enough to purchase them as their vehicle."

Keyword(s):

Electric Vehicle, Affordability, Availability, Comparison, Literature Review

Mentor(s):

Brandon Allen (Engineering); William Walls

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 345
Presentation Time: 7/27, Session 2: 1pm-2:30pm

NSF REM Program for High School: ASPIRE Youth Engineers in the Sustainability of Electric Vehicles (YES-EV) Program

"The Rise of Electric Vehicles"

Author(s):

Daniel White† (Purdue Polytechnic High School); Aspen Arnold* (Purdue Polytechnic High School); Kaydence Hall* (Purdue Polytechnic High School); Georgia Alexander* (Purdue Polytechnic High School); Francisco Hurtado* (Purdue Polytechnic High School); Jarrett Harris* (Purdue Polytechnic High School)

Abstract:

Electric Vehicles (EVs) are one solution to the fossil fueled vehicles that are currently used but have the consequence of air pollution. Presently, EVs are thought of as a luxury of those within higher socioeconomic classes, however experts see EVs will be a need within the next decade. Currently, the technology regarding EVs is still in its earlier stages, hindering widespread adoption. Traditional technologies like gas-powered and hybrid vehicles are still more common than EVs for a variety of reasons, including: pricing, long charging time, limited batteries, limitations or reliability on long trips, and a lack of charging stations in rural areas, as well as additional and socioeconomic concerns. The purpose of this research is to examine how charging time can be decreased to provide a more consumer friendly experience. This study will use experiments that can solve the question: What are ways to optimize Charging batteries to be able to decrease EV charging time.

Keyword(s):

Limited Batteries, Charging Time, Lack of Charging Station

Mentor(s):

Brandon Allen (Engineering); William Walls

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 346
Presentation Time: 7/27, Session 2: 1pm-2:30pm

PURE-PD

Carbohydrate phloem loading mechanism in Nicotiana tabacum via the downregulation of sucrose transporter 1

Author(s):

Jennah Brown† (Cal Poly Humboldt University)

Abstract:

Food security has become a growing concern as we look to the future. Having a more thorough understanding of plant functioning can help to improve the efficiency of crops and their response to changing environmental conditions. In this study, we seek to outline specific carbohydrate phloem loading mechanisms in Nicotiana tabacum by intentionally downregulating sucrose transporter 1 (SUT1). Phloem loading is a significant mechanism utilized in plants to transport sugars and amino acids from photosynthetic sites to conducting sieve tubes. This process is fundamental to growth, storage, and other significant plant functions. The cellular structure of

N. tabacum resembles those of major crops and can be utilized as a model species for the transformation technique to better understand physiological mechanisms. We measured SUT1 mRNA concentration in transformed leaf samples to analyze the effectiveness of downregulation. Downregulated N. tabacum samples showed phenotypic chlorosis made evident by the accumulation of carbohydrates in leaf tissue. To quantify the difference among SUT1 downregulated N. tabacum and wild type, we performed a soluble carbohydrate analysis. Accumulation of carbohydrates among downregulated N. tabacum is suspected to result in decreased photosynthetic efficiency. Therefore, photosynthetic rates were measured for downregulated N. tabacum and wild type. The results indicate that downregulated N. tabacum utilized apoplastic phloem loading and when manipulated, affects sucrose transport and photosynthetic abilities.

Keyword(s):

Phloem Loading, Transformation, Food Security, Physiology, Downregulating

Mentor(s):

Cankui Zhang (Agriculture); Hannah Levengood (Agriculture); Samantha Barker (Agriculture); Jing Huang (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 347
Presentation Time: 7/27, Session 2: 1pm-2:30pm

PURE-PD

Comparative Analysis of Toxicity Variation Among Strains in Prymnesium parvum, a Harmful Algal Bloom-Forming Species

Author(s):

José David Colón Miranda† (University of Puerto Rico)

Abstract:

Prymnesium parvum is a type of alga from the haptophyte lineage of eukaryotes. It is commonly known for its harmful algal blooms that result in significant ecological and economic impacts. These blooms can be characterized by the release of toxins which primarily affect fisheries, in addition to aquatic ecosystems, water quality, and recreational activities. Effective monitoring and management strategies for controlling these algae require a comprehensive understanding of toxin production among different strains of P. parvum. In this study, we aimed to investigate the variation in toxin production among different strains of P. parvum by quantifying toxin levels through pigment fluorescence measurements. A diverse collection of P. parvum strains, obtained from various locations and ecological conditions, were utilized. Toxicity assays were conducted, where sensitive organisms (Cryptophytes) were exposed to strains of P. parvum. Through this examination of multiple P. parvum strains, we aim to identify the extent of variation among them. We anticipate significant differences in toxicity levels among P. parvum strains, indicating the presence of strain-specific characteristics that may modulate the production of toxins. These findings shed light on the variation in toxin production within P. parvum strains and contribute to the development of new areas of research to capture the full spectrum of factors that may influence toxin production in this species. Furthermore, these insights could aid in the development of monitoring and management strategies for combating harmful algal blooms caused by P. parvum.

Keyword(s):

Harmful Algal Blooms, Toxin Production, P. Parvum Strains, Ecological Impacts

Mentor(s):

Jen Wisecaver (Agriculture); Nathan Frederick Watervoort (Agriculture); Timilehin Jeje

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 348
Presentation Time: 7/27, Session 2: 1pm-2:30pm

PURE-PD

Soluble sugar accumulation during cold acclimation

Author(s):

Audrey Couturier† (Siena Heights University); Stephen Mills‡ (Agriculture)

Abstract:

Adaptations to seasonality are important across temperate zones and are likely to be disrupted by climate change. Cold acclimation is one adaption that allows plants to survive winter freezing temperatures. When exposed to cooler autumn temperatures, plants change gene expression and metabolism, producing various soluble sugars and other compounds to protect cell components from freezing temperatures. Previous studies have suggested that soluble sugars play a role in freezing tolerance by osmoregulation, photosystem II protection, and by decreasing cellular freezing points. Since cold acclimation pathways are induced rather than constitutive, they are thought to be energetically costly. Allocating resources to synthesize soluble sugars during cold acclimation may lead to lower fitness in cool but non-freezing temperatures because carbon used in this synthesis cannot be used for other carbohydrates important for growth, storage, or reproductive processes. To investigate the accumulation of soluble sugars during cold acclimation, we quantified soluble sugar production using Megazyme assay kits. Tissue was collected, and soluble sugars were quantified before and after a period of cold acclimation, where plants were grown under short days at 4°C. We discuss our results in the context of the costs of cold acclimation and the potential consequences for climate change.

Keyword(s):

Cold Acclimation, Sugar Accumulation, Abiotic Stress

Mentor(s):

Christopher Oakley (Agriculture); Juan Diego Rojas Gutierrez (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 349
Presentation Time: 7/27, Session 2: 1pm-2:30pm

PURE-PD

Trigger Warning: Impacts of mutants and heat on the stability of silencing of MuDR after exposure to Mu Killer

Author(s):

Alison Garland† (Agriculture)

Abstract:

MuDR is a highly mutagenic transposable element (TE) in maize. Mu Killer (MuK) is a locus that can heritably silence MuDR elements. MuK is one of two loci in maize or any other organism that can do this, making it a model for epigenetic silencing. The effects of mutants and the stability of silencing of MuDR will be examined after exposure to MuK by genotyping families of plants segregating for MuDR and selected mutants known to affect silencing. One such mutant, mop1 plays an important role in the methylation of silenced MuDR elements. Another mutant dcl4 is important for generating small RNAs possibly responsible for MuDR silencing initiation. Because the experimental families segregate for mutants and wild type plants with and without MuDR and MuK, they provide built in controls.

The experiments involve examining both initiation of silencing, where MuDR is exposed to MuK in mutant backgrounds, and maintenance of silencing, in which previously silenced MuDR elements are put in a mutant background after MuK is lost via segregation. Currently, it is known that silenced MuDR elements do not reawaken in mop1 mutants although DNA methylation associated with silencing is lost. However, MuDR reactivates with the addition of heat stress. My experiments seek to replicate these results, first by examining expression of the two genes from active MuDRs with and without heat, and then by examining the expression of silenced MuDR elements under identical conditions. Understanding silencing patterns is vital for understanding genetic variation over generations.

Keyword(s):

Transposable Elements, Segregation, Silencing, Mutant, MuDR

Mentor(s):

Damon Lisch (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 350
Presentation Time: 7/27, Session 2: 1pm-2:30pm

PURE-PD

Suppressors of the ref5 mutant of Arabidopsis reveal mechanistic insights into the crosstalk between glucosinolate and phenylpropanoid metabolism

Author(s):

Chase Hearn† (University of Maryland College Park)

Abstract:

Phenylpropanoids are specialized metabolites derived from the amino acid phenylalanine and include lignin, as well as the natural sunscreen sinapoylmalate. In addition to phenylpropanoids, plants in the order Brassicales also produce specialized metabolites known as indole glucosinolates from the amino acid tryptophan, which have a role in defense against herbivory and pathogen infection. In the Arabidopsis thaliana reduced epidermal fluorescence5 (ref5-1) mutant, sinapoylmalate fails to accumulate due to the accumulation of an indole glucosinolate aldoxime precursor (IAOx), resulting in a phenotype characterized by elongated hypocotyls and decreased UV-induced fluorescence. In Arabidopsis thaliana, glucosinolate-phenylpropanoid crosstalk is facilitated by the Mediator complex (MED5) which limits phenylpropanoid levels by increasing expression of a group of Kelch Domain F-Box genes (KFBs) in response to levels of IAOx. These KFBs participate in the degradation of phenylalanine ammonia-lyase (PAL) which is required to catalyze the first step of phenylpropanoid metabolism. Here, we set out to identify as-yet-unidentified genes involved in phenylpropanoid-glucosinolate crosstalk by performing a ref5-1 mutant suppressor screen. We characterized ten candidate ref5-1 suppressors by analyzing levels of sinapoylmalate, hypocotyl length, KFB expression, PAL activity, and lignin content. We plan to use ref5-1 suppressors with expected phenotypes to discover new mechanisms by which members of the Brassicaceae and their allies coordinate the production of indole glucosinolates and phenylpropanoids.

Keyword(s):

Biochemistry, Plant Metabolism, Plant Genetics, Arabidopsis

Mentor(s):

Clint Chapple (Agriculture); Zhiwei Luo (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 351
Presentation Time: 7/27, Session 2: 1pm-2:30pm

PURE-PD

Interplay between Autophagy and Ethylene in Arabidopsis thaliana

Author(s):

Manasvi Lingampally† (Agriculture)

Abstract:

Autophagy plays a crucial role in maintaining cellular homeostasis and recycling nutrients in response to various stress responses such as carbon limitation, oxidation, pathogen attacks and senescence. On the other hand, ethylene is a gaseous hormone that plays a role in plant growth and is best known for being a key factor for fruit ripening, root growth, senescence, and various stress responses. Both ethylene and autophagy are related to plant stress response and senescence but their relation to each other is not fully understood, and further research is needed to uncover their interaction in Arabidopsis thaliana. To reveal the relationship between ethylene and autophagy, the hypocotyl length was measured in different concentrations of 1-aminocyclopropane-1-carboxylic acid (ACC) with autophagy related mutants. The comparison of hypocotyl length between autophagy mutants and wild type revealed noticeable differences, implying a potential association between autophagy and ethylene. Further, to investigate the relation between autophagy and ethylene signaling, carbon starvation stress was applied to ethylene signaling mutants in combination with autophagy mutants, resulting in significantly different resistance to carbon limitation. These indications point to potential regulatory interaction between ethylene signaling and autophagy. Overall, these findings suggest a coordinated interplay between autophagy and ethylene as supported by the assessment of hypocotyl length and carbon starvation using different mutants. This contributes to the understanding of regulatory mechanisms underlying plant stress responses.

Keyword(s):

Authophagy, Ethylene, Stress Response, Arabidopsis Thaliana, Relationship Between Autophagy & Ethylene

Mentor(s):

Gyeong Mee Yoon (Agriculture); Hye Lin Park (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 352
Presentation Time: 7/27, Session 2: 1pm-2:30pm

PURE-PD

Functional Characterization of the miR171 Family in Arabidopsis thaliana

Author(s):

Olivia Moffett† (Libraries)

Abstract:

MicroRNAs (miRNAs) control the expression of a target gene by destroying the target mRNA or inhibiting its translation. MiRNA171 (miR171) is a highly conserved family in land plants. The miR171 genes play a critical role in plant growth and development, and they specifically regulate shoot-branching activity by directly repressing the HAM (hairy apical meristems) family transcription factors. Mature miR171 aligns with the conserved 21-base pair sequence of HAM genes through direct binding and cleavage, which will hinder the production of the HAM proteins in plants. In this study, six candidate miR171 genes (named CrmiR171A through CrmiR171F) were identified and characterized. The function of each candidate gene is tested by overexpressing each CrmiR171 in the model plant Arabidopsis thaliana. Multiple individual transgenic plants were isolated through hygromycin selection and confirmed by PCR. The phenotype of transgenic plants, such as the number of branches produced, meristem development, number of leaves, flowering time, and the traits related to shoot architecture, have been or will be quantified. This study will provide important information on how we can modify crops like maize or soybean for better yields, pest resistance, and improved nutritional value and overall quality of our foods.

Keyword(s):

MicroRNAs, HAM Protein, Mir171

Mentor(s):

Yun Zhou (Agriculture); Chong Xie (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 353

Presentation Time: 7/27, Session 2: 1pm-2:30pm

PURE-PD

Investigating Interactions between Agrobacterium VirD2 Protein and Plant DNA Polymerase θ

Author(s):

Connor Murray† (Connecticut College)

Abstract:

Species of Agrobacterium infect plant cells, transporting bacterial Transfer-DNA (T-DNA) which may then integrate into the plant chromosome. Integrated T-DNA and the disrupted plant DNA sequences often contain deletions or insertions at junctions where T-DNA is inserted into plant DNA, as well as major plant genome rearrangements such as translocations or inversions. These integration-induced changes are similar to changes in the genome that occur after repair of DNA breaks, prompting research that investigates the role of DNA repair mechanisms in T-DNA integration. This paper describes an experiment designed to test if the proteins DNA Polymerase θ (PolQ) and VirD2 interact in plants. PolQ is a low fidelity DNA polymerase that is necessary for microhomology-mediated end-joining, a highly mutagenic pathway of double strand DNA break repair. VirD2 is an Agrobacterium virulence protein that plays a key role in processing and secretion of T-DNA from Agrobacterium, and in T-DNA transport to the plant cell nucleus. Bimolecular fluorescence complementation will be used to determine if these proteins interact. In the T-DNA region of a binary vector, there is a red fluorescent nuclear marker, an nVenus-VirD2 expression cassette, and a cCFP-PolQ expression cassette that will be introduced into Agrobacterium. The resulting strain will be used to infect plants. The infection site will be analyzed by fluorescence microscopy. Infected cells will have a red fluorescent nucleus. If PolQ and VirD2 interact in the proper orientation, the attached fragments of the fluorescent protein Venus will fold and create visible yellow fluorescence.

Keyword(s):

DNA Polymerase Θ, VirD2, Agrobacterium, T-DNA Integration

Mentor(s):

Stan Gelvin (Science); Lan-Ying Lee (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 354
Presentation Time: 7/27, Session 2: 1pm-2:30pm

PURE-PD

Characterizing DMP9 Overexpression Lines Regarding Stomata Regulation

Author(s):

Joy Richardson† (University of Texas at Austin)

Abstract:

DMP 8/9 are proteins expressed at the plasma membrane of sperm cells and are required for double fertilization in Arabidopsis thaliana. In the dmp8/9 mutant, where DMP 8/9 are not expressed, double fertilization cannot occur due to the two sperm cells failing to separate and subsequently fuse with the egg and central cell. To address the molecular function of DMP9, we examined the effects of DMP9 ectopic overexpression in vegetative tissues. Previous studies showed that overexpression lines have reduced plant growth and defects in stomata regulation. To determine how DMP9 interferes with signaling pathways, we examined the effects of known factors involved in stomata regulation including ABA, H2O2, organic acids, and toxic cations in seed germination and root growth. We also examined if the DMP9 ectopic overexpression line presents any stomata developmental defects. Based on the results, we will report a possible model on how overexpression of DMP9 may be interfering with plant osmoregulation.

Keyword(s):

Osmoregulation, Double Fertilization, Stomata Development, DMP9

Mentor(s):

Leonor Boavida (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 355
Presentation Time: 7/27, Session 2: 1pm-2:30pm

PURE-PD

KAI2 intermediate clade and MAX2 complex via the sesquiterpene signaling pathway

Author(s):

Kaitlin Riggan† (Agriculture)

Abstract:

Pants synthesize and secrete volatile organic compounds (VOCs) as an essential avenue for plant communication, pollinator attraction, and communication between different parts of the plant. These VOCs include sesquiterpenes such as (-) Germacrene D, which is produced in the tubes of petunia flowers and accumulates in the pistil via natural fumigation. As the biosynthetic pathways and transport mechanisms for these sesquiterpenes are better understood, it is also important to uncover the receptor pathways for VOC communication between floral organs. In petunia pistils, KAI2ia has been shown to act as a receptor of (-) Germacrene D and may form a complex with F-box protein MAX2a/b. The KAI2ia receptor pathway of (-) Germacrene D and the downstream effects on the formation of a KAI2ia-MAX2a/b complex are not well understood. Through analysis of rhythmic expression patterns, transient pistil transformation, and co-immunoprecipitation assays, we can uncover the VOC perception pathway for communication between floral organs in petunia. The rhythmic expression pattern is similar between both KAI2ia and KAI2ib, but there is no detectible rhythmicity in MAX2a nor MAX2b expression. Uncovering the receptor pathways for flower communication via natural fumigation may reveal opportunities to increase pollination and improve overall plant health.

Keyword(s):

Petunia, Volatile, KAI2, MAX2, Transformation

Mentor(s):

Natalia Dudareva (Agriculture); Shannon Stirling (Agriculture); Varun Dwivedi (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 356
Presentation Time: 7/27, Session 2: 1pm-2:30pm

REU in Structural and Computational Biology & Biophysics

Effect of artificial light at night (ALAN) and traffic noise on amphibian communities

Author(s):

Adriana A. Bustos Torres† (Science)

Abstract:

The rapid land change for human habitation, known as urbanization, has been the primary source of sensory pollutants such as artificial light at night (ALAN) and traffic noise. Alteration of the sensory environment affect many species by impacting the physiology, behavior, and reproduction. To persist in urban habitats, animals must deploy plastic responses or adaptations in response to these sensory pollutants. While some species can survive in these changing environments, others face local extinction. The breeding behavior in many species is highly influenced by ALAN and traffic noise, and can alter the timing or spatial use of their breeding activities. As for anurans, they depend on wetlands to breed but are unlikely to avoid these sensory pollutants, which can affect their reproductive patterns. Here, we assess how ALAN and traffic noise influence the structure of frog breeding communities and their calling behavior. By broadcasting ALAN and traffic noise to represent a local road to different frog choruses and communities, we investigate how species diversity and abundance at frog breeding sites is affected. In addition, by presenting both pollutants individually and together, we investigate their interactive effects on frog-calling behavior. Preliminary results may indicate that together, ALAN and traffic noise decrease the abundance of individuals calling at a breeding site, and that they may have synergistic effects on the calling behavior of entire frog communities. Our findings will help us understand the effect of these pollutants in the community structure and behavior of anurans, a group of high conservation concern.

Keyword(s):

Sensory Pollution, Artificial Light At Night, Anthropogenic Noise, Breeding Behavior, Bioacoustics

Mentor(s):

Ximena Bernal (Science); Ana Maria Ospina (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 357
Presentation Time: 7/27, Session 2: 1pm-2:30pm

REU in Structural and Computational Biology & Biophysics

Refolding Analysis of Canine PD-L1 for Structural Determination of PD-L1-IgG Complex

Author(s):

Alexander Crook† (Science)

Abstract:

The interaction between programmed death ligand 1 (PD-L1) and programmed death 1 (PD-1) inhibits immune responses and promotes tumorigenesis. Therefore, this immune checkpoint has been considered a significant target for the treatment of cancers. Previously we have identified a specific canine immunoglobulin G (cIgG) antibody that targets the canine PDL1 (cPD-L1) and showed a significant effect on the inhibition of cancer cell proliferation. However, the precise cPD-L1 epitope and the interaction between the cIgG and cPD-L1 are unknown. In this study, we aim to determine the complex structure of the cIgG-PD-L1 using X-ray crystallography. The primary focus is to express the N-terminal domain of cPD-L1 (cPD-L1-ND) in the inclusion bodies using the E. coli expression system, followed by refolding procedures to obtain monomeric cPD-L1-ND proteins. This can be used to form a complex with the Fab fragments derived from the cIgG antibodies. A variety of refolding conditions were screened by several assays to attempt to purify and identify the properly refolded proteins. Currently, rapid dilution of the denatured proteins into pure water gives the best refolding result, yielding 2% monomeric cPD-L1-ND proteins. Alternatively, we have attempted to produce native-folded cPD-L1-ND proteins using the bac-to-bac insect cell expression system. We have obtained enough baculovirus stocks for large-scale protein expression. Additionally, commercially available full-length cPD-L1 was purchased and can be used for screening crystallization conditions of cPD-L1-Fab crystals. Successful structural determination will provide insight into the binding of cIgG and cPD-L1, which will benefit the development of immune checkpoint inhibitors.

Keyword(s):

PD-L1, Refolding, Immune Checkpoint, IgG

Mentor(s):

John Tesmer (Science); Chun-Liang Chen (Science); Pooja Yadav

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 358
Presentation Time: 7/27, Session 2: 1pm-2:30pm

REU in Structural and Computational Biology & Biophysics

The nanoscale molecular organization of Myo2 and Myp2 in the contractile ring of fission yeast

Author(s):

Javier Joel Diaz Laboy† (University of Puerto Rico at Ponce)

Abstract:

The contractile ring is a key component during cell division consisting of more than 100 types of proteins including actin and myosin. Understanding the precise organization and dynamics of myosin during the ring's constriction is critical for understanding the mechanisms of cytokinetic ring formation and force generation. Specifically, two types of myosin: conventional myosin-II (Myo2) or unconventional myosin-II (Myp2) play distinct roles during the ring function; Myo2 contributes to the assembly and constriction of the contractile ring, while Myp2 helps maintain ring stability and peripheral organization (Laplante et al., 2015). Single-molecule localization microscopy (SMLM) allows resolving the ultrastructure of cellular organelle and protein assemblies through its diffraction unlimited spatial resolution well beyond the conventional resolution of light microscopy systems. Imaging immune-labeled myosin in fission yeast with SMLM, we investigate the nanoscale organization of the two types of myosin's (Myo2 and Myp2) in the contractile ring. We acquire single molecule super-resolution images reconstructed by pinpointing centers of individual myosin molecules labeled with anti-GFP nanobody for Myo2 and anti-RFP nanobody for Myp2. Analysis of the obtained super-resolution images demonstrate clustering patterns of myosin molecules in high-resolution images of the contractile ring, giving better understanding of their spatial organization inside the ring. The findings of this study have the potential to provide unique insights into the regulation of contractile ring dynamics, as well as implications for the development of targeted therapeutic approaches in disorders associated with the division of the cell.

Keyword(s):

Myosin, Cytokinesis, Fission Yeast, Resolution, Imaging

Mentor(s):

Fang Huang (Engineering); Cheng Bi (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 359
Presentation Time: 7/27, Session 2: 1pm-2:30pm

REU in Structural and Computational Biology & Biophysics

Characterization of the DdmABC Complex: Structural & Mechanistic Insights into Vibrio Cholerae's Apoptotic Defense

Author(s):

Marielle Denise Melendez† (Science)

Abstract:

Transferable genetic elements, such as plasmids and bacteriophages, can pose a significant threat to bacterial colonies. As a result, bacteria evolved numerous defenses against invasive DNA. Pandemic Vibrio cholerae strains reportedly employ the DdmABC complex, a Lamassu-2 system, to defend against potential decimation. DdmABC is composed of three proteins: DdmA, DdmB, and DdmC. Based on hypothesized structures of the complex, DdmA & DdmC exhibit structural similarities with the domains of Acinetobacter baumannii's Cap4 protein's endonuclease and an SMC-like (Structural Maintenance of Chromosomes) protein, respectively. Given a protein's structure strongly correlates to its function, this information suggests that DdmC recognizes and binds to DNA, and DdmA cleaves the DNA indiscriminately. Based on this, we speculate that the DdmABC complex may trigger apoptosis upon recognition of palindromic DNA within the hairpin structure of foreign plasmids. More investigation is needed to understand the functions of each protein, the precise mechanism, and the triggers of self-induced cell death.

Our research aims to confirm the activation of apoptosis by the DdmABC system. After generating a recombinant protein from protein purification, biochemical assays will be applied to assess the functionality of the protein complex, and cryogenic electron microscopy will be utilized to elucidate the complex's molecular structure. While the DdmABC complex is unique to V.cholerae, Lamassu systems like DdmABC are widespread in all bacteria. By studying the DdmABC complex, we hope to gain more structural and mechanistic information on intricate defense systems in bacteria.

Keyword(s):

DdmABC Complex, Apoptosis-in-Vibrio Cholerae, DdmABC Defense System, Lamassu System, Self-Induced Apoptosis

Mentor(s):

Leifu Change (Science); Dan Xie (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 360
Presentation Time: 7/27, Session 2: 1pm-2:30pm

REU in Structural and Computational Biology & Biophysics

Decoding VceC: B. abortus mechanism that influences the host ER stress response

Author(s):

Hugo Ortiz-Garcia† (Science)

Abstract:

The filamentation induced by cAMP (Fic) adenylyltransferases have a vital role in cellular signaling via a unique post-transitional modification called AMPylation. The variant HYPE (Huntingtin yeast interacting protein E), only found in humans, has an important role in the adenylylation of the endoplasmic reticulum (ER) molecular chaperone BiP that regulates ER homeostasis by targeting misfolded proteins and managing ER stress. The focus of this study is Brucella abortus, an intracellular pathogen that can induce the unfolded protein response (UPR) by releasing toxins through its type 4 secretion system that manipulate cellular functions.This microorganism causes human brucellosis which is a serious zoonotic disease that represents a risk of abortion in pregnant women and poses a risk to animal health. Infected animals may experience reduced fertility resulting in significant economic and agricultural impacts. The aim of this research is to understand VceC, an effector of B. abortus, and its proline-rich (PR) domain; previous studies have demonstrated their correlation with UPR induction. We aim to isolate and purify VceC's PR domain in order to determine its structure and study its interactions with HYPE and BiP. Despite previous unsuccessful attempts using computational methods like AlphaFold2, our aim is to solve the structure of the purified PR domain and determine its role in UPR on mammalian cells. Using modern biochemical techniques we can comprehensively understand VceC's contribution to host ER stress response induction and determine the potential cytotoxicity of its PR domain.

Keyword(s):

VirB Coregulated Effector C, Brucellosis, Unfolded Protein Response, Brucella Abortus, BiP/GRP78

Mentor(s):

Seema Mattoo (Science); Ben G Watson (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 361
Presentation Time: 7/27, Session 2: 1pm-2:30pm

REU in Structural and Computational Biology & Biophysics

Morphometry and Morphology Of Uranotaenia lowii Larvae

Author(s):

Kanishka Singh† (Science)

Abstract:

Mosquitoes have been at the forefront of global entomological research due to their crucial role as disease vectors for both humans and animals. Understanding the larval stage of mosquitoes can provide valuable insights into their life history strategies and aid in implementing preventive mosquito control measures. However, a limited number of studies focus on investigating larval morphology and morphometry, particularly in non-human biting mosquitoes. One such species, Uranotaenia lowii, which feeds exclusively on frogs, remains understudied. Investigating the larval development of this species can significantly contribute to our comprehensive understanding of mosquito larvae's developmental stages. This study aims to examine the morphological developmental changes occurring during the four larval instars of Ur. lowii. Additionally, I investigate the sexual differentiation across these larval instars, a key trait of sexual dimorphism during development, and could lead to more effective research methods allowing early sexual discrimination. To achieve these goals, I performed imaging and morphometrical analyses across larval instars. This research sheds light on the biology of frog-biting mosquitoes, an understudied group, and also provides broader insights into host-prey interactions.

Keyword(s):

Uranotaenia Lowii, Larvae, Instar, Morphology, Morphometry

Mentor(s):

Ximena Bernal (Science); Richa Singh (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 362
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SROP

Review of Interventions for HIV Medication Adherence among Individuals using Substances

Author(s):

Brielle Lowther† (Rowan University; Purdue University); Abdulrazzaq Altararwa† (HHS); Libbie Lawson† (HHS, Liberal Arts)

Abstract:

Introduction: Individuals with problematic substance use and/or substance use disorders, especially people who inject drugs (PWID) are at increased risk for human immunodeficiency virus (HIV). Further, individuals engaging in problematic substance use may have poorer adherence to antiretroviral (ARV) medications that are used to both prevent and treat HIV.

Objectives: The purpose of this literature review was to examine studies that evaluated behavioral interventions to enhance ARV medication adherence in samples of HIV-infected individuals or individuals at risk for HIV.

Methods: Utilizing PRISMA guidelines for systematic reviews, searches of PubMed and electronic databases were used. Studies were included in the review if they: (a) reported outcomes from a behavioral intervention to enhance ARV adherence; and (b) included a sample of either HIV-infected or at-risk individuals engaging in problematic substance use.

Results: The review included 28 articles. The methodology employed across studies was summarized; around 25% of studies used cognitive behavioral therapy, 14% used modified ART interventions, 11% used motivational interviewing, and 50% used other intervention approaches. Overall, cognitive behavioral therapy was the most effective intervention in enhancing ARV medication adherence compared to other modalities.

Discussion: We examined the most common interventions and methods used in targeting HIV medication adherence. Cognitive behavioral therapy showed promise for enhancing ARV adherence rates. In conclusion, there is a need for further research on interventions increasing adherence that are feasible to administer among HIV-infected and at-risk individuals using substances.

Keyword(s):

HIV, Medication Adherence, Antiretroviral Medications (ARV), Behavioral Interventions

Mentor(s):

Jennifer Brown (HHS); Stephen Beegle (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 363
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Summer Stay

Effects of Bacterial Density Normalization in Fecal Fermentation Protocols

Author(s):

Marcelo Inaki Guerrero Montalvan† (Agriculture)

Abstract:

The gut microbiome is a biologically diverse system that enjoys a symbiotic relationship with the host. To describe food interactions in this system, rigorous laboratory methods must be employed because of the multitude of factors affecting responses of bacterial communities from different origins. In this context, in-vitro fermentations are techniques that offer great insight into how microbial cultures evolve throughout different kinetic growth stages. This study focuses on the effect of bacterial normalization at time of inoculation in these protocols, which we hypothesized would influence the fermentation outcomes of these assays. Batch fermentation cultures were used to study how bacteria metabolize different substrates. Two assays were performed, pre- and post-adaptation of the bacterial communities to substrates. The anaerobic cultures studied were prepared with samples taken from three donors. The substrates used were wheat bran, isolated wheat bran arabinoxylan, short chain inulin (positive control) and no substrate (negative control). The methodology involved measuring concentration of different metabolites on a Gas Chromatograph with a Flame Ionization Detector, namely, 14 compounds some belonging to the group of Short-Chain Fatty Acids (SCFAs). The results suggest that bacterial cell count is a factor that when normalized, influences fermentation outcomes. These results help us better distinguish difference of metabolite production, which is dependent on the origin of the bacterial community. In conclusion, bacterial normalization is a crucial factor that influences outcomes of in-vitro fermentations. Fermentation protocols, when experimental setup is proper, are useful tools to study the relationships and interactions of bacterial communities with dietary components.

Keyword(s):

Short Chain Fatty Acids, Gut Microbiome, In-Vitro Fermentation, Metabolite Production, Arabinoxylan

Mentor(s):

Steve Lindemann (Agriculture); Miguel Alvarez (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 364
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

DVFL: Decentralized, Blockwise Vertical Federated Learning for Secure and Robust Collaborative Machine Learning

Author(s):

Avi Amalanshu† (Engineering)

Abstract:

Vertical Federated Learning (VFL) is a distributed machine learning paradigm wherein owners of disjoint features of a common set of entities collaborate to learn a global model while maintaining data privacy. This allows agents who individually have incomplete information about their target to learn meaningful joint representations when regulations or ethics disallow data sharing. For instance, an imaging center, pathology lab and OPD may come together to predict rare types of cancer, even though HIPAA norms may disallow them from collecting each others' data. In VFL, the "host" client owns data labels for each entity. The host learns a final representation based on intermediate local representations from all participants. Therefore, the host is a single point of failure for faults and attacks. Furthermore, the label feedback can be used by malicious “guest” clients for various inference attacks. Requiring the label owner to remain active and trustworthy during the entire training process is impractical and limits the applicability of VFL.

We propose Decentralized VFL (DVFL), a blockwise approach to VFL that addresses these issues by decentralizing aggregation and decoupling guest training, aggregation and label supervision. We also introduce an asynchronous variant, Async-DVFL, which relaxes the entity alignment phase, viz. participants need not agree on the specific data sample they will process during a training round. This leads to a higher degree of privacy during training and makes implementation more practical. We show that the added redundancy due to decentralization greatly improves robustness and fault tolerance, and that decoupling the training process in a self-supervised manner does not sacrifice performance. We present experiments using this technique on standard machine learning tasks.

Keyword(s):

Machine Learning, Distributed Systems, Federated Learning, Distributed Learning, Fault Tolerant Learning

Mentor(s):

David Inouye (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 365
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Efficient Induction of Hematopoietic Stem Cells from 3D Cell Culture of Human Pluripotent Stem Cells through Wnt and TGFβ Signaling Modulation

Author(s):

Valentina Andrade Pérez† (Engineering)

Abstract:

Hematopoietic stem cells (HSCs) are widely recognized as promising candidates for therapeutic interventions in hematological and immunological disorders. Current scientific investigations are primarily dedicated to the creation of robust platforms and reliable techniques for effective differentiation of human pluripotent stem cells (hPSCs) into HSCs, to overcome the limitations associated with allogenic HSCs. Here, we show that HSCs can be efficiently obtained from a 3D cell culture of hPSCs by modulating Wnt and TGFβ signaling pathways via small molecules. To initiate the differentiation process, we used the hanging drop method to induce the formation of embryoid bodies (EBs) from hPSCs. Subsequently, we treated these EBs with vascular endothelial growth factor (VEGF), CHIR99021 (a Wnt activator) and SCF and FLT3L, along with SB431542 (a TGFβ signaling inhibitor) to induce HSC differentiation. The resulting HSCs were treated with GlutaMax, granulocyte stimulating factor (G-SCF) and AM-580 to further differentiate into neutrophils. Immunostaining analysis was performed to monitor the differentiation progress of EBs into HSCs and then neutrophils, which showed the presence of HSC makers within the EBs after 13 days of treatment. These findings suggest that Wnt agonists and TGFβ inhibitors can promote the differentiation of 3D cell culture of hPSCs into HSCs. Future studies should focus on optimizing and characterizing this differentiation protocol to enhance the efficiency and functionality of the derived HSCs.

Keyword(s):

Stem Cell Differentiation, Hematopoietic Stem Cells, Embryoid Body, Wnt Signaling Pathway, Immunotherapy

Mentor(s):

Xiaoping Bao (Engineering); Yun Chang (Engineering); Jingqiao Shen (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 366
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Conversion of Medical Face Masks to Valuable Products Through Low-Pressure Hydrothermal Processing

Author(s):

Kathryn Ault† (Engineering)

Abstract:

Redacted.

Keyword(s):

Medical Plastic Waste, Low-Pressure, Hydrothermal Processing, Polypropylene

Mentor(s):

Linda Wang (Engineering); Cagri Un (Engineering); Clayton Gentilcore (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 367
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Lunar Shadow Mapping: Optimizing Agrivoltaic Systems for Sustainable Lunar Outposts

Author(s):

Eshaana Aurora† (Engineering, Science)

Abstract:

As space exploration advances, the establishment of sustainable habitats on extraterrestrial bodies, such as the Moon, becomes a critical objective. Integrated agrivoltaic systems, which combine agricultural cultivation with photovoltaic (PV) energy production, offer a promising solution for renewable generation of power, food, and oxygen in these environments. The Lunar surface poses distinct challenges, including varying sunlight intensity, extreme temperature variations, and limited oxygen, water, and soil nutrients. Designing efficient agrivoltaic systems in this context necessitates a comprehensive understanding of the complex interdependencies between plant growth, energy production, and environmental factors. The limited number of prior studies and lack of relevant simulation tools both inhibit the development and optimization of agrivoltaic systems for such extraterrestrial environments. In this study, we build upon the Ag-PV MATLAB code, incorporating lunar-specific parameters and constraints derived from the JPL Horizons software tool. Through extensive data analysis, numerical modeling, and simulations, we assess the feasibility and performance of integrated agrivoltaic systems on the Moon, focusing on the shadow depth parameter, which directly impacts total solar irradiation. Additionally, we explore various crop options for potential lunar agricultural systems, considering their compatibility with the unique lunar environment. This study therefore provides insight into how close photovoltaic panels can be co-located with agricultural production in these exotic environments. Our findings underscore the need for customized solutions to leverage the potential of agrivoltaics on the Moon, contributing to the development of sustainable and self-sufficient habitats for long-term space exploration, with potential long-term implications for similar systems here on earth.

Keyword(s):

Environmental Characterization, Material Modeling & Simulation, Ecology & Sustainability

Mentor(s):

Peter Bermel (Engineering); Geoffrey Sanchez (Engineering); Changkyun Lee (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 368
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Closed-loop evaluation of behavior-specific human-machine trust-calibration strategies

Author(s):

Matthew Beecher† (New Mexico Institute of Mining and Technology); Douglas Nyberg‡ (University of Montana)

Abstract:

Automation is increasingly used for improving system performance across a broad range of applications. For example, intelligent decision aid systems, designed to aid humans in a variety of tasks, such as navigation. In such systems, it is vital the operator appropriately utilize the decision aid without over or under-reliance. In other words, the operator's trust should be calibrated to the reliability of the decision aid. In prior research, researchers showed that a partially observable Markov decision process (POMDP) model could be used to estimate an operator's trust state by observing their behavior, namely decision-aid reliance. The POMDP was then used to design a near-optimal policy to adapt the user interface transparency displayed by the decision aid to operators' trust to mitigate the consequences of improper reliance. However, this work was limited in that a single POMDP was trained using an aggregated dataset of human data; additional research has identified the presence of two distinct trusting behaviors among the dataset, with two distinct POMDP models trained and associated adaptive transparency policies designed and synthesized.

This work aims to implement the two proposed policies in closed-loop (conducted via Amazon Mechanical Turk) and evaluate their efficacy in calibrating trust as compared to the generalized policy. It will utilize a classifier trained to identify operator trust behavior with behavioral data during the experiment to then determine which control policy the operator experiences. This research will illustrate the usefulness of this split modelling approach in a practical setting and open the door for further developments.

Keyword(s):

Machine Learning, Controls, Behavior Analysis, Markov Processes

Mentor(s):

Neera Jain (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 369
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Analysis of worker preferences for decarbonized manufacturing job attributes

Author(s):

Dongting Cai† (University of Minnesota, Morris); Ellison Zhu‡ (Engineering)

Abstract:

With the ongoing decarbonization of the Midwest manufacturing industry, it has become increasingly vital to understand how workers balance wage considerations with non-monetary job attributes. Such understanding directly influences their quality of life and community well-being, indirectly affecting energy production costs. However, a gap in comprehensive data and nuanced analysis of this field impedes this understanding. A key challenge in the shift towards decarbonized manufacturing lies in ensuring worker satisfaction and understanding their preferences in the context of this transition. To address this issue, we are trying to implicate a discrete choice model. With the result of the designed choice-based conjoint survey tailored to the context of decarbonized manufacturing, we could create a Logit-based machine-learning model designed for survey data analysis. The Logit model, selected for its capability to handle categorical data and binary outcomes, aligns well with the choice-based survey data. The model output is expected to aid in fitting a multinomial logit model, further enabling a transformation from the preference space into the willingness-to-pay space. While specific results are yet to be derived as we are at the starting year of this three-year project, we emphasize the importance of designing robust survey instruments and the role of extensive pretesting at the current stage to ensure the derived results are meaningful and reliable. The overarching objective is to contribute to formulating sociotechnical models to promote inclusive industrial practices and facilitate a smoother transition toward renewable resources in the manufacturing sector.

Keyword(s):

Decarbonization, Worker Satisfaction, Logistic Regression, Sociotechnical Models, Energy Transition

Mentor(s):

Rebecca Ciez (Engineering); Meenakshi Narayanaswami (Engineering); Ivan Arturo Nunez (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 370
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Design of a Robotic Sensor Deployment System for Soil Monitoring

Author(s):

Alan Chen† (Santa Clara University)

Abstract:

By 2050, the world population is projected to reach 9.7 billion, and the agricultural industry is responsible for maintaining food security. Recent advances in the internet of things have facilitated the development of precision agriculture techniques that will improve resource efficiency by informing farmers about local crop needs. Researchers are developing distributed sensors for soil monitoring, as well as autonomous navigation algorithms for robotic agents, but the robots currently lack the ability to interact physically with the sensors. In this work, we introduce a novel robotic system that can be mounted on an unmanned ground vehicle to deploy sensors autonomously. This system uses an auger to drill a hole in the soil and plants a sensor using a rotating dispenser. The designed dispenser system successfully unloaded a full magazine of sensors during 90% of lab trials. Field tests will be conducted to evaluate the integrated system's ability to perform the deployment process from start to finish. The sensor deployment system provides farmers with a reliable means of deploying sensors over hundreds of acres and contributes to the automation of essential agricultural practices that have traditionally required significant human inputs.

Keyword(s):

Precision Agriculture, Distributed Sensors, Robotics

Mentor(s):

David Cappelleri (Engineering); Aarya Deb (Engineering); Kitae Kim (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 371
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

The flexoelectric properties of various polymers and their associated energetic composites

Author(s):

Conor Costello† (Engineering)

Abstract:

Flexoelectricity is defined as the coupling between strain gradient and electrical polarization in a dielectric material. It has become a topic of increasing interest since the turn of the century as its potential application in nanoscale sensors, actuators, energy harvesters, and more is researched. This project investigated the flexoelectric properties of several polymers and their associated energetic material composites including poly(vinylidene fluoride-co-trifluoroethylene) (P(VDF-TrFE)) and aluminum (Al)/P(VDF-TrFE), poly(vinylidene fluoride-co-hexafluoropropylene) (P(VDF-HFP)) and Al/P(VDF-HFP), hydroxyl-terminated polybutadiene (HTPB), ammonium perchlorate (AP)/HTPB, Al/AP/HTPB, polytetrafluoroethylene (PTFE), and polydimethylsiloxane (PDMS). The roughly thumb-sized samples were tested using the cantilever beam method, which involves clamping one end and oscillating of the free end of the sample to generate a strain gradient. The resulting current from the electrode-covered sample is measured. The micron-scale-thickness P(VDF-TrFE) samples showed higher flexoelectric performance after the addition of aluminum powders, although no statistically significant difference between the neat and aluminized samples was found. All other polymeric and energetic materials were of millimeter-scale thickness and tested with the same experimental setup. The study on the flexoelectric properties of HTPB and its propellant compositions (AP/HTPB and Al/AP/HTPB) concluded that adding Al and AP to HTPB to create a solid propellant sample vastly decreased the flexoelectric performance, with similar, yet less extreme, trends present for the other aluminized (energetic) materials. This study has furthered the understanding of flexoelectric performance in energetic materials, yet more research must be conducted to bridge the gap between experimental results and applications in nano-scale devices.

Keyword(s):

Flexoelectricity, Energetic Materials, Polymers

Mentor(s):

Steve Son (Engineering); Thomas Hafner (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 372
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Animation From Single Image and Text

Author(s):

Hyungjun Doh† (Engineering)

Abstract:

Visual understanding and action prediction in computer vision present fundamental challenges. Recent advancements in diffusion models have achieved state-of-the-art synthesis results in image data. Conversely, despite the emergence of transformers as the dominant mechanism in large language models, they have not been used effectively generating an animation. Animation from a single image remains a complex task. This research addresses this challenge by proposing a diffusion model that generates a sequence of frames from a single image. To enhance the smoothness and accuracy of the animation generated by our approach, we leverage the NW-UCLA dataset. This dataset encompasses 10 action categories and includes RGB, depth, and human skeleton data. Keyframe information is extracted from each action category, consisting of an image frame, a text description, and human skeleton data. The diffusion model is trained using sequences of frames as ground truth, with the keyframe information serving as conditioning. Perceptual metrics, specifically the Structural Similarity Index (SSIM), are employed to evaluate the performance of our implementation. The results demonstrate that our project achieves realistic animations that faithfully depict the text descriptions based on the provided images. Furthermore, our research holds potential beyond applications in animation, encompassing diverse domains such as human-computer interaction and virtual reality.

Keyword(s):

Machine Learning, Deep Learning, Diffusion Model, Generative Model

Mentor(s):

Karthik Ramani (Engineering); Rahul Jain (Engineering); Jingyu Shi (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 373
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Automation of Elevation Dataset Analysis

Author(s):

Connor Durkin† (Grinnell College)

Abstract:

The 3D Elevation Program (3DEP) managed by the U.S. Geological Survey (USGS) made publicly available the elevation data at any geospatial point in the nation. Similarly, the U.S. Department of Agriculture (USDA) has the Soil Survey Geographic Database (SSURGO) providing data such as drainage class and soil type. The USGS 3DEP data was collected via Light Detection and Ranging (LiDAR) while the USDA SSURGO data was collected on foot, meaning they have different data types. Both researchers and farmers alike struggle to make use of datasets such as these as they differ in source and in data types. We will develop an open-source Python package that automates the transformation of low-level data into high-level data, allowing both researchers and farmers to easily interpret it. The package will use Network Mapper's Application Programming Interface (Nmap's API) to contact USGS 3DEP and USDA SSURGO and will transform the data using GeoPandas. The result of which will allow the user to more efficiently analyze the elevation and soil data of a specified geospatial point, increasing throughput and accuracy of later statistical analysis.

Keyword(s):

USGS 3DEP, USDA SSURGO, Elevation Datasets

Mentor(s):

James Krogmeier (Engineering); Sneha Jha (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 374
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Programming the Stiffness of a Ferroelastomer

Author(s):

Newt Fey† (Engineering)

Abstract:

Mitigating vibrations has a wide variety of applications from earthquake defense to protecting victims in otherwise devastating car accidents. For decades, vibration attenuation technology has been limited to dampeners and such devices. While effective, to actively reduce vibrations in bike helmets or the bumper of a car, these solutions are bulky and prone to defects after prolonged use. Smart structures, materials that can manage vibration control autonomously and actively in response to their environment, are able to stiffen and soften to counteract vibration waves, thus preventing damage while also being lightweight and compact. This tunable stiffness is the key to mitigating vibrations. In this study, we use mechanical stress testing and the application of a magnetic field to characterize the stiffness of ferroelastomers with different wt% filler ratios. We use silicon molds to produce our samples composed of silicone and iron particles. We apply horizontal and vertical magnetic fields and observe the change in stiffness. In the future, we plan to create samples of a complex geometry using the most effective wt% composition. By embedding magnetic filler particles in an elastomer, we will be able to fabricate a ferroelastic metastructure whose stiffness we can manipulate by applying a magnetic field.

Keyword(s):

Ferroelastomer, Programmable Stiffness, Magnetic Fillers, Vibration Attenuation, Compression Testing

Mentor(s):

James Gibert (Engineering); Xinhao Quan (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 375
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Investigating Corrosion Properties of Advanced Manufactured Materials in Extreme Environments

Author(s):

Evan Frishholz† (Engineering); Donovan Simonton‡ (Engineering); William Appel* (Engineering); Morgan Smith* (Engineering)

Abstract:

Advanced manufacturing techniques such as additive manufacturing and material coatings provide the ability to economically fabricate parts with complex geometries and specialized properties, however, before these materials can be used in industry their corrosion behaviors must be understood. To understand the behavior of additively manufactured stainless steel in chlorine environments additively manufactured and traditionally wrought stainless steel samples were electrochemically corroded in a 3.5wt% NaCl solution. To understand how aluminized and boronized stainless steel samples will corrode high temperature stagnation corrosion tests were performed in a molten eutectic $MgCl_2$-NaCl-KCl mixture, and liquid sodium. Analyzing the potentiodynamic polarization and electrochemical impedance spectroscopy curves for both additively manufactured and traditionally wrought stainless steel showed a bilayer of passive films formed but metastable pitting was absent and passivation regions were weaker in the additively manufactured potentiodynamic curves. This behavior is likely a result of minimized MnS inclusions and non-uniformities in the microstructure generated in the additive manufacturing process. The high temperature corrosion samples were analyzed by energy dispersive X-ray spectroscopy. The boronized samples tended to be inert in molten salt and liquid sodium, however some cracks formed showing further investigation must be done to make the coating more ductile. The aluminized samples were slightly more reactive than the boron coated samples, potentially caused by pores created during the coating process, but cracking didn’t occur showing the coating is more ductile the boronized coating. This information informs under what conditions advanced manufacturing techniques can be used.

Keyword(s):

Corrosion, Stainless Steel, Electrochemical Corrosion, Additive Manufacturing, Material Coatings

Mentor(s):

Yi Xie (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 376
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Analysis of Ca2+ dynamics for 1 and 2 cell-stage

Author(s):

Emmanuel Gichaba† (Engineering)

Abstract:

Calcium ions (Ca2+) play a critical role in various processes, including contraction, transcription, fertilization, and proliferation. While the significance of Ca2+ in these processes is well-established, the specific underlying mechanisms remain elusive. This work aims to develop a computational model that elucidates Ca2+ dynamics, integrates previously observed patterns, and tests the effects of different parameters, such as the synthesis of IP3 (VPLC) and the Ca2+-dependent rate of IP3R inactivation (Kτ). This study successfully reproduced a single-cell model that captures the Ca2+ dynamics of a single cell. The model utilized a set of Nonlinear Ordinary Differential Equations (ODEs), accounted for Ca2+ concentrations in the cytoplasm and the lumen of the endoplasmic reticulum (ER), the formation and degradation of inositol 1,4,5-trisphosphate (IP3) in the cytoplasm, and IP3 receptors (IP3R) located in the ER membrane. Furthermore, the single-cell model was expanded to develop a two-cell model. Results from the single cell model show that the VPLC parameter leads to an increased frequency of the Ca2+ spikes, from 1 spike/hour to 6 spikes/hour as VPLC goes from 0.75 to 1.6 µM, while Kτ leads to an increase of the period of a Ca2+ spike, from 44.43 seconds to 163.28 seconds as Kτ goes from 0.5 to 1.2 µM. The two-cell model showed that two cells with the same parameter values and different initial conditions will always reach equilibrium. Thus, the two models accurately reproduce previously studied Ca2+ dynamics and serve as valuable tools for comprehending the effects of VPLC, Kτ, and initial condition values.

Keyword(s):

Calcium Dynamics, Computational Model, ODE, Biological Simulation & Technology

Mentor(s):

Adrian Buganza-Tepole (Engineering); Elsje Pienaar (Engineering); Norma Perez-Rosas (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 377
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Relation of power, time, and temperature on the joining of materials at an interface

Author(s):

Samuel Greenaway† (Engineering, JMHC)

Abstract:

Most joining practices such as welding and brazing have defined methods and processing parameters for different materials. There have been numerous processing parameters on temperatures and holding times for a variety of materials developed, but there is little true understanding of the universal relationship that leads to joining for each category of materials. To tackle the problem, the research objective is to elucidate the interdiffusion and bonding mechanism with a focus of processing parameters of power, time, and temperature. The work includes a review of literature regarding joining dissimilar materials at interfaces through interdiffusion in addition to conducting heating experiments to reveal the relation of interdiffusion and processing parameters in terms of power, time and temperature. To do so, a custom-designed fast heating source was used to heat a thin piece of steel that has either a small polished steel foil square or ceramic piece pressed into it at a variety of temperatures and hold times to allow for the power output from the heating source to be recorded. Results suggest that increased power, time, and temperature lead to greater interdiffusion for both steel and ceramic, but too much of each parameter has negative effects such as undesired phase change and grain growth. This relationship will help with developing innovative methods of joining similar and dissimilar materials and will help more materials to be joined such as the ones needed in extreme environment applications of the aerospace and nuclear industry.

Keyword(s):

Interdiffusion, Power, Dissimilar Materials, Steel, Temperature

Mentor(s):

Yi Xie (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 378
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Numerical Investigation of Nonlinear Waves in Compressible Liquid Propellants

Author(s):

Bora Haller† (Engineering)

Abstract:

Redacted.

Keyword(s):

Propulsion, Combustion, Rotating Detonation Engines, Liquid Propellants, Numerical Simulations

Mentor(s):

Carlo Scalo (Engineering); Forrest Lim (Purdue University); Vaibhav (Havi) Rajora (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 379

Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Recyclable Polymers Synthesized Through Free-Radical Polymerization

Author(s):

Tejaswini Haraniya† (Engineering)

Abstract:

Inefficient and costly recycling strategies of current commercial plastics are the cause of a growing environmental concern surrounding plastic waste. The lack of circular recycling strategies has led to the underutilization of the chemical potential of single-use plastics. Therefore, it is imperative that polymer recycling methods are scalable and efficient in the selective cleavage of carbon-carbon bonds between monomers. Here, we report the scalable free radical synthesis of muconate ester-based polymers. The structure of the polymer allows it to depolymerize with up to 70% yield at an accessible temperature of 250 °C. The synthesized polymers are easily processable in chloroform without elevated temperatures. Modifying the side chains of the polymer as well as synthesizing copolymers, allows for easy tuning of mechanical properties. The absence of catalysts and a short depolymerization time of around 30 minutes makes the synthesis and recycling of the polymers cost-effective, while the simple procedure makes the process scalable. By using an alternative recycling strategy, our findings pave the way for the use of sustainable polymers across a variety of applications ranging from 3-D printing to packaging.

Keyword(s):

Polymers, Sustainability, Organic Synthesis

Mentor(s):

Letian Dou (Engineering); Qixuan Hu (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 380
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Magnetocaloric Refrigeration for Lunar Hydrogen Liquefaction

Author(s):

Sahda Haroon† (Engineering)

Abstract:

In order to ensure efficient operations in future lunar settlements and Earth-based systems, the liquefaction of hydrogen is necessary for its optimized transportation and storage. However, traditional gas compression liquefaction technology suffers from issues such as refrigerant pollution, low efficiency, and high energy consumption. This research focuses on developing a hydrogen liquefaction technique by investigating High entropy alloys, or alloys with a large proportion of many elements, as magnetocaloric materials within an Active Magnetic Regenerative Refrigeration (AMRR) system. The proposed strategy entails a comparative analysis of HEAs to assess their suitability for hydrogen liquefaction by analyzing properties, including heat lift, temperature change, magnetic response, and other relevant characteristics. Subsequently, the selected HEAs will be modeled and integrated into a customized AMRR system iteratively designed and developed for Lunar hydrogen liquefaction. The research aims to provide a detailed comparison of the HEA experimental analysis results, evaluate their effectiveness as magnetocaloric refrigerants, and offer recommendations for a modified Technology Readiness Level (TRL) 4-6 AMRR system tailored for lunar settlements. The primary conclusion drawn from this research is that using HEAs as magnetocaloric materials has the potential to significantly enhance the efficiency of hydrogen liquefaction systems in lunar settlements, thereby validating the exploitation of In-Situ hydrogen.

Keyword(s):

Hydrogen Liquefaction, Active Magnetic Regenerative Refrigeration, High Entropy Alloys, Magnetocaloric Materials, Lunar Settlements

Mentor(s):

David Warsinger (Engineering); Xavier Morgan-Lange (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 381
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Super Resolution Sensing with Relative Motion in Structured Illumination and Single Photon Correlations

Author(s):

Ian Holda† (Science, JMHC)

Abstract:

Conventional far-field imaging techniques have a maximum achievable resolution of approximately half a wavelength, and many applications, such as nanotechnology and biological imaging, would benefit from higher resolution. Here we describe two experiments which relate to new paradigms for sensing and imaging beyond the diffraction limit, based on the concepts of relative motion in structured illumination and correlations between photon counting detectors. The first experiment involves translating nanostructured membranes through a standing wave field in an interferometer and using intensity measurements at one of the interferometer arms to extract the physical parameters of the membrane. A mathematical model based on plane wave decomposition was developed to assist experiment design and facilitate inversion for membrane parameters. The approach used in this experiment will provide the capability to characterize multilayered dielectric structures with far-subwavelength resolution, significantly improving on what is possible with conventional methods such as ellipsometry. The second experiment involves measuring Hanbury Brown and Twiss (HBT) correlations through a heavily scattering medium. After transmission through the medium, scattered light falls upon two detectors. One detector is stationary and the other moved in set increments. Coincidences between arriving photons are measured to build up correlations over detector position, which are related to the properties of the light before it entered the medium. This experiment will improve understanding of how heavy optical scattering affects HBT correlations, potentially enabling a new paradigm for super resolution sensing.

Keyword(s):

Nanotechnology, Biological Characterization & Imaging, Super-Resolution Sensing, Quantum Optics

Mentor(s):

Kevin Webb (Engineering); Christopher Lacny (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 382
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Fault-Tolerance in Blockwise Learning

Author(s):

Connie Kang† (Engineering)

Abstract:

Distributed machine learning has grown in popularity due to data privacy, edge computing and large model training. Increasing the number of components in a distributed system means increasing the probability that some of these components will be subject to failure during the execution of a distributed algorithm. This demonstrates the reliability of a system, which also refer to a system's fault tolerance. Therefore, in distributed machine learning, we sought to improve the fault tolerance of the model against random devices failures and communication attacks. To achieve this, we utilize a blockwise training paradigm consisting of training devices independently with Barlow Twins, a recent self-supervised learning rule at each device. Experiments were conducted on MNIST to provide conclusions and recommendations based on our observation of the blockwise training model performance under different failures. We provide some preliminary analysis and experimental results to showcase the problem and naive baseline methods on a toy problem. This study indicates that the new model increases the fault tolerance level with the use of a self-supervised learning algorithm.

Keyword(s):

Mentor(s):

David Inouye (Engineering); Surojit Ganguli (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 383
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Co-AIdeator: A Collaborative Human-AI Ideation System For Product and Process Design

Author(s):

Nachiketh Karthik† (Engineering)

Abstract:

The recent emergence of large language models (LLMs) have opened exciting possibilities for ideation and concept generation. However, understanding the true capabilities of these LLMs and utilizing them efficiently in design remains a challenge, as it requires (a) experience in using LLMs, (b) expertise in prompt engineering, (c) effective utilization of LLM outputs, and (d) comprehension of LLM functionality to explore diverse design pathways. Moreover, within the design context, an interaction pattern has been observed wherein users rely heavily on the model's responses, leading to an over-reliance and a lack of ownership over ideas. We introduce an interaction framework derived from an elicitation study that maps LLM capabilities to support design workflows in novel ways. The framework guides the development of Co-AIdeator, a system comprising a web-based interface and a task-specific design toolkit. Co-AIdeator treats the LLM as a collaborative partner, unlocking the potential for symbiotic ideation between humans and AI. By providing user-centric prompts and intuitive, context-sensitive multimodal design representations, Co-AIdeator empowers users to explore uncharted design spaces and leverage AI capabilities. This study compares the results of the Co-AIdeator system's user study with those of a baseline LLM system, drawing conclusions about our system's effectiveness in enhancing idea quality, including novelty-diversity, user engagement, and expectation alignment.

Keyword(s):

Ideation, Interaction, Design, Framework, System

Mentor(s):

Karthik Ramani (Engineering); Runlin Duan (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 384
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Random walks with applications in polymer physics and protein crystallization

Author(s):

Kashif Khan† (University of Kansas)

Abstract:

Simulating the equilibrium conformations of polymers in complex systems has been used to calculate the macroscopic polymer properties in such systems. However, rare conformations of polymers require many samples to be produced which becomes computationally expensive for complex systems. For example, to study polymers in an external field that form a ring, we must restrict the state space to account only for the polymers that have the same starting and ending point, which is a very small subset of all possible conformations. The Brownian Bridge is a biasing technique that leads paths to a desired outcome and has been employed for the simulation of such rare events. Although applicable in theory, the Brownian Bridge requires the solution to the Backward Fokker-Planck (BFP) equation, which becomes computationally expensive for complex or higher dimensional systems. To avoid this, one can use the Wong-Zakai Theorem to generate the

exact statistics by solving a boundary value problem. This paper plans to solve such boundary problems to produce the exact statistics of semi-flexible polymer

chains with a desired conformation. Since this procedure avoids the solution to the BFP equation, we will show that it will accelerate the generation of polymers conditioned to a certain conformation, whilst producing the exact conditioned statistics.

Keyword(s):

Brownian Bridge, Wong-Zakai, Semi-Flexible Polymer, Simulation

Mentor(s):

Vivek Narsimhan (Engineering); George Curtis (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 385
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Electrical Resistance Analysis of Back-Side Power Delivery Networks(BSPDN) with Nano Through Silicon Vias(nTSV) for Power Efficient Chip Design

Author(s):

Ohik Kwon† (Iowa State University)

Abstract:

Due to the increasing demand for high-performance chips with greater functionality, transistors have continued to scale according to Moore's Law. However, as we approach the limitations of transistor scaling, 3D integrations have emerged as a promising solution to enhance the power and performance of chips. One crucial technology enabling vertical chip stacking is Through Silicon Vias (TSV). By utilizing Buried Power Rails (BPR) and Nano TSV (nTSV), which separate signal and power wires and position the power signals at the back side of wafers, improved Power Performance Area (PPA) is achieved. This technique holds great promise for further enhancing chip performance. Nevertheless, the complex fabrication process and the electrical performance of the BPR+nTSV structure on a device chip are not yet fully understood. Previous research has focused on analyzing the impact of simplified BPR+nTSV electrical simulations on IR drop and the device's thermal stress through thermo-mechanical simulations. However, there is a lack of comprehensive research examining the contact resistance and resistance of different materials (such as barrier or liner layers) in the nano-scale regime.

In this study, we employ ab-initio simulations to obtain the electrical properties of materials at the nano-scale and investigate their influence on the BPR+nTSV structure. Our aim is to present a thorough analysis of the electrical performance of the BPR+nTSV structure, considering various material combinations and geometries. By doing so, we seek to deepen the understanding of the electrical properties of the BPR+nTSV structure necessary for the intensive scaling of both devices and BPR+nTSV structures.

Keyword(s):

Through Silicon Vias, Buried Power Rails, Resistance, Simulation

Mentor(s):

Tiwei Wei (Engineering); Shuhang Lyu (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 386
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

HTGR Depressurization Event Through Steam Generator in Comparison to Through the Reactor Cavity

Author(s):

Tim Lane† (Engineering); Donovan Simonton* (Engineering); Andrew Bergeon* (Engineering)

Abstract:

High Temperature Gas-Cooled Reactors (HTGRs) are widely considered one of the safest next-generation nuclear power plants because they use helium, an inert gas, as coolant and especially stable TRISO fuel. In the case of a breach in the cooling system, helium can escape and eventually, air containing oxygen can enter the system and react with the graphite in the core of the reactor, permanently damaging the most expensive asset of the plant. This study attempts to characterize the HTGR buildings' response during such a break. Tests were conducted using a 1:28 scale model of a 350MW HTGR. Helium was injected into the apparatus until the internal pressure reached 1 psig, the actuation pressure of a commercial plant's louvers. A ball valve on one end was opened to mimic louver actuation and was left open with helium continually being injected for a period determined using the flow rate, temperature, and pre-established scaling laws before being considered "exhausted" and being turned off. Temperature and oxygen concentration in various parts of the reactor cavity, which houses the reactor pressure vessel, steam generator cavity, and vent flow path, were monitored for approximately 24 hours. Trials varied flow rate, break location and temperature. Results from these tests have shown that the system behavior is highly dependent on coolant break location. Scaled experimental data sets presented can assist HTGR vendors with information to impellent necessary engineering designs to protect their products during sever accident scenarios. A robust HTGR capable of restarting after serious accidents is expected to draw further investment and deployment resulting in a clean and reliable energy source for the U.S.

Keyword(s):

HTGR, Reactor Cavity, Helium, Oxygen, Depressurization

Mentor(s):

Shripad Revankar (Engineering); Derek Kultgen (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 387
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

A Toy Movie Review Microservice benchmark written in a compiler that uses a packed representation of data structures

Author(s):

Qingyuan Li† (Engineering)

Abstract:

A pointer-based data structure usually means every single node would be allocated randomly in memory. Although this approach is ubiquitous, it might be inefficient in some cases. Especially when we need to traverse most of the tree in bulk. In that situation, using a packed representation could provide improvements on both time and space usage. However, it would be difficult and error prone for a programmer to write code that uses packed representation. Therefore, the Gibbon Compiler was introduced to automatically transform programs written in high-level programming language (a subset of Haskell) into C code that uses packed representation. Although there is evidence showing the advantage of Gibbon's packed representation over the regular compilers, providing more benchmarks would be necessary to strengthen it. Therefore, we propose a movie review microservice benchmark to evaluate the efficiency of Gibbon's packed mode. We will compare the performance of Gibbon's packed mode with Gibbon's pointer mode, as well as the Glasgow Haskell Compiler(GHC) over a variety of traversals performed by the microservice benchmark.

Keyword(s):

Compiler Optimization, Microservice Benchmark

Mentor(s):

Milind Kulkarni (Engineering); Vidush Singhal (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 388
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Ocean Thermal Energy Conversion

Author(s):

Darren Lie† (Engineering); Maxwell Bolt* (Engineering); Andrew Showalter* (Engineering)

Abstract:

Oceans compose over 70% of the earth's surface area. Such a large body of water is capable of absorbing and storing an incredibly large amount of useful energy, or exergy, in the form of heat, which mainly comes from sunlight. Exergy from a specific location in the ocean can be calculated easily, however, there does not exist a global mapping of available exergy around the globe. The goal of this project is to generate a global map of exergy stored around the globe. The exergy stored at a specific location in the ocean can be quantified by analyzing the region in the ocean where temperature changes most rapidly, known as the thermocline, and using thermodynamic equations to calculate exergy based on temperature and fluid property difference. However, ocean thermoclines are generally difficult to predict accurately since they depend on factors such as location and time of year, which is where the role of machine learning comes in. A neural network was developed to predict ocean temperature based on geographical location and time, capable of predicting within 2 °C of the actual recorded temperature. Results from the model are then used to predict the thermocline at each location and subsequently, the available exergy, which averages about 2.5 x 10^8 J/m^2 around the equator and 0 J/m^2 near the poles. The global exergy map created from this study helps visualize the distribution of exergy around the globe and can be useful in determining the most viable locations to build an ocean energy plant.

Keyword(s):

Ocean Thermal Energy, Machine Learning, Computational Study, Global Mapping

Mentor(s):

David Warsinger (Engineering); Sandra Cordoba (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 389
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Stock Solution Preparation for the Coating of Palladium on Barley Stripe Mosaic Virus (BSMV) Nanorods

Author(s):

Josephine Lesley Liebrata† (Engineering)

Abstract:

Barley Stripe Mosaic Virus (BSMV) is a plant virus that acts as a bio-template for metal deposition to synthesize nanorods. The coating of metals such as palladium (Pd) on BSMV provides a higher adsorption capacity compared to the previously employed Tobacco Mosaic Virus (TMV), increasing cost- and time efficiency. High-quality nanorods could be utilized to develop highly-demanded devices such as batteries, nanoelectronics, and sensors. This project aims to determine what palladium solution works optimally in limiting the generation of palladium clusters while still providing even coatings on BSMV. Sodium tetrachloropalladate solution easily undergoes hydrolysis reactions, forming undesired palladium species in the form of clusters. The experiment began by heating a sodium tetrachloropalladate solution at 57 C for 30 minutes. The solution was centrifuged to remove undesired palladium species and was diluted before examining it with Ultraviolet-Visible spectrophotometry (UV-Vis). Significant peaks in the UV-Vis spectrophotometry spectrum indicate the absorbance of desired or soluble palladium species, which could be utilized to calculate the optimal palladium solution. Dynamic Light Scattering (DLS) would measure the growth rate of undesired palladium species. Upon achieving these, coatings of palladium on BSMV were performed. Three coating processes were done per sample, with five subsequent washes after each coating. Finally, the palladium-coated BSMV was imaged under Transmission Electron Microscopy (TEM). At optimized conditions, the nanorods would have smooth coatings with minimum aggregations. A sodium tetrachloropalladate solution with a lower pH yields a higher retainment percentage of soluble palladium species and hence is suitable for palladium solution preparation.

Keyword(s):

Nanorods, BSMV, Palladium, UV-Vis Spectrophotometry, Coatings

Mentor(s):

Michael Harris (Engineering); Che-yu Chou (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 390
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Validation and Analysis of RISC-V Based System-On-Chip Device Through Simulation and FPGA testing

Author(s):

Andrew Lykken† (Engineering)

Abstract:

System On a Chip devices contain everything a computer needs to execute programs all in one packaged integrated circuit. Creating System on a Chip (SoC) devices involves the design process, integration, extensive testing, and finally, manufacture of the SoC. Purdue's System on a Chip Extended Technology (SoCET) team develops RISC-V based SoC devices. RISC-V chips are used to simplify the SoC creation process by using a standard instruction set which is open-source, for any team to use and develop on. Previous generations of the AFT chips have limited features and performance. The design for the latest iteration, AFTx07, includes more integrated features, enhanced peripherals, and overall better performance than previous generations. This project aims to help validate the functionality of AFTx07 using comprehensive test scripts and a field programmable gate array (FPGA) to simulate and run programs on the current design of AFTx07. In this project, a mixture of C and RISC-V assembly was used to write test cases for the chip's features and run on an Intel Cyclone IV FPGA. The code is compiled with the RISC-V standard instruction set and run with an off-chip memory module. Code execution tests will be performed and analyzed with coverage tests, compile and runtime figures, power usage, and resource usage. A validation test suite will be used for compiling results. After FPGA testing of AFTx07, final routing and die design will need to be completed prior to manufacturing the chip.

Keyword(s):

FPGA, System On A Chip, Validation, RISC-V

Mentor(s):

Mark Johnson (Engineering); Cole Nelson (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 391
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Advancements in Fluid Mechanics Research through Physics-Informed Machine Learning Using the Nonlinear-Elasto-Visco-Plastic Model.

Author(s):

Jalen Magee† (Savannah State University)

Abstract:

Fluid mechanics use various methods to solve different types of practical problems. Conventional methods suffer from long computation times and need hands-on manual intervention, prompting us to seek a better method. In our study, we investigate the potential of physics-informed machine learning (PIML) and neural networks in the field of fluid mechanics, specifically through the Nonlinear-Elasto-Visco-Plastic (NEVP) model. Our research is driven by combining machine learning techniques using Python with physics principles, thereby shedding new light on fluid mechanics. The proposed methods entail collecting experimental data using a rheometer to measure and analyze the flow properties of the fluids with the data including the shear stress, the elastic modulus, etc. Next, in Python, we will be using PIML, more specifically, the DeepXDE library that specializes in physics-informed neural networks (PINN) to train the NEVP model using supervised learning, allowing the network to incorporate the experimental data. Adding on, our results showcase that the NEVP model features enhanced accuracy and efficiency in capturing the elastic behavior and the stress buildup of certain complex fluids. Through this study, we present an innovative approach for fluid mechanics research to progress by harnessing the power of PIML and PINNs to learn the NEVP model and thus the behavior of complex fluids (such as thermal greases) and how they flow.

Keyword(s):

Machine Learning, Deep Learning, Fluid Mechanics, Physics, Coding

Mentor(s):

Ivan Christov (Engineering); Pranay Nagrani (Engineering); Shrihari Pande (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 392
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Filling Vials, Not Filling Time: Design and Fabrication of a Mobile Vial-Filling Station for Pharmaceutical Freeze-Drying

Author(s):

Christine Mayo† (Engineering)

Abstract:

Lyophilization, or freeze-drying, is a vital pharmaceutical manufacturing process used to stabilize compounds that exhibit heat sensitivity or a lack of stability in solution. As part of the ongoing advancement of lyophilization technologies, LyoHUB is a consortium of pharmaceutical companies with the goal of continuous improvement of lyophilization practices. LyoHUB has a Purdue University specialized laboratory used as a demonstration facility, primarily dedicated to advancing freeze-drying technologies. One of the key preparatory processes with daily characterization practices is filling vials with solutions to design lyophilization "cycles" complete with temperature and pressure profiles. In certain instances, the vial-filling process is required to adhere to aseptic standards, particularly with biologics. In the pharmaceutical industry, aseptic processes often utilize peristaltic pumps for automated dose delivery rather than the pilot-scale use of pipettes. To improve the efficiency of regular vial-filling within the LyoHUB laboratory, a mobile filling station has been designed to substitute manual pipetting with more precise delivery by a peristaltic pump. To answer the demands of an aseptic work environment and hasten the dose delivery process, the mobile filling station has been designed with doors that allow flexible access to operating with laminar flow and a glove box. The mobile filling station not only improves the cleanliness and time-efficiency within the hood but also creates a more organized laboratory by being mobile and eliminates the strain on research scientists that follows repetitive manual pipetting. Therefore, the mobile filling station increases safety and accuracy for the medicines and those working to produce them.

Keyword(s):

Lyophilization, Filling Station, Aseptic Manufacturing, Laboratory Automation, Laboratory Management

Mentor(s):

Alina Alexeenko (Engineering); Petr Kazarin (Engineering); Andrew Strongrich (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 393
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Impact of powder blending and process parameters on granule bulk density and particle size distribution in a dry granulation process

Author(s):

Dhruv Mendpara† (Engineering); Jayden Pierce* (Engineering)

Abstract:

Continuous dry granulation is one of the common processes used for pharmaceutical tablet manufacturing which involves feeder, blender, roller compactor (RC) and tablet press. Compared to wet granulation, dry granulation approach allows the usage of heat and moisture-sensitive materials opening up the possibility of applying granulation technique on various other powder materials to improve qualities such as flowability and bulk density. The process of RC involves compression of powder by two counter-rotating rolls, then milled into granules before using them to make tablets. For this project, the effect of the change in the type of blenders at different process parameters such as rotor-screen gap (RSG) and hydraulic pressure on the bulk density and particle size distribution of the granules will be focused. Alexanderwerk WP120 RC was employed to collect sample granules at different conditions which were then analyzed for the distribution of fines and granules in each sample using CANTY SolidSizer. A blend mixture of 10% Acetaminophen (APAP) and 90% Microcrystalline Cellulose (MCC-102) was used with the design of experiments being to operate the RC with Tote blender (batch blending based on weight) and continuous Gericke blender (blending based on flowrate) at RSG 0.2, 0.5, 1.0, and 1.5 mm with the hydraulic roll pressure at 30 bar and 60 bar each. The results show that at both pressures, the number of fines decreases as the RSG decreases for each blender type. However, the number of fines produced for each blender type varied indicating that blending approach can impact the granule properties.

Keyword(s):

Granulation, Roller Compaction, Rotor-Screen Gap, Particle Size Distribution, Bulk Density

Mentor(s):

Rex Reklaitis (Engineering); Yan-Shu Huang (Engineering); Marcial Gonzalez (Engineering); Zoltan Nagy (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 394
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Semiconductor Quantum Wells in 2D Hybrid Halide Perovskites

Author(s):

Nodebechukwu Mgbodille† (Engineering)

Abstract:

Recently, two-dimensional hybrid halide perovskites (e.g., lead halides sandwiched between organic ligands) have proven to be an excellent class of semiconductors in optoelectronic applications because of their fine tunability and wide variation of optical absorption; however, a complete structure-property relationships profile in terms of the inorganic band alignment is missing. Here, we evaluate different types of band alignments in quantum wells in a systematic manner. Due to the toxicity of lead, we synthesized materials based on tin halides. Large ammonium ligands were synthesized through a series of Stille coupling reactions. The ligand synthesized was used to grow perovskite crystals and the resulting two-dimensional hybrid perovskite is tested for the desired band alignment in its quantum wells. Various band alignments of semiconductor quantum wells will control and manipulate different spectra of light making them versatile for an extensive variety of purposes.

Keyword(s):

Quantum Wells, Semiconductors, Ligands, Perovskites, Band Alignments

Mentor(s):

Bryan Boudouris (Engineering); Dharini Varadharajan (Engineering); Letian Dou (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 395
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Measuring the Effect of Crack Parallel Stress on the Toughness of a 3D Printed Quasi-brittle Polymer

Author(s):

Nathan Miles† (Engineering)

Abstract:

Cracks are unavoidable features of any engineering or biological material. Thus, understanding fracture toughness is central to ensuring structural integrity of mechanically loaded systems. Fracture mechanics provides a framework to investigate such problems. The quantity stress intensity factor is a key parameter. It combines information of stress perpendicular to the crack, the crack length, and structure geometry. Recently, Bazant et al. have demonstrated that fracture behavior can also be dependent on stress parallel to the crack. General knowledge on the effect of crack parallel stress on fracture toughness is not yet available. For concrete, an isotropic, heterogeneous solid, crack parallel stress was found to increase fracture toughness while for carbon fiber composites, an anisotropic, strongly heterogeneous solid, it was found to decrease fracture toughness. Here a mildly elastic anisotropic, mildly heterogeneous 3D printed polymer is selected to investigate the effect of crack parallel stress on fracture toughness. This choice of material is motivated by the ultimate objective to investigate the effect of crack parallel stress in cortical bone, which shares the characteristics of mild elastic anisotropy, heterogeneity, and quasi-brittle response with the material considered here. It is predicted that crack parallel stress will increase the measured toughness of the 3D printed samples due to the microstructure induced by the printing process. Evaluation of quasi-brittle materials, like bone, is important to further the development of effective treatment for bone-related disease.

Keyword(s):

Fracture Toughness, Quasi-Brittle Materials, Stress State

Mentor(s):

Glynn Gallaway (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 396
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Experimental Characterization of Vapor Selective Membranes for Air Dehumidification in Industrial Drying Applications

Author(s):

Ansh Mishra† (Engineering)

Abstract:

Heat pump-based drying processes are gaining attention as a potential technology because of their high efficiency and electrification. However, the heat pump-based drying processes are still energy intensive due to excessive cooling for dehumidification and reheating of the process air. Vapor selective membrane technology is one way of eliminating the energy penalty to improve the efficiency of heat pump drying processes. The vapor selective membranes have a dense hygroscopic active layer and a porous hydrophobic support layer. The hygroscopic nature of the active layer is used to segregate vapor particles from humid air and the support layer is used to provide mechanical strength and stable structure to the membrane. Consequently, air dehumidification can be performed by eliminating the energy penalty associated with cooling and reheating the air in heat pump drying processes. However, determining a membrane having the desired properties is challenging and needs further scrutiny. This work focuses on fabricating high-performance vapor selective membranes by utilizing various materials for the active layer coating and comparing membrane performances to establish an optimal membrane for industrial dehumidification applications. NEXAR, Polybenzimidazole (PBI), PEBAX 1657, Graphene Oxide, Polyvinyl Alcohol (PVA), and Poly-Ether-Ether-Ketone (PEEK) are promising polymer candidates considered for this work. Vapor permeability, nitrogen permeability, H2O/N2 selectivity, and thermal conductivity are characterized in detail. In addition, the difference in active layer thickness is studied to understand how it affects membrane performance and is observed through scanning electron microscope imaging. A general framework for membrane fabrication and characterization of various polymer materials is presented.

Keyword(s):

Heat Pump Dryer, Dehumidification, Polymer Membrane, Permeability, Selectivity

Mentor(s):

David Warsinger (Engineering); Jinwoo Oh (Engineering); Setareh Heidari (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 397
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Liquid Crystalline Nonconjugated Organic Radicals

Author(s):

Lukas Peng† (Engineering)

Abstract:

In recent years, research has been done to further the understanding of organic conducting materials as an alternative to limited metal resources. Specifically, organic radicals have shown specific conductive, paramagnetic, and structural properties that make them potential candidates to supplement, or replace, other more established organic electronic materials. Moreover, liquid crystals (LC) are already well known as suitable materials for optoelectrical devices, such liquid crystal displays (LCD), due to their distinguished oriented domains. However, radical-containing liquid crystalline behavior has been infrequently reported and little is known about the behavior of these polymers. This work focuses on understanding the behavior of liquid crystallinity structures shown by a class of 2,2,6,6-tetramethyl-1-piperidinyloxyl (TEMPO) derivatives. Depending on the length of the carbon chain on the tail of TEMPO LCs, various crystalline phases and liquid crystalline (e.g., the nematic and smectic phases) were observed. The conductivity and magnetoresistance measurements (MR) of TEMPO LCs were further processed, performing up to conductivity value of ~ 30 S m-1 and ~ 100% MR, which are both state-of-art values reported from organic nonconjugated radicals to date. These data have provided critical insights to the structure-property relationships in this nascent class of materials, and these design rules will allow for the optimization of conductivity and magnetic field-dependent properties.

Keyword(s):

Liquid Crystalline, Organic Radicals, Conducting Radicals, TEMPO Derivatives

Mentor(s):

Bryan Boudouris (Engineering); Hyunki Yeo (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 398

Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Utilizing ETV2-endoding modRNA to Efficiently Differentiate Human Pluripotent Stem Cells into Hemogenic Endothelium

Author(s):

Nathan Petrucci† (Engineering, JMHC)

Abstract:

Current immunotherapies, including CAR T cell therapies, rely on the time-consuming and costly procedures of harvesting and culturing patient or donor cells. Pluripotent stem cells provide a potential alternative source of cells which could alleviate the time and expense involved in immunotherapies. However, the lack of robust and efficient protocols to differentiate pluripotent stem cells into hemogenic endothelium is a current barrier preventing the implementation of stem cell-derived cells in immunotherapy. In this study, building off existing methods to produce hemogenic endothelium, we attempt to develop a new protocol with higher yield and less complexity. Modified mRNA encoding the ETV2 gene was synthesized from plasmid DNA. The successful production of modified mRNA was verified by gel electrophoresis and NanoDrop. The modified mRNA was lipofected into human pluripotent stem cells at different times in the differentiation process. The transient expression of ETV2 in the cells effectively differentiated them into hemogenic endothelium. The cells were characterized by using fluorescence immunostaining and flow cytometry analysis. All treatments successfully produced hemogenic endothelium, but further analysis is required to definitively determine the time of ETV2 expression which maximizes yield. Additionally, in future studies the ETV2-directed hemogenic endothelium will be further differentiated into hematopoietic stem cells. Ultimately, this established protocol could help streamline the process of producing immune cells from human pluripotent stem cells, improving their feasibility of use in clinical immunotherapy.

Keyword(s):

Immunotherapy, modRNA, Human Pluripotent Stem Cell, Hemogenic Endothelium, Hematopoietic Stem Cell

Mentor(s):

Xiaoping Bao (Engineering); Yun Chang (Engineering); Jingqiao Shen (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 399
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Integration of QUDI into Single Photon Emitters Experiment Setups

Author(s):

Khoi Pham† (Engineering); Alina Stuleanu‡ (Engineering)

Abstract:

Single-photon emitters (SPEs) are possible candidates for ideal sources of flying qubits in the field of quantum photonics and information technology. Experiments and developments of SPEs seek to provide an alternative method of implementing quantum photonic technologies. This project aims to design and implement a software suite that can control a time-correlated single photon counting and confocal microscopy setup that is under construction. The implementation of this software is designed to assist research by automating data collection from SPEs. Our team has chosen QUDI, a modular Python suite, as our main framework to build the software application. QUDI has 3 different module layers: the graphical user interface (GUI) module, the logic module, and the hardware module. The GUI helps the users interact with the machine more easily; the logic module is for controlling and synchronizing a given experiment; and the hardware module will turn the commands made by the logic modules into specific communication protocols for different devices. Combining these three types of modules, we have demonstrated the implementations of multiple parts of the experiment setup, including a proportional–integral–derivative (PID) controller, a piezoelectric driver, and the linear actuated variable attenuator thus far. The ultimate goal is to finish implementation of the rest of the hardware required and integrate all of the hardware modules into a fully functional GUI and automation codes. With this software, experiments on SPEs can achieve much higher throughput which is required for any potential breakthroughs in SPE based quantum technologies.

Keyword(s):

Single Photon Emitters, SPEs, QUDI

Mentor(s):

Alexander Kildishev (Engineering); Samuel Peana (Engineering); Vladimir Shalaev (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 400
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

A Level II Driving Simulator for Cognitive State Modeling of Human Machine Interactions

Author(s):

Bao Quoc Phan† (Science); Alex Wang‡ (Science, Polytechnic Institute)

Abstract:

Worldwide, automotive companies are investing in the development of automated and autonomous vehicle technologies. While most research has been devoted to developing self-driving technology itself, there has been far less research on the interactions between human drivers and self-driving agents. Ultimately, we aim to improve such human-machine interaction by modeling and analyzing the driver's trust, self-confidence, mental workload, and perceived risk (which are the cognitive states that have been known to affect human-machine interactions). However, modeling the driver's cognitive states in real life scenarios can be expensive, dangerous, and complicated. Instead, Unreal Engine (UE) 5.1 is used as a platform for developing a dedicated SAE Level II driving simulator as a research testbed. Given the interest in human cognition during interactions with the autonomous vehicle, the simulator must not only include realistic driving scenarios, but additional sensing modalities, including psychophysiological and self-report data collection, must be integrated with the UE5 environment. In this research effort, an approach for integration and coordination of multiple sensing platforms with the UE5 environment is proposed and demonstrated. Python and UE5's UDP (User Datagram Protocol) message plugin are used to design a communication system between the simulator and iMotions, a software that integrates and synchronizes psychophysiological and behavioral sensors. The proposed system facilitates data post processing and analysis by enabling the simulator to send real time event markers to iMotions.

Keyword(s):

Human Factors, Driving Simulation, Unreal Engine

Mentor(s):

Neera Jain (Engineering); Michael Williamson Tabango (Engineering); Sibibalan Jeevanandam (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 401
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Unraveling the Puzzle of Perovskite Stability

Author(s):

Hithesh Rai Purushothama† (Arizona State University)

Abstract:

Perovskite solar cells (PSCs) have gained significant attention as a promising alternative to traditional solar cell technologies due to their exceptional photovoltaic performance, cost-effectiveness, and ease of fabrication, making them attractive candidates for various applications such as solar cells, LEDs, and photodetectors. Despite the remarkable efficiency improvements witnessed in the past decade from 3.8% to 25.8%, the stability of perovskite structures remains a crucial challenge that must be addressed for their widespread deployment. The problem is that understanding the stability of PSCs has not been given much prominence in the past, which makes it an important aspect to understand. This study focuses on analyzing different device structures and compositions to identify those additives and charge transport materials (CTMs), that can enhance the stability of perovskite devices. Through the comprehensive review of the literature, we identify key factors that determine the stability of devices. We first discuss primary factors influencing perovskite stability which are identified, including moisture, temperature, light exposure, and chemical interactions. By addressing these stability challenges, various strategies like encapsulation, adding additives, and using CTMs mitigate the defect and contribute to the ongoing efforts to commercialize perovskite materials. This paper aims to provide a deeper understanding of the stability of perovskite materials, as the current knowledge on this topic is still limited and lacks clarity. By exploring the stability of perovskite materials in more detail, this research aims to uncover important insights and fill the gaps in our understanding of perovskite stability.

Keyword(s):

Perovskite Solar Cells, Stability, Electronic Properties, Performance

Mentor(s):

Letian Dou (Engineering); Ke Ma (Engineering); Jiaonan Sun (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 402
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Implementing the Forward-Forward Algorithm in Fault-tolerant Decentralized Learning

Author(s):

Amritanshu Ranjan† (Engineering)

Abstract:

Distributed machine learning is a technique of training machine learning models across multiple devices in a network, allowing for large datasets to be processed in less time. The network's devices, sometimes known as "end devices," are tasked with data collection and making predictions. In most approaches to distributed learning, fault-proof end devices and communication are requirements. However, this is not fair to assume in many use-cases due to network connectivity issues, environmental factors, security breaches, etc. Although almost all deep learning models today are trained using the backpropagation algorithm, in distributed learning settings using modern hardware, backpropagation produces communication overhead, scalability limitations, and privacy concerns due to the heavy exchange or synchronization of model parameters. With faulty devices, this can lead to slower training time and poorer accuracy. To maximize the efficiency of end devices in fault-tolerant decentralized learning, we propose utilizing the Forward-Forward (FF) algorithm as an alternative to backpropagation. Not only can FF efficiently train devices with power limitations, but it also cultivates decentralization (and thereby privacy) because its local layer-wise learning can be simulated in devices that individually learn towards a global objective. However, FF has not been explored in the context of fault-tolerance and distributed data. In this study, we adapt FF and investigate its capability to handle device faults in a decentralized learning setting. We demonstrate an implementation of FF in fault-tolerant decentralized learning and compare the accuracy rates of FF versus backpropagation to determine which is better under our constraints.

Keyword(s):

Distributed Learning, Fault-Tolerance, Decentralization, Forward-Forward Algorithm, End Devices

Mentor(s):

David Inouye (Engineering); Surojit Ganguli (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 403
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Physics-based computational E-field dosimetry of transcranial magnetic stimulation (TMS)

Author(s):

Rodrigo Romero† (Engineering)

Abstract:

Transcranial Magnetic Stimulation (TMS) is a non-invasive brain stimulation approach using coils driven by low-frequency currents to stimulate a targeted region. Common applications are brain function studies and clinical purposes. Electric field (E-field) generated during TMS has been shown to be the effective ingredient, and computational E-field dosimetry has been accepted to improve TMS cortical mapping and TMS targeting. Finite element method (FEM) is one of the popular numerical techniques applied to evaluate the E-field during TMS, where a scalar potential determining the E-field in the brain is obtained by solving Poisson's equation derived from the current continuity condition. However, due to a large number of unknowns, the induced linear equation in FEM is usually solved with iterative solvers, where the convergence tolerance needs to be judiciously chosen to balance the accuracy and the efficiency of the solver. In this study, different convergent tolerances are first tested on the linear equations derived from the 1st-order FEM applying to different head models (i.e., spherical head model, lower-resolution MRI-derived head model, and high-resolution MRI-derived head model). Then they are tested on the linear equations derived from the FEM of different orders (1st and 2nd order). The results show that an optimal trade-off tolerance can be found in different cases, and this tolerance could improve the computational speed by at least 1/3 without losing the necessary accuracy.

Keyword(s):

Numerical Analysis, Transcranial Magnetic Stimulation, Iterative Solver, Convergent Tolerance, Finite Element Method

Mentor(s):

Dezhi Wang (Engineering); Luis Gomez (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 404
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Stress Breakdown Sleuth: Uncovering the Thermal Grease Secrets with Physics-Informed Neural Networks!

Author(s):

Luke Sanders† (Savannah State University)

Abstract:

Thermal grease is an important component of electronics and computer hardware and is the medium between a heat source and a heat sink. Thermal grease breaks down after being subjected to stress in a particular limit. We sought to predict and graph the stress breakdown or the relaxation regime of the thermal grease (DOWSIL TC-5622) through physics-informed neural networks that use a Thixotropic-elasto-visco-plastic (TEVP) model for the stress. The material behavior of thermal greases follows the TEVP model, which is a certain set of ordinary differential equations with certain unknown parameters. First, we created a model to solve stress as a forward problem with the unknown parameters given, so we can observe the relaxation regime. Then we take the experimental data and turn the model into an inverse problem. In this way we can use it to find the unknown parameters of the model. Specifically, we used the DeepXDE library implemented in Python and experimental data of the stress-strain to solve the problem. The goal of this study is to find the optimum of the six unknown parameters of the TEVP model. The unknown parameters are elastic shear modulus, background viscosity, plastic viscosity, yield stress, structure build-up coefficient, and structure breakage coefficient. Once the parameters are optimized, we can then predict how the test data shear stress should change over time. By comparing this predicted data to the actual test data, we will learn how well our physics-informed neural network is predicting the thermal grease behavior.

Keyword(s):

Machine Learning: Neural Networks, Thermal Grease, Fluid Mechanics

Mentor(s):

Ivan Christov (Engineering); Shrihari Pande (Engineering); Pranay Nagrani (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 405
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Calibrating Human Cognitive States for Effective Human-Automation Teaming: A Markov Decision Process Approach in Search and Rescue Scenarios

Author(s):

Arghya Sarkar† (Science)

Abstract:

As automation becomes more prevalent across industries, achieving effective coordination between humans and autonomous systems is crucial. Human decisions to rely on automation are influenced by human cognitive states such as trust in the automation, self-confidence in task execution and workload. Furthermore, it has been observed that both under-reliance and over-reliance on automation pose risks. Consequently, there is a need to develop autonomous systems that can appropriately calibrate human cognitive states in human automation interaction contexts. To verify the relationship between workload and self confidence in human automation teaming (HAT) contexts, we built a search and rescue game in which the number of roles assigned to the human and automation varies. A probabilistic model of human self-confidence and workload is to be trained from the data by using a Markov decision process framework. Additionally, an optimal control policy is developed using a reward matrix to maximize HAT task performance and calibrate human cognitive states. The implications of this research lie in the improved understanding of workload and self-confidence in HAT scenarios. Future research should focus on applying these findings in practical settings and further refining the calibration algorithms.

Keyword(s):

Automation, Coordination, Human-Automation Interaction, Workload, Self-Confidence

Mentor(s):

Neera Jain (Engineering); Madeleine Yuh (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 406
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Plasmonic Nanoparticle Densities for Physical Verification of Unclonable Spectral Tags in Microelectronics Packaging

Author(s):

Daksh Kumar Singh† (Engineering, JMHC)

Abstract:

Over the past half-century, the semiconductor industry has seen extraordinary growth. This expansion necessitated the division of the fabrication pipeline into multiple steps, each of which has the potential to introduce security vulnerabilities. In order to enhance security within these weak links, we have incorporated gold nanoparticles into the packaging material as stealthy tags. These nanoparticles contribute to fortifying the overall process, minimizing the likelihood of disruptions or tampering.

In this study, we examine the efficacy of plasmonic verification methods using gold nanoparticles, randomly dispersed on the surface of microelectronic device packaging. These nanoparticles serve as stealth tags; their spectra produces a unique physically unclonable function that cannot be duplicated. We utilize the Drop Casting method to implant these particles and analyze the samples using Dark Field Microscopy and Variable Angle Spectroscopic Ellipsometry.

Furthermore, we compare the spectral variance in relation to the differing concentrations of nanoparticles. This comparison enables us to determine the optimal density and particle placement ratios for secure verification. Our results indicate that the second peak intensity of the spectra has a correlation with the particle density in both coating methods. The spectra are blue-shifted when the concentration is constant and the reflection angle increases, and red-shifted when the reflection angle is kept constant, while the concentration is increased.

These findings suggest that gold nanoparticles provide random and unique spectral tags for the verification of microelectronics. Future research will involve the application of machine learning to develop robust verification frameworks based on these plasmonic spectral tags.

Keyword(s):

Nanoparticles, Plasmonic Verification, Spectral Tags, Security, Nanofabrication Methods

Mentor(s):

Alexandra Boltasseva (Engineering); Blake Wilson (Engineering); Yuheng Chen (Engineering); Alexander Kildishev (Engineering); Vladimir Shalaev (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 407
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Misynform - A Synthetic Data Generation Method with Intentional Misdirection for Adversaries

Author(s):

Michael Solmos† (Engineering)

Abstract:

Synthetic data generation is vital for increasing data availability, especially for engineering processes requiring extensive data. Valuable data transfers are necessary; however, they pose the risk of interception by adversaries. There is a gap in the process of data encryption when attackers have knowledge of the specific data properties. Generation of surrogate time-series data requires the preservation of dominant trends found within the original data as well as the stochastic properties of the associated noise. Data transfers are necessary; however, they are vulnerable to cyber-attacks and potential threats of exposure. This paper proposes a novel method of synthetic data generation that includes a deception component to mislead adversaries. The primary objective of the following techniques is to preserve the dominant trends of the original data and to introduce subtle modifications within the surrogate data sets. The process decomposes an input time series into its dominant and noisy components and generates synthetic data. Spurious correlations are introduced into the data via a “deception operator” to mislead adversaries who intercept it. The data will have identical statistical properties to the original data and additionally will remain unbeknown to adversaries. The results provide compelling evidence of the method's efficacy in protecting against cyber security adversaries.

Keyword(s):

Deception, Synthetic Data, Misinformation, Data Interception

Mentor(s):

Hany Abdel-Khalik (Engineering); Arvind Sundaram (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 408
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Numerical modeling and experimental visualization flow behaviors of impingement jet cooling and Tesla channel cooling

Author(s):

Yubo Song† (Engineering, JMHC)

Abstract:

The ongoing quest for enhancing cooling efficiency in various industrial sectors fuels our research, as we delve into the flow dynamics of two unique cooling methodologies: Impingement Jet Cooling and Tesla Channel Cooling. The heart of our study lies in unveiling the operational mysteries of these systems, where the former employs high-velocity jets to cool heated surfaces, and the latter leverages the diodic flow properties of Tesla valves. We adopt a dual-pronged approach combining numerical modeling and experimental visualization to thoroughly dissect the fluid behaviors in these systems. Our methodology involves experiments using Particle Image Velocimetry for flow visualization of the water inside the jet cooler and ANSYS software simulations for a deeper interpretation of flow resistances and diodicity index in Tesla valves. These comprehensive tools help us unravel the complexities of the fluid dynamics associated with these cooling methods. Initial findings suggest a substantial difference in forward and reverse flow resistances of the Tesla valves, highlighted by a significant diodicity index. Visual representation of the pressure fields using ANSYS provides a clearer image of the dynamics at play. The forthcoming conclusion from our study is anticipated to enrich the current understanding of these cooling systems. By demonstrating the unique unidirectional flow characteristics of the Tesla valve and the potential efficiency of Impingement Jet Cooling, we aim to spur future research and development efforts in the realm of advanced cooling technologies.

Keyword(s):

Fluid Dynamics, Heat Transfer, Cooling Efficiency, Experimental Visualization, Numerical Modeling

Mentor(s):

Tiwei Wei (Engineering); Zheng Gong (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 409
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Coherent Text Encryption via Semantically-Driven Word Embeddings: A Novel Approach using sense2vec

Author(s):

Ashwin Sreedhar† (Engineering); David Fall‡ (Engineering); Nikhil Pisolkar‡ (Engineering)

Abstract:

This paper proposes a novel encryption method leveraging semantic word embeddings generated via sense2vec for encoding plaintext messages into coherent encrypted text. In today's digital age, encryption is necessary for securing sensitive text data. Traditional encryption methods render ciphertext as seemingly random sequences of characters, preventing any readability or contextual understanding without decryption. However, our approach maintains a degree of semantic coherence in the ciphertext, making it appear as comprehensible text while preserving security. This research outlines an encryption algorithm that applies spectral clustering to sense2vec-generated embeddings; these clusters are then mapped to plaintext words. By selecting random words within the clusters, a ciphertext is generated. This ensures that the resulting ciphertext remains coherent, providing a semblance of natural language text. By masking the true content behind contextually similar but inherently distinct wording, the methodology protects the original message while obfuscating its meaning to unauthorized readers. The paper further assesses the semantic coherence of the encrypted text through verifying that natural language processing tasks such as authorship attribution and text classification are capable on the ciphertext. The results provide strong evidence for the robustness and effectiveness of this encryption method, demonstrating its potential for securing sensitive textual data while evading censorship or detection efforts that target traditional encryption artifacts. By advancing the intersection of cryptography and natural language processing, this paper introduces a new paradigm in text encryption, highlighting the potential for further research in this field.

Keyword(s):

Machine Learning, Natural Language Processing, Encryption, Cybersecurity

Mentor(s):

Hany Abdel-Khalik (Engineering); Arvind Sundaram (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 410
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Neo-Coyote: An Optimization for Vectorizing Encrypted Arithmetic Circuits

Author(s):

Sreevickrant Sreekanth† (Engineering); Dulani Wijayarathne‡ (Engineering)

Abstract:

Fully Homomorphic Encryption (FHE) is a cryptographic technique that allows secure computations on encrypted data. However, FHE suffers from slow execution. Previous attempts to improve FHE performance through vectorization techniques have often overlooked the costly rotations of vector operands. To address this issue, we propose a novel approach that builds upon Coyote, a method known for effectively vectorizing computational kernels while minimizing rotations in encrypted circuits. Coyote addresses scheduling and data layout challenges by identifying vectorizable subcircuits with minimal data movement overhead. By conducting a joint search for optimal vectorization and lane placement, Coyote achieves efficient vector schedules and intelligent rotation schemes, resulting in significant speedups for computational kernels in FHE. Nevertheless, Coyote is hampered by long compilation times and excessive rotations when generating vector schedules for large circuits. To overcome these limitations, we leverage Coyote's capabilities by vectorizing smaller replicated subcircuits and then combining and interleaving them to generate a more efficient vector schedule for the large circuit. This approach not only results in faster compilation times but also reduces the number of excessive rotations. In summary, our project presents a novel approach to optimize FHE through vectorization by addressing the challenges of identifying repeated subcircuits that can be vectorized together.

Keyword(s):

Vectorization, Homomorphic Encryption, Arthimetic Circuits, Compilers, Optimization

Mentor(s):

Milind Kulkarni (Engineering); Raghav Malik (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 411
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Building a Collaborative Platform for Secure AI/ML Research in the Nuclear Domain

Author(s):

Yashaswini Subramaniam† (Science)

Abstract:

Sharing sensitive data among AI/ML researchers in nuclear research is vital for collaboration and advancing scientific progress. However, this practice comes with risks, such as reverse engineering and data leaks, which can have severe consequences. This abstract presents a collaborative platform designed to facilitate secure collaboration in the nuclear domain. The sharing of sensitive nuclear data is driven by the need to accelerate research and foster collaboration. However, the potential risks associated with exposing critical nuclear data cannot be overlooked. Unauthorized access, reverse engineering, and data leaks pose significant threats to safety, security, and national interests. The main challenge is to establish a secure collaborative platform that enables researchers to work together without compromising proprietary or confidential information. The research proposes innovative approaches to address this challenge, including synthetic data generation, data masking, and covert embedding techniques. Synthetic data generation allows the creation of realistic but non-sensitive data, enabling researchers to work with representative datasets while ensuring the confidentiality of actual nuclear data. Data masking techniques obscure sensitive information by modifying the data in a way that makes it difficult for unauthorized individuals to decipher or understand the sensitive information, further safeguarding the integrity of shared data. Covert embedding methods embed hidden watermarks or signatures to ensure traceability and authenticity of shared information. By building a collaborative platform that leverages these techniques, the research aims to establish a secure environment for AI/ML researchers in the nuclear domain. The platform ensures the protection of sensitive nuclear data while promoting innovation and facilitating knowledge exchange among researchers.

Keyword(s):

Reverse Engineering, Proprietary Information, Synthetic Data Generation, Covert Embedding Techniques, Data Masking

Mentor(s):

Arvind Sundaram (Engineering); Tyler Lewis (Engineering); Hany Abdel-Khalik (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 412
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

User Feedback Analysis for a Video-Based, Automated Handwash Monitoring System

Author(s):

Brooklin Toombs† (Engineering)

Abstract:

Handwashing performs a vital role in reducing the spread of hazardous pathogens in domains such as food processing, hospital settings and public health. However, despite hand hygiene's importance, people often fail to wash their hands with proper technique. Automated handwash verifications systems have been developed, but little data has been gathered on their user-friendliness. This is an issue because hand hygiene monitoring devices will be difficult to successfully implement if users to not approve of them. Since there are many different types of monitoring devices, our research focuses on collecting user feedback for a camera-based system. A notable feature of the handwash system that we have opted to use is that its software can run using three different imaging models. So, feedback will be gathered via surveys that ask study participants about the following aspects of each model: speed, accuracy, reliability and user interface design. The survey data will then be analyzed to rank each model based on how well it performed in each attribute. Overall, our research will provide insight into how a particular type of handwash verification system can be improved. Such insight could then be extended to other similar systems and aid in the development of user-friendly, automated handwash verification technology.

Keyword(s):

Hand Hygiene Compliance, User-Friendliness, Video Monitoring System, Artificial Intelligence

Mentor(s):

Amy Reibman (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 413
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

A Glimpse into the Future of Manufacturing: IoT Sensors and AI Machine Learning

Author(s):

Nathon Tubbs† (Engineering)

Abstract:

Industry 4.0 is a rapidly advancing and expanding field as manufacturers across the globe begin to adopt intricate technologies to improve industrial practices. AI-in-manufacturing is a leading-edge technology to gain quality, efficiency, and productivity but requires more process data than ever. By comparing recently established systems in accordance with Industry 4.0 and the traditional manufacturing observations, we realized that the study is needed to explore the challenges associated with the implementation of IoT Sensors on industrial machinery. First, an analysis was conducted on a local manufacturing site to determine a relation between operational process data, such as downtime events and maintenance repair order logs, and the recorded controlled process data collected by sensors on the machinery. The process data across the sixteen machines at the manufacturer were analyzed primarily on the root cause of the heater element failures in their oven processes. This practice was then replicated on the campus of Purdue University in Birck Nanotechnology Center. We installed ACCUENERGY current transducers (CTs) and an IoTa Watt Electricity Monitoring system onto a fluid jetting printer to collect an operational fingerprint for the system. Such information is not only useful to identify operational/material defects in the process but also to save energy consumption. These inexpensive and modern IoT sensors technologies have proven to add the monitoring capability on to the currently existing machineries. Through further testing and documentation, this IoT monitoring can evolve into a deep understanding of the processes as well as the basis of AI machine leaning in manufacturing.

Keyword(s):

Machine Learning, Big Data, Industry 4.0, Current Transducers, AI-in-Manufacturing

Mentor(s):

Airehenbuwa Blessing (Birck Nanotechnology Center)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 414
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Computational Modeling of Electric Coupling Between Neurons

Author(s):

Amanda Walenciak† (University of Central Florida)

Abstract:

Electromagnetic brain stimulation (EMBS) can be used to treat a variety of neurological disorders, including OCD, depression, and Parkinson's Disease. There is difficulty delivering effective treatment due the limited understanding of the biological principles by which electric fields (E-fields) influence neurons. Neuron solvers rely upon equivalent circuit models to model the behavior of neurons under device E-fields. Currently, hybrid and bidomain approaches are used to analyze neurons under device E-fields. The cable equation provides limited predictive power due to being one-dimensional. A multidimensional bidomain model provides more rigorous predictions. Recently, a bidomain integral equation approach was developed and validated with Hodgkin-Huxley membrane dynamics. The purpose of this study was to augment the existing bidomain tools by adding a myelinated mammalian membrane model. MATLAB was used to formulate a double-cable neuron solver. The double cable neuron solver was constructed to extract functions of the membrane models for the bidomain integral solver.

A pointwise Hodgkin-Huxley model was the basis of the subsequent models. This initial subroutine was then modified to accommodate additional ion channels. Codes for a cable equation and activation function were developed for use as a hybrid approach. A bidomain integral approach was augmented with a double cable model for simulation of myelinated neuron morphology. Implementations for transcranial electric stimulation and transcranial magnetic stimulation were simulated to showcase the efficacy of the models. These computational tools can be used to compare the experimental results with simulations in order to improve the accuracy of the models, thereby improving the efficacy of EMBS.

Keyword(s):

Electromagnetic Brain Stimulation, Medical Science & Technology, Cellular Biology, Neuronal Modeling

Mentor(s):

Luis Gomez (Engineering); David Czerwonky (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 415
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Developing Clients for Streaming 360-Degree Video to End Users

Author(s):

Clayton Walker† (Engineering, JMHC)

Abstract:

Due to tremendous growth in VR, 360-degree video has become a focus for internet content providers. 360 video promises more immersive and interactive experiences but can be four to six times larger than traditional videos. Previous research has created systems to overcome the high bandwidth requirement by spatially dividing the video and only streaming the relevant portion back to the user. Yet, these systems fall short in experimenting with real users. As a result, the interactivity of these systems is untested, and their capability of delivering an immersive experience efficiently is still questionable. To set the seal on interactive user evaluation, this work aims to develop a standalone client application for 360 video, with the purpose of improving evaluation of 360 video systems on end users. We designed a streaming pipeline for Android phones and head mounted displays that utilizes various programming libraries and APIs to fetch, decode, and render 360 video. This is challenging, as it requires optimizing each step along the pipeline to minimize computing overhead and deliver a desirable framerate video to the user. Dynamic parallelization and careful memory management are critical to this optimization. Upon completion, this work will provide a framework to conduct evaluation that better reflects the end-to-end user experience. Continued research into such clients will make testing of 360-degree video easier and obtain a more complete understanding of factors that affect the user experience.

Keyword(s):

Virtual Reality, 360-Degree Video, Video Decoding, Parallelization, Client Optimization

Mentor(s):

Sanjay Rao (Engineering); Ehab Ghabashneh (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 416
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Temperature Dependence of Permittivity in Biaxially Anisotropic 2D material alpha-MoO3

Author(s):

Benjamin Wassgren† (Engineering)

Abstract:

Light propagates differently inside different materials. One special class is hyperbolic materials, named after their hyperbolic isofrequency surfaces in wavevector space. This quality allows for negative refraction or sub-wavelength information storage. One promising hyperbolic material is alpha-MoO3, a biaxial anisotropic material. These properties are rare, but make it uniquely capable in nanoscale radiative energy transport applications. The dielectric function is a fundamental property of hyperbolic materials, but has only been measured in alpha-MoO3 at room temperature. This paper measures the temperature dependence of alpha-MoO3's dielectric function in the infrared region. The Lorentz model, a building block of the dielectric function, is used with Fresnel's equations to generate a reflectivity spectrum. This spectrum is then compared to a spectrum measured using Fourier Transform Infrared Response (FTIR) spectroscopy, iterating unknown parameters until error is minimized. For a more accurate fitting, Raman spectroscopy is used to determine some unknowns in the Lorentz model prior to fitting. The dielectric functions of varying temperature are then used to determine temperature dependence. The dielectric function is both a crucial optical property and related to radiative heat transfer. An understanding of its temperature dependence is a crucial step towards alpha-MoO3's use in optical and heat transfer settings.

Keyword(s):

2D Material, Anisotropic Material, Dielectric Function, Hyperbolic Material, Infrared Reflection

Mentor(s):

Xianfan Xu (Engineering); Yikang Chen (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 417
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Neo-Coyote: An Optimization for Vectorizing Encrypted Arithmetic Circuits

Author(s):

Dulani Wijayarathne† (Engineering); Sreevickrant Sreekanth† (Engineering)

Abstract:

Fully Homomorphic Encryption (FHE) enables secure computations on encrypted data but suffers from slow execution. Existing efforts to enhance FHE performance through vectorization techniques have often overlooked the expensive rotations of vector operands. In this project, we propose a novel approach that builds upon Coyote, a method effective at vectorizing computational kernels while minimizing rotations in encrypted circuits.

Coyote tackles scheduling and data layout challenges by identifying vectorizable subcircuits with minimal data movement overhead. By conducting a joint search for optimal vectorization and lane placement, Coyote achieves efficient vector schedules and intelligent rotation schemes, resulting in significant speedups for computational kernels in FHE. However, Coyote suffers from long compilation times and excessive rotations for vector schedule generated for large circuits.

To overcome these limitations, we leverage Coyote's capabilities by vectorizing smaller replicated subcircuits and then combining and interleaving them to generate a more efficient vector schedule for the large circuit. This approach not only results in faster compilation times but also reduces the number of excessive rotations.

In conclusion, this project presents a novel approach to optimize FHE through vectorization by addressing the challenges of identifying repeated subcircuits that can be vectorized together.

Keyword(s):

Homomorphic Encryption, Arithmetic Circuits, Vectorization, Cryptography, Compilers

Mentor(s):

Milind Kulkarni (Engineering); Raghav Mailk (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 418
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

Deceptive Infusion of Data for Audio Data

Author(s):

Chloe Yoder† (Engineering)

Abstract:

The modern age has become increasingly reliant on artificial intelligence and machine learning (AI/ML) to analyze their systems. This has led to the rise of some serious security concerns. The confidentiality of data across various industries necessitates a secure data protection technique that allows data to be securely masked while maintaining its utility. State-of-the-art encryption and data masking techniques employed in industry either limit analysts' capability or can be reversed-engineered. These methods also require a level of trust between industries and analysts because of potential data misuse and legal concerns. Most techniques do not require this level of trust and can impose limitations on the analyst, and therefore the data. Different industries capture a multitude of data ranging from time series to audio files all of which need to be protected against potential misuse from a collaborator or adversary. Additionally, when working with and encrypting audio data, the sound can become noticeably distorted to collaborators and adversaries. This encryption also means that the data is not preserved for AI/ML applications, like voice recognition. Using the deceptive infusion of data (DIOD) method solves the issues of encryption methods by allowing for the inferential capabilities to be preserved while protecting the data. This allows for the most important features needed for AI/ML tools to be concealed without compromising performance or proprietary information.

Keyword(s):

Data Masking, Audio Data, Data Trustworthiness

Mentor(s):

Hany Abdel-Khalik (Engineering); Arvind Sundaram (Engineering); Tyler Lewis (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 419
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF

PoseAR: Immersive Mixed-reality Environment for IoT-Human Joint Interaction

Author(s):

Lijun Zhu† (Engineering)

Abstract:

augmented reality has transformed the realm of digital content interaction and holds substantial potential for educational and training applications. Current software for pose instruction is not intuitive for the user to use. To overcome this challenge, we introduce PoseAR, an integrated AR environment devised to provide accurate, personalized pose corrections for users wishing to master pose-learning skills ranging from dance to sports. PoseAR employs Apple's ARKit for precise body tracking, utilizing machine learning and computer vision technologies to generate a comprehensive skeleton model. Our system provides real-time visual feedback for posture correction, and it facilitates user interaction by enabling users to create their own poses. Additionally, PoseAR leverages Internet of Things (IoT) developments for identifying specific equipment in exercises and offering custom-tailored guidance. Utilizing the YOLO item segmentation algorithm, our system delivers clear contours of objects and triggers pre-recorded poses and actions, allowing users to compare and adjust their movements. Our evaluations suggest that PoseAR provides an immersive, interactive, and user-centric learning experience.

Keyword(s):

Artificial Reality, AR Human Body Tracking, Item Segmentation

Mentor(s):

Ziyi Liu (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 420
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF,CISTAR

Analysis of Hydrogen Binding Energy on Non-Pristine Graphene Structures

Author(s):

Camden Bettag† (Engineering)

Abstract:

Redacted.

Keyword(s):

Catalyst, Graphene, Morphological Defects, Carbon

Mentor(s):

Jeffrey Greeley (Engineering); Luke Pretzie (Engineering); Anik Biswas (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 421

Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF,CISTAR

Synthesis of Zeolite-Based Catalysts for Non-Oxidative Conversion of Methane (NOCM)

Author(s):

Jackson Boodry† (Johns Hopkins University); Mahagani Lasciers‡ (North Carolina A&T University)

Abstract:

Non-oxidative conversion of methane (NOCM) into value-added longer-chain hydrocarbons facilitates the transport of gas resources from drilling locations to chemical plants/refineries. The NOCM reaction is hypothesized to be catalyzed by edge-defect sites on carbon-based supports at high (>1100 K) temperatures to overcome thermodynamic constraints. Zeolite-templated carbons (ZTCs) and carbon deposited on desilicated zeolite frameworks such as chabazite (CHA) are proposed to contain large densities of these edge-defects. ZTCs are synthesized via furfuryl alcohol impregnation into a faujasite (FAU) zeolite before heat treatment and propylene chemical vapor deposition (CVD). The zeolite framework is subsequently dissolved with hydrofluoric acid, leaving a carbonaceous material with the negative pore structure of FAU. Desilication of CHA zeolites involves selectively removing silicon from the framework through an alkaline (NaOH) treatment by preserving structure-directing-agents (SDAs) from zeolite synthesis inside the material, creating mesopores at crystallite exteriors to increase the surface area for carbon formation during NOCM. The crystallinity and pore volume of ZTC and CHA-based materials were studied via X-ray diffraction and gas adsorption characterization. Broader use of desilicated CHA as a catalyst is dependent on maintaining the number of Brønsted acid sites, which is quantified through temperature-programmed desorption. ZTC crystallinity and stability depends on CVD time and reactor hydrodynamics. Desilicated CHA stability is related to the Si/Al ratio of the parent framework and the temperature used for SDA removal. These results indicate a complex relationship between synthesis conditions and crystal stability, with application to NOCM necessitating treatment at conditions best suited for the reaction.

Keyword(s):

Methane Activation, Zeolite-Templated Carbon, Desilication, Carbon-Based Catalysis, Energy

Mentor(s):

Raj Gounder (Engineering); Angel Santiago-Colon (Engineering); Justin Rosa-Rojas (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 422
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF,CISTAR

Optimal Integration of Microwave Heating in a Combined Heat and Power Plant

Author(s):

Carson Felton† (Engineering)

Abstract:

Combined heat and power (CHP) plants are facilities where the two products are cogenerated, often used to reduce energy consumption and carbon emission. Typically, these plants use electric or conventional steam processes for all of their heating requirements. Previous studies optimized these methods in a CHP but have not considered microwave heating. Compared to traditionally utilized heat supplying methods, this process has the potential to provide improved energy efficiency and reduced waste production. To investigate the potential for integrated microwave heating and its benefits, optimization techniques are required. This study simultaneously considers the design and operation of a CHP and a microwave heater using a systematic optimization framework that we developed. A computational fluid dynamics (CFD) model generated simulation data and machine learning techniques created a data-driven model. We first implemented a CHP optimization model from literature and then integrated the aforementioned microwave heating model. We then performed sensitivity analysis with the newly structured model to see the effects of certain parameters on key outputs such as profit and energy consumption. After we obtain a good understanding of these effects, we will perform a case study to recognize the impact of microwave heating on the overall energy usage of the CHP plant. Comparisons can be made between the different heating methods to see if any significant improvements are found, which can be used to inform the future development of chemical plants.

Keyword(s):

Microwave Heating, Optimization, Mixed Integer Linear Programming, Combined Heat & Power Plant, Machine Learning

Mentor(s):

Can Li (Engineering); Kaiyu Cao (Engineering); Asha Ramanujam (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 423
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF,CISTAR

Sustainable fuels: Assessment of diffusional constraints on MFI zeolites for propene oligomerization

Author(s):

Kyla Fung† (Engineering)

Abstract:

Converting shale gas to liquid transportation fuels attracts attention to the pressing global issue of unsustainable fossil fuel consumption. One route to produce higher molecular weight hydrocarbons is by oligomerization of light alkenes such as propene. MFI zeolites is widely used for this reaction due to their unique shape selectivity, tunable acidity and high thermal stability. Properties such as diffusion pathlength (e.g. crystallite size) and acid site density have shown an influence in reactivity, selectivity, and deactivation for acid-catalyzed reactions attributed to diffusional limitations. Current methods to determine average crystallite size do not account for structural defects that could have an effect on the diffusional phenomena occurring during the reaction. Here, we conduct transient sorption experiments of 2,3-DMB to address this diffusional characteristics. Synthesis and characterization of a suite MFI zeolites with varied crystallite sizes and fixed molar composition (e.g. Si/Al) were conducted to validate the effectiveness of this method. Characterization techniques such as X-ray diffraction (XRD), scanning electron microscopy (SEM), inductively coupled plasma (ICP), N2 physisorption, and transient sorption of 2,3-DMB were performed to evaluate the properties of the zeolites. By comparing the transient sorption behavior of these catalyst, we will aid provide a more accurate assessment of the effects of the diffusional constraints on MFI zeolites for propene oligomerization reaction. The results from this study will provide more insight into the key properties desirable for the design of catalysts for acid-catalyzed reactions.

Keyword(s):

Sustainable Fuels, Heterogeneous Catalysis, Zeolites, Diffusion, Transient Sorption

Mentor(s):

Raj Gounder (Engineering); Diamarys salome rivera (Engineering); Ricem Diaz Arroyo (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 424
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF,CISTAR

Developing efficient gas diffusion electrodes with emulsion electrodeposition for sustainable electrochemical energy storage and hydrocarbon transformation

Author(s):

Rebecca Hurwitz† (Vanderbilt University); Hallie Todd‡ (Pennsylvania State University); Logan Maddox‡ (Milwaukee School of Engineering); Alexa Earle* (Engineering)

Abstract:

CO_2 electrolyzers use energy from renewable sources to reduce carbon dioxide and produce valuable chemical products, including carbon monoxide, through an electrochemical reaction on the surface of gas diffusion electrodes (GDEs). Previously, drop casting or air brushing manually deposited catalyst layers onto gas diffusion electrodes, but this study uses emulsion electrodeposition to gain control over the morphology of metal nanoparticles. Emulsion electrodeposition is the process of reducing the metal salt precursor in aqueous nanodroplets to deposit nanoparticles on the electrode. These nanoparticles provide more surface area for the reduction of CO_2, acting as a catalyst layer. This work directly reduced platinum nanoparticles onto GDE surfaces from an emulsion to compare to standard catalyst layer preparation methods. The shape and size of the deposited platinum nanoparticles were determined using scanning electron microscopy (SEM). The emulsion procedure and electrochemical conditions were optimized to deposit platinum nanoparticles on carbon paper, and then this methodology was adjusted to deposit metal catalyst onto gas diffusion electrodes. To prevent flooding of the electrode, hydrophobic polytetrafluoroethylene (PTFE) in the next-generation polymer based gas diffusion electrodes was employed. This study evaluated the use of emulsion electrodeposition to control metal nanoparticle deposition onto gas diffusion electrodes. It evaluated the performance of the CO_2 electrolyzer, via a probe Hydrogen Evolution Reaction (HER) in acid media. Cyclic voltammetry and linear sweep voltammetry were used to compare the performance of the CO_2 electrolyzer with previous research.

Keyword(s):

Nanotechnology, Renewable Energy, Electrochemistry, Carbon Dioxide, Catalysis

Mentor(s):

Brian Tackett (Engineering); Ashutosh Bhadouria (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 425
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF,CISTAR

Shale Gas to Diesel Fuel: Characterizing Alumina-supported Indium Catalysts

Author(s):

Emmanuel Ortiz† (Engineering, JMHC); Matthew Gerona‡ (Engineering, JMHC)

Abstract:

Within the U.S., there is a push to transition the production of transportation fuels from crude oil to natural gas liquids. Natural gas liquids (NGLs) serve as a bridge fuel to produce diesel fuel since NGLs produce less CO2 emissions compared to petroleum feedstocks. Shale deposits yield natural gas liquids that provide a long-lasting energy source and feedstocks to produce high-value commodity chemicals. Single-site indium(III) alumina-supported catalysts will catalyze light hydrocarbon reactions to produce heavy hydrocarbon fuels such as diesel and gasoline. Literature suggests that indium is not known to perform these reactions. We synthesized indium-alumina catalysts and tested varying reactor conditions including metal loadings, gas flow rates, temperatures, and pressures. We analyzed gas chromatography data to compare the conversion and product selectivity of indium-alumina and pure alumina catalysts. X-ray absorption spectroscopy has confirmed that this catalyst contains the desired microstructure. This study compares the catalytic properties of indium-alumina and alumina catalysts to determine the viability of using indium catalysts for hydrocarbon reactions. Indium-alumina has proven to be a more effective catalyst for these reactions than pure alumina. Establishing indium-alumina as a catalyst capable of performing hydrocarbon chemistry will deepen our understanding of the mechanisms that govern these reactions. Thus, allowing scientists to produce more efficient catalysts capable of manufacturing transportation fuels and commodity chemicals.

Keyword(s):

Propylene Oligomerization, Propylene Hydrogenation, Propane Dehydrogenation, Single-Site Catalyst, Lewis Acid Catalysis

Mentor(s):

Jeff Miller (Engineering); Ted Kim (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 426
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF,CISTAR

The Use of Heterogenous Lewis Acids for Hydrocarbon Reactions

Author(s):

Cora Powell† (Engineering)

Abstract:

In the last 20 years, the US has developed new drilling technology to produce oil and gas from deep shale formations. These hydrocarbons have potential to produce gasoline and diesel transportation fuels. When converting small hydrocarbons like ethane and propane into diesel fuel, these alkanes are first converted to more reactive olefin, e.g., ethylene and propylene. Currently, there are two types of catalysts that convert these olefins in to higher molecular weight hydrocarbons, Brönsted acids and transition metal alkyl compounds. However, neither of these are ideal. Brönsted acids make poor diesel fuel and deactivate rapidly, while transition metal alkyl compounds are sensitive to exposure to air and water and cannot be reused or regenerated. Our goal was to prepare new Lewis acid catalyst compositions that are active, stable, and regeneratable for the oligomerization of olefins to higher diesel fuel hydrocarbons. The goal of this project is to identify new, potential catalysts for further development. We prepared and tested several Lewis acid catalyst compositions to determine if they have potential for converting propylene to higher molecular weight hydrocarbons. Since alumina is a Lewis acid catalyst that successfully performs oligomerization, although with low rates and poor selectivity to diesel fuel, we compared our catalysts to alumina to find which catalysts have a higher rates and better product distributions than alumina. A 10% cobalt on alumina catalyst was the most successful of all the catalysts, with about a 9% conversion compared to about 1.5% for alumina. In the future cobalt should be optimized for higher activity, evaluated at a higher pressure and conversion to determine what products are possible. Additional catalyst compositions are also under investigation.

Keyword(s):

Catalyst, Oligomerization, Lewis Acids, Hydrocarbons, Conversion Rate

Mentor(s):

Jeffery Miller (Engineering); Ted Kim (Engineering); Wei-Ling Huang (Engineering); Hamta Bardool (Engineering); Shan Jiang (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 427
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF,SCALE

Electroplating Design for 3D System Integration

Author(s):

Lavinia Barker† (Rice University)

Abstract:

Through Silicon Via (TSV) technology allows for advancements in 3D heterogeneous packaging solutions of semiconductor devices by enabling vertical innerconnection of Si dies. However, reliable TSV filling of semiconductor chips must be achieved without void or seam defects, requiring a defined and uniform current density during the electroplating process. Therefore, the ALPHA lab at Purdue University required the development of an electrode holder exposing chips to a defined area of electroplating solution, with uniform current density applied around the chip’s conductive surface. Additionally, drawing on previous literature into Cu nanograin electroplating with impinging jet electrodes (IJEs), an IJE system for TSV electroplating was designed to integrate into the lab’s existing set-up. The development and manufacturing of these devices allow the ALPHA lab to mitigate defects in the TSV manufacturing process and conduct further research into the effects of current density, electroplating bath stirring velocity and electrolyte additive concentrations in ensuring even, replicable and efficient Cu TSV electroplating.

Keyword(s):

Packaging, 3D Integration, TSV, TSV Electroplating, IJE Plating

Mentor(s):

Tiwei Wei (Engineering); Shuhang Lyu (Engineering); Keyu Wang

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 428
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF,SCALE

Design and Investigation for Microporous Surface Modification for Fine-Pitch Microbump Bonding in 3D Integration.

Author(s):

Antariksh Krishnan† (Engineering)

Abstract:

Three-dimensional Integrated Circuits (ICs) offer a solution to the limitations of two-dimensional ICs, which are reaching the limit of Moore's Law. Chips are stacked using microbumps, solder materials heated until melting to form high melting point intermetallic (IMC) bonds, allowing for heterogenous integration. The main issue with these microbumps is solder leakage beyond microbump boundaries, causing inter-bump shorting. To address this, high-density microbumps can be formed on a surface to mitigate solder leakage. The focus of this project is on designing the porous structure and developing a microfabrication process. Regarding the porous structure design, three different types of porous models were explored by utilizing the capabilities of 3D printing and considering the dimensions of the microbump geometry. For the fabrication process, we will carefully review and discuss the detailed process flows, including factors such as chemicals and equipment. In our preliminary results, we followed a specific process flow. We developed three microbump models using SOLIDWORKS software and microfabricated five samples of each model onto a copper surface using IP-Q resin. After microfabrication, the model was electroplated with copper and treated with Acetone to reveal the etched surface. The porosity and microbump density of the modified copper surface were then examined using a Scanning Electron Microscope (SEM). Upon analyzing all the samples, the microporous layer with a fixed diameter of 1 µm exhibited the highest porosity and the smallest microbump pitch among the three models. The objective of this project is to enable safe and reliable microbump interconnections between Flip Chips.

Keyword(s):

Heterogenous Integration, Microbumps, Microfabrication, Moore’s Law, Electroplating

Mentor(s):

Tiwei Wei (Engineering); Keyu Wang (Engineering); Shuhang Lyu (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 429
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF,SCALE

Deriving the Transition Between Field Emission and Space-Charge-Limited Emission in Trap-Filled Semiconductors

Author(s):

Reagan McCafferty† (Engineering)

Abstract:

Ionizing radiation has been observed to induce structural defects known as traps in the crystalline structure of semiconductors. These traps affect electron emission throughout the material and may ultimately impact its performance and reliability in electronic devices. Understanding and modeling this phenomenon to inform breakdown understanding in semiconductors and improve mitigation through radiation-hardening techniques necessitates further characterization of the transitions between different electron emission phenomena. This paper expands on previous work unifying field emission (FE) and space charge limited emission (SCLE) in planar diodes through a third order nexus that defines the transitions between the Ford-Nordheim (FN) equation for FE, Child-Langmuir (CL) law for vacuum SCLE, and Mott-Gurney (MG) law for collisional SCLE. Traps are introduced into the nexus theory through the fundamental electron continuity equation and the Mark-Helfrich (MH) law governing emission in trap-filled solids. From this, we expect to derive exact solutions for current density as a function of voltage and yield a fourth order nexus curve linking FN, CL, MG, and MH as a function of trap density. Such a curve would help characterize diode performance under various conditions including ionizing radiation.

Keyword(s):

Electron Emission, Space-Charge-Limited Emission, Semiconductors, Traps

Mentor(s):

Allen Garner (Engineering); Lorin Breen (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 430
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF,SCALE

Simulations of Electroplating for Heterogeneous Integration

Author(s):

Andrew Modin† (Engineering)

Abstract:

Electroplating plays a critical role in the fabrication of high aspect ratio through-silicon vias (TSVs) in microelectronics. However, achieving optimal electroplating parameters for desired quality and processing time remains a challenge. This comprehensive study employs the COMSOL electrodeposition module to simulate the electroplating of high aspect ratio TSVs, with a focus on tracking trends associated with additives, specifically the chloride-polyethylene glycol suppressor and the 3-mercapto-1-propanesulfonate (MPS) accelerator. This will help enhance understanding of the relationship between these additives and electroplating quality, aiming to improve electroplating time, uniformity, and cost-effectiveness. Currently, conventional electroplating techniques often encounter issues such as uneven deposition, voids, and poor adhesion. To overcome these challenges, a modeling approach is adopted using COMSOL's electrodeposition module to reduce research costs and drastically decrease research times. Various combinations of additives are investigated to evaluate their impact on improving electroplating quality. The analysis reveals trends related to additive concentration and distribution, providing insights into factors like deposition uniformity and surface roughness. These findings contribute to a better understanding of the underlying mechanisms in electroplating and inform the development of strategies to optimize electroplating parameters. In conclusion, this research utilizes COMSOL simulations to investigate the correlation between additives and electroplating quality in high aspect ratio TSVs, shedding light on the relationships at play.

Keyword(s):

Electroplating, High Aspect Ratio, Through-Silicon Vias, COMSOL, Additives

Mentor(s):

Tiwei Wei (Engineering); Shuhang Lyu (Engineering); Keyu Wang (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 431
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF,SCALE

Bi-Based Solders for Heterogenous Integration of Semiconductors for High Temperature Applications

Author(s):

Kyle Wiegand† (Engineering)

Abstract:

High Pb solders (95Pb-5Sn, 92.5Pb-5Sn-2.5Ag) are most common solders for operating temperatures above 200 degrees Celsius for SiC or GaN-based power electronics. A main challenge in developing Pb-free solder or transient liquid phase bonding (TLP) technique is comparable or superior mechanical and thermal properties to Pb-based solders. Further, a drop-in solution of an alternative to Pb-based solder alloy is preferred that can be reflowed on the existing die and substrate metallization without significant changes to the established manufacturing processes. Bismuth-based solder alloys are notably promising in this sector as viable substitutes for lead-based solder, offering favorable properties and reduced environmental impact. These alloys demonstrate excellent thermal and electrical conductivity, low toxicity, and improved mechanical properties, making them suitable for various electronic applications. However, a significant drawback of bismuth-based solder alloys lies in their wettability issues, particularly when it comes to commonly used substrate materials like copper and nickel. Poor wetting behavior can result in insufficient adhesion and compromised joint integrity, leading to unreliable solder connections and increased failure rates. Overcoming this challenge requires ongoing research and development efforts to enhance the wetting behavior, ensuring reliable solder connections and wider adoption of bismuth-based solder alloys in the electronics industry. Here we compare the morphology and mechanical properties of 58Bi-42Sn and 95Bi-5Sn alloys, which will lead to customizing the properties of these solder materials through alterations in their composition and structural dimensionality.

Keyword(s):

Alloys, Semiconductors, Bismuth, Soldering, Structural Dimensionality

Mentor(s):

Shubhra Bansal (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 432
Presentation Time: 7/27, Session 2: 1pm-2:30pm

SURF,SCALE

Tungsten And Hexagonal-Boron Nitride Hybrid Shielding For Space Radiation Sources

Author(s):

Elliot Wong† (Engineering)

Abstract:

With increased interest in launching satellites for a broad range of missions, predicting the performance of microelectronics in space environments is an increasingly critical need. Space radiation, a possible source of failures, consisted of the Van Allen Radiation Belts, Solar Particle Events (SPE), Galactic Cosmic Rays (GCR) and a broad range of particles. As just one charged particle is capable of causing system failure, shielding is often needed. However, the added weight introduces the necessity for careful design. The shielding effectiveness of various materials from GCR consisting of protons, alpha particles, and high atomic number Z and energy ions are analyzed using the Stopping and Range of Ions in Matter (SRIM) 1D Monte Carlo simulation tool. Initial investigations proved protons to be the most significant source of radiation in the space environment. As such, subsequent investigation concentrated on the most common 1 GeV proton at a fluence of 10^4 particles m^2s^-1. The SRIM metrics of ion distribution, ionization, energy to recoils, and collision events were used to methodically evaluate and compare the materials selected, to minimize adverse effects on microelectronics. A multi-layer approach was initially proposed containing Lead and Polyethylene; however, recent simulations have proven hexagonal-Boron Nitride to be a more effective low Z material for blocking remaining energy at reduced weight. The model data will be compared to experimental data, with additional experiments being planned to resolve any inconsistencies. Geant4, a 3D Monte Carlo simulation tool, will be used to verify the importance of alternating layers.

Keyword(s):

Material Modeling & Simulation, Nanotechnology, Composite Materials & Alloys

Mentor(s):

Peter Bermel (Engineering); Allen Garner (Engineering); Sayan Roy (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 433
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Vet Med Summer Research

Growth characteristics of a DDX5 knockout liver cancer cell line

Author(s):

Dawn Burch† (Agriculture)

Abstract:

The enzyme DDX5 regulates every aspect of RNA metabolism and is part of a protein family known as DEAD-box RNA helicase. RNA helicases hydrolyze ATP and use the energy from ATP hydrolysis to bind and remodel RNA. In earlier studies, the Andrisani lab discovered that the expression level of DDX5 correlates with the prognosis of liver cancer patients as patients with lower levels of DDX5 had a poorer prognosis. However, it is not yet understood why low expression of DDX5 contributes to a poor prognosis, leading to the question, “What happens to the liver cell/hepatocyte if DDX5 is no longer expressed?” A gene editing technique (CRISPR/CAS9) was used to eliminate the two genes coding for DDX5, ultimately knocking out the expression of DDX5 from the liver cell. In this study, the goal was to assess the effect of knockout DDX5 (DDX5KO) on the growth characteristics of a human liver cancer cell line (Huh7) compared to wild-type (WT) Huh7 cells. We hypothesized that since DDX5 regulates the mRNA metabolism elimination DDX5 will change the growth characteristic of the WT Huh7 cell line. This study was conducted by comparing the growth of the WT and DDX5KO Huh7 cells in 12-well plates over a four-day period. The results demonstrate that WT Huh7 cells grew faster than the DDX5KO Huh7 cells at higher densities. Further research is needed to better understand the role of DDX5 in liver cancer.

Keyword(s):

RNA Helicase DDX5, Gene Edited DDX5/Knockout, Huh7 Human Liver Cancer Cells, Cell Culture, Doubling Time

Mentor(s):

Ourania Andrisani (Veterinary Medicine); Zhili Li (Veterinary Medicine)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 434
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Vet Med Summer Research

Diagnosis of Plant Poisonings Using PCR

Author(s):

Paola Diaz† (St Olaf College)

Abstract:

Many plants can cause poisoning or death of animals following ingestion. Currently, identification of the plant is performed by visual identification of plant material in stomach/rumen contents. In instances where plant parts are too small and digested to be identified, another method is needed to identify the causative plant. The goal of this study is to develop a quantitative polymerase chain reaction (qPCR)-based test to identify Taxus (yew) DNA in stomach/rumen contents.Taxus DNA can be identified using qPCR. Taxus and non-Taxus samples were collected around the Purdue campus. DNA from each plant was extracted utilizing Qiagen's DNeasy Plant Pro Kit. qPCR primers were designed to amplify sequences specific to Taxus. Amplified DNA was verified by direct sequencing of amplicons. Sensitivity was determined by extracting decreasing concentrations of Taxus, or by decreasing the concentration of Taxus in spiked stomach/rumen contents. Specificity was determined by introducing controls such as non-Taxus plant species, non-spiked stomach/rumen contents, or with nuclease free water.

Results: Cycle threshold (Ct) values were positive for samples containing Taxus DNA. Samples from other trees were also positive. DNA from poison hemlock, an herbaceous plant, was negative. Nuclease-free water was negative. Sequencing of amplicons from reactions of each plant correctly identified the plant in each case, including the samples containing Taxus at each concentration. This study indicates that PCR with sequencing can be utilized as a specific and sensitive test to identify Taxus DNA in stomach/rumen contents.

Keyword(s):

Livestock, Poisonings, qPCR, Taxus

Mentor(s):

Steve Hooser (Veterinary Medicine)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 435
Presentation Time: 7/27, Session 2: 1pm-2:30pm

Vet Med Summer Research

Evaluation of the Anti-proliferative Effects of Indenoisoquinoline Dual MYC and Topoisomerase I Inhibitors in Canine Osteosarcoma Cell Lines

Author(s):

Camila Gutierrez† (Veterinary Medicine)

Abstract:

Three cytotoxic topoisomerase 1 (TOP1)-inhibiting indenoisoquinolines, I400 (indotecan), I776 (indimitecan), and I744, have demonstrated anticancer activity in preclinical and clinical trials. These drugs have recently been found to strongly bind to the MYC promoter G-quadruplex and potently downregulate the expression of MYC. MYC is a crucial oncogene overexpressed in most cancers; the G-quadruplex secondary structures in the promoter region acts as a transcriptional silencer. Osteosarcoma (OS) is a rare, aggressive primary bone cancer with a low survival rate of approximately 60% due to cancer metastasis. Though no new effective therapies for this cancer have emerged over 40 years, the overexpression of MYC is common in OS and may be a therapeutic target in this cancer. Naturally-occurring OS in pet dogs is a relevant animal model for the human disease, and is also characterized by MYC overexpression. We hypothesized that MYC-inhibitory indenoisoquinoline analogs would have antiproliferative effects on canine osteosarcoma cell lines. This study aimed to provide proof-of-concept for the efficacy of indenoisoquinoline drugs in canine OS. Two osteosarcoma cell lines, D-17 and OSCA-8, were treated with three indenoisoquinolines to calculate the percent growth inhibition. Cell-based cytotoxicity screening with sulforhodamine B colorimetric assays was used as a measurement of cellular protein content to identify the IC50 of each drug in the concentration range of 2 to 2000 nM. The results are expected to contribute to the design of follow-up studies in canine comparative oncology models with the goal of supporting further research on MYC-targeting agents in both canine and human OS.

Keyword(s):

Topoisomerase 1, Osteosarcoma, MYC Oncogene, Canine, Bone Cancer

Mentor(s):

Mike Childress (Veterinary Medicine); Deborah Knapp (Veterinary Medicine); Danzhou Yang (Pharmacy); Deepika Dhawan (Veterinary Medicine); Alexander Enstrom (Veterinary Medicine)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 436
Presentation Time: 7/27, Session 2: 1pm-2:30pm

VIP

Securing Open Source Software Using Static Analysis

Author(s):

Zeyad Aljaali† (Engineering)

Abstract:

This study investigates the effectiveness of utilizing static analysis tools, namely CodeQL and the alpha-omega analyzer, for securing open source software projects. The goal of this research is to identify potential vulnerabilities within these open source systems, emphasizing the need for improved code security. This paper demonstrates how existing static analysis tools can be employed and, if necessary, modified or customized, to cater to the unique requirements of each project. The research provides a comparative analysis of the tools' capabilities and efficacy, providing practical guidelines for their application. The outcomes of this research offer critical insights for developers and open-source communities, advocating for a proactive, preventive approach towards securing software projects, thereby reducing susceptibility to potential cyber threats.

Keyword(s):

Open Source, Static Analysis, Omega Analyzer

Mentor(s):

Aravind Machiry (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 437
Presentation Time: 7/27, Session 2: 1pm-2:30pm

VIP

UAV and Maze

Author(s):

Natasha Gundapaneni† (Engineering, JMHC)

Abstract:

Our research focuses on the autonomous navigation of Unmanned Aerial Vehicles (UAVs) or drones within maze-like structures, with an emphasis on speed and efficiency. Using advanced mapping software and sensors, we construct accurate representations of these structures and identify the most optimal paths through path-planning algorithms. Our study utilizes a Docker environment that integrates ROS2, Gazebo Garden, and a PX4 simulator for drone operations. The methodology involves a two-stage testing process: we initially validate path efficiency through simulated tests, then proceed to real-world trials with UAVs, taking into account factors such as air resistance and hardware constraints. These insights not only make significant contributions to our understanding of autonomous UAV navigation but also set the stage for potential applications in sectors such as agriculture and defense, marking an important advancement in the evolution of autonomous UAV technology.

Keyword(s):

UAV, ROS2, Gazebo Garden, PX4, Speed & Efficiency

Mentor(s):

Yung-Hsiang Lu (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 438
Presentation Time: 7/27, Session 2: 1pm-2:30pm

VIP

Investigating current practices of research data management in computer vision

Author(s):

Vikram Oddiraju† (Science, JMHC); Zachary Heskett† (Science, JMHC)

Abstract:

Data sharing, publication, and management are crucial and yet challenging. This NSF REU funded study aims to investigate current practices of research data management in the field of computer vision. The team designed the semi structured interview questions in the early summer. We are currently interviewing scholars in computer vision across multiple research tier 1 institutions in the USA and other countries as well. The practices will be discussed.

Keyword(s):

Data Management, Computer Vision, Big Data

Mentor(s):

Wei Zakharov (Libraries); Siqing Wei (Engineering); Yung-hsiang Lu (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 439
Presentation Time: 7/27, Session 2: 1pm-2:30pm

VIP

AFTx07 Microprocessor Digital Design

Author(s):

Yiyang Shui† (Engineering); Boheng Zhao‡ (Engineering, Science); Edmund Leung‡ (Engineering)

Abstract:

AFTx07 is a RISC-V based microcontroller under design by the SoCET team, to be taped out in October 2023. In particular, the AFTx07 project concerns implementation of digital modules using hardware description language and computer architecture design principles, all of which are critical to the successful fabrication of the design. To properly design and test AFTx07 prior to tape-out, the team has been using SystemVerilog to create custom digital modules that are simulated using tools such as Verilator and Xcelium. After passing simulation tests, the design is synthesized to gate-level netlist using electronic design automation (EDA) tools such as Cadence Genus. FPGA synthesis is done using Quartus Prime software, and then tested on FPGA hardware. FPGA hardware tester module has also been developed to validate individual AFTx07 components on bus level.

For AFTx07, beyond integration of peripheral modules, the team has established optimization and RTL goals to improve the functionality and performance of the SoC. Major achievement includes adding L1 caches to increase performance with respect to instruction and data fetches, and a buffered memory controller to interface the CPU with memory. The final product, AFTx07, will be able to provide the Purdue engineering community with the unique experience of testing and using a custom SoC. After tape-out, we plan to provide AFTx07 chips for use by other Purdue organizations that make use of microcontrollers, such as Purdue Electric Racing and Purdue IEEE teams.

Keyword(s):

Computer Engineering, Digital Design, Semiconductor, Microprocessor, Embedded System

Mentor(s):

Mark Johnson (Engineering); Cole Nelson (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 440
Presentation Time: 7/27, Session 2: 1pm-2:30pm

VIP

New PCB Design for the AFTx04 Microcontroller

Author(s):

Benjamin Zou† (Engineering); Steven Huang† (Engineering); Niels Van Ritbergen* (Engineering); Rauf Erkiletlioglu* (Engineering); Ferati Ogunwemimo* (Engineering); Dila Bodur* (Engineering)

Abstract:

This process is part of the SoCET X04 design project, a student researched microprocessor and microcontroller, and is a required step in order to interface with the X04 chip and to replace the previous printed circuit board design. Creating a wiring schematic with all the necessary components for interfacing is the first step in the process. The X04 microcontroller chip has strict operating requirements to function properly, therefore it needs multiple sub-circuits placed on the same circuit board to unlock its functionality. These include GPIO headers to allow external devices to be connected to it, a USB header for a computer to program it and provide power, and a power filtering circuit to ensure that the electronics are not compromised due to an unclean power source. The schematic is translated into a 4-layer PCB. This board serves to hold all the wires and components on a stable and compact package. It is also a platform for external connections. Once all wires are connected, a Bill of Materials is generated and sent to a PCB manufacturer of choice. This results in a circuit board with the desired components and ready for testing and debugging by the PCB team. A successful board allows the SoCET X04 design team to verify their design and improve on it for the next chip the team may decide. It may test the practicality of the X04 design and whether it can handle a variety of computational tasks.

Keyword(s):

PCB Design, Purdue SoCET Team, Circuit Design, Microcontroller

Mentor(s):

Mark Johnson (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

700 *Jiaxuan Li†*
Mentor(s): Matthew Lanham

701 *Zhaoming Hu†*
Mentor(s): Zhaoming Hu

702 *Danhe Tang†*
Mentor(s): Matthew Lanham

703 *Spencer Burkhalter†*
Mentor(s): Jan-Anders Mansson

704 *Adam Hafez†*
Mentor(s): Daniel Schiff; Alejandra Magana; Lucas Wiese

705 *Natasha Lepiocha†*
Mentor(s): Joshua Cook

706 *Yunlei Tang†*
Mentor(s): Matthew Lanham

707 *Ethan Zhang†*
Mentor(s): Lixia Cheng

708 *Wentong Zhang†*
Mentor(s): Matthew Lanham

ASPIRE REU

709 *Paul Bradford†*
Mentor(s): Hongie Wang

710 *William Currey†*
Mentor(s): Adeeba Raheem

711 *Agustina Peck†*
Mentor(s): Mario Harper; Brandon Allen

COLOMBIAN RESEARCH SCHOLARS

712 *Gina C. Baquero†*
Mentor(s): Jose Garcia-Bravo

713 *Julián Andrés Navarrete Urrego†*
Mentor(s): Robin Tanamachi

REEU – DATA SCIENCE FOR AGRICULTURE

714 *Yu Mo†*
Mentor(s): Mark Ward

DUIRI

715 *Tansi Zhang†*
Mentor(s): Yingjie Chen

SURF - ANVIL

716 *Ved Arora†, Nayeli Gurrola‡, Oluwantumininu Oguntola**
Mentor(s): Guangzhe Jin, Amiya Maji

717 *Aneesh Chakravarthula†*
Mentor(s): Christopher Thompson; Lev Gorenstein

718 *Nayeli Gurrola†, Ved Arora‡*
Mentor(s): Guangzhe Jin, Amiya Maji

719 *Oluwatumininu Oguntola†*
Mentor(s):Erik Gough, Rajesh Kalyanam

720 *Henry Olson†*
Mentor(s): Erik Gough; Ryan DeRue

VIP – VERTICALLY INTEGRATED PROJECTS

721 *Yunhao Lan†*
Mentor(s): Mark Johnson; Cole Nelson

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 700
Presentation Time: 7/26-7/31

Predictive Analysis of Credit Risk Using Statistics and Machine Learning

Author(s):

Jiaxuan Li† (Science, DSB)

Abstract:

Loans are the core business of banks. Banks' main profit comes directly from the loan’s interest. This project analyzed important factors that cause a loan applicant to have bad credit risk, such as loan duration, Checking Account Balance, Age, etc. This is important for commercial banks to decide whether to grant loans to applicants and reduce financial losses due to loan defaults and bad credit risk. The motivation for this work is the rise in bad credit and loan losses among major banks during COVID. I built several models such as Nominal Logistic Regression model, K-Nearest Neighbors model, Classification Tree model, and Support Vector Machine to predict whether a loan applicant will have bad credit risk. My prediction model also provides potential business value. I will estimate how much bad credit cost our prediction model will save for the bank based on the confusion matrix. My predictive modeling and predictive analytics not only help commercial banks strengthen their credit risk management/prediction systems and reduce loan losses. It can also give future loan applicants a basis of exactly what parts of their information will be vital to the loan approval process.

Keyword(s):

Credit Risk Prediction, Machine Learning, Validation Set Approach, Nominal Logistic Regression, Confusion Matrix

Mentor(s):

Matthew Lanham (DSB)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 701
Presentation Time: 7/26-7/31

Diabetes Prediction

Author(s):

Zhaoming Hu† (DSB)

Abstract:

My motivation behind this project stemmed from the urgent need to identify individuals at high risk of developing diabetes. I aimed to develop a machine learning model for predicting the risk of diabetes based on various demographic and health factors. The dataset was collected from a diverse population, enabling me to conduct robust analysis and establish generalizability. My findings revealed significant associations between age, BMI, hypertension, and elevated blood glucose levels, which emerged as strong predictors, highlighting the importance of these factors in diabetes risk assessment. The machine learning model achieved promising accuracy, demonstrating its potential for aiding healthcare professionals in making informed decisions and improving patient outcomes.

Keyword(s):

Mentor(s):

Zhaoming Hu (DSB)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 702
Presentation Time: 7/26-7/31

Predictive Analysis of Credit Card Attrition

Author(s):

Danhe Tang† (DSB)

Abstract:

This project evaluated two predictive models to determine the most accurate model for banks to better predict the credit card attrition. Credit card attrition can have negative impacts on banks, causing revenue loss. It’s a valuable capability for banks to predict credit card customer churn as it allows them to address customer concerns and retain business to boost the overall profit. I built and evaluated K-Nearest Neighbors (KNN) and Decision Tree models of 10,127 observations and select the most accurate model to forecast if the customer will churn based on misclassification rate. The model provides a way for bank practitioners to understand what attributes historically can be an indicator of credit card attrition and strategically identify the potential customer churn.

Keyword(s):

Mentor(s):

Matthew Lanham (DSB)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 703
Presentation Time: 7/26-7/31

Withdrawn

Virtual Presentation Abstract Number: 704
Presentation Time: 7/26-7/31

Being Proactive for Responsible AI: Analyzing Multiple Sectors for Innovation via Systematic Literature Review

Author(s):

Adam Hafez† (Liberal Arts, Polytechnic Institute)

Abstract:

This study presents a systematic literature review (SLR) exploring proactive strategies for ensuring responsible and ethical artificial intelligence (AI) within the framework of the Quintuple Innovation Helix model. The model encompasses academia, government, industry, civil society, and the natural environment. The PRISMA framework and Hess & Fore's 2017 methodology were adapted to guide the SLR, examining English-language scholarly articles from 2018-2023. Our sources include prominent databases and key publications in the field of AI and ethics.

Despite the broad and complex nature of the field, we focus on how each of the five sectors proactively addresses AI responsibility and ethics. We plan to present preliminary findings and our qualitative coding process in a poster format to gather valuable expert opinions for refining the SLR dataset. This exercise will help identify potential research gaps and inform future inquiries.

Our primary goal is to provide a comprehensive framework identifying proactive strategies for cultivating responsible and sustainable AI, harmonious with the innovation sectors. In addition, we will explore the roles of experts in AI, ethics, education, and policy in this context. Our study is intended to contribute towards a collective, interdisciplinary effort in ethical AI, highlighting the need for proactive, rather than reactive, approaches.

Keyword(s):

Artificial Intelligence, Responsible AI, Ethics

Mentor(s):

Daniel Schiff (Liberal Arts); Alejandra Magana (Polytechnic Institute); Lucas Wiese (Polytechnic Institute)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 705
Presentation Time: 7/26-7/31

Promoting Positivity to Curb Toxic Behavior in Online Video Games

Author(s):

Natasha Lepiocha† (Purdue University Global)

Abstract:

Toxic gamer culture has become prevalent and normalized in gaming communities to the point where it is not seen as a real-life threat to the gamers behind the screens. Severe harassment is increasing every year not only causing serious psychological damage, but causing death, suicide, or other physical harm. Severe harassment includes categories such as swatting, doxing, stalking, and sexual harassment. I analyze peer reviewed articles and journals to define the variety of toxic behaviors, study the yearly increase in toxic behaviors, and understand the range of impact psychologically and physically from the behaviors. I also highlight that these threats don't only impact the gamers, but there is reported death of a third-party individual with no involvement in the video game. Members from the Black Desert gaming community, to which I belong, provided me with insights into their personal experiences with toxic behavior and showed that toxicity decreases their mental health, discourages competitive gameplay, and decreases overall enjoyment in the game. Based on these findings, the developers and the gaming community could and should be taking the necessary steps to prevent toxicity by promoting positivity and utilizing an advanced human-operated muting system for a safer gaming experience.

Keyword(s):

Toxic Behavior, Online Behavior, Grief, platform Governance, Online Games

Mentor(s):

Joshua Cook (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 706
Presentation Time: 7/26-7/31

Customer Churn Prediction on Telecommunication Industry

Author(s):

Yunlei Tang† (DSB)

Abstract:

This project analyzes the factors that influence customer churn in a telecom company, such as the age of the customer, location of residence, marital status, etc. This is important for a B2C company to predict customer churn because it helps the company to identify and proactively reach out to customers at risk of churn and try to repair the relationship beforehand, reducing the risk of lower revenue for the business. I analyzed which factors have a greater impact on customer churn and brought to the company's attention which types of customers have a high probability of canceling their subscription service. I also built several models such as Lasso, Logistic regression, KNN, and Decision Trees to predict the probability of customer churn. This analysis is important because when the company predicts a high probability of customer churn, it can take action to avoid it.

Keyword(s):

Customer Churn Prediction, Statistical Learning

Mentor(s):

Matthew Lanham (DSB)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 707
Presentation Time: 7/26-7/31

Energy Efficient Soft Robot: A Simulation Study

Author(s):

Ethan Zhang†

Abstract:

Redacted.

Keyword(s):

Soft Robot, Energy Consumption, Thermal Expansion, VoxCad, Simulation Study

Mentor(s):

Lixia Cheng (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 708
Presentation Time: 7/26-7/31

Machine Learning Implementation on Diabetes Prevention

Author(s):

Wentong Zhang† (DSB)

Abstract:

This research uses machine learning methods to predict the incidence of diabetes and identify drivers of the disease. The motivation for this study is that diabetes is one of the most common and dangerous chronic diseases, it cost billions ($) of medical expenditures annually and causes great suffering and inconvenience to people. Our objective is to develop a model that can accurately predict and detect diabetes and identify significant causes. Four classification models were trained on real data. We found a decision tree model successfully identified diabetes with the lowest misclassification rate and features such as HbA1c level, blood glucose, and age were significant drivers. We show how the those in the medical community might use this information to reduce diabetes in the future and the potential outcomes.

Keyword(s):

Diabetes Prediction, Diabetes Prevention Program, Decision Tree, Machine Learning

Mentor(s):

Matthew Lanham (DSB)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 709
Presentation Time: 7/26-7/31

ASPIRE REU

Reliability analysis framework for EV fast chargers

Author(s):

Paul Bradford† (Utah State University)

Abstract:

Electric Vehicle (EV) charging is a critical aspect of EV adoption. The unreliability of EV chargers in recent years, as EV popularity grows rapidly, has been a major pain point. Designing reliable EV chargers requires accurate models for reliability prediction. Current EV charger design focuses less on reliability and more on improving power converter performance through metrics such as efficiency, power factor, and THD. This research sought a mission-profile-based reliability analysis for a power converter topology that could reasonably be used in an EV fast-charging station. This reliability analysis allows for the consideration of reliability when designing EV chargers. Appropriate lifetime models from the literature were determined to measure the lifetime of vulnerable power electronics components. These lifetime models are then used to create a framework for reliability analysis in EV chargers that utilizes typical EV charger usage data to predict charger lifetime. The framework will allow for prediction of charger failure rate, mean time to failure (MTTF) and other related reliability metrics based on different converter topologies and devices.

Keyword(s):

Electric Vehicle Charging, Reliability, Fast Charging, Lifetime Model, Power Electronics Reliability

Mentor(s):

Hongjie Wang (Utah State University)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 710
Presentation Time: 7/26-7/31

ASPIRE REU

Roadway Electrification Cost Analysis

Author(s):

William Currey† (University of Texas at El Paso)

Abstract:

Electrified roadways are a new technology that uses magnetic wireless power transfer (WPT) to charge an electric vehicles (EV's) battery as they drive. This technology has been implemented in some European countries but has yet to make its way to the United States. While there are plans for the Michigan Department of Transportation to partner with Electreon, the company responsible for the development of European electrified roadways, data on the costs of electrified roadways in the U.S. remain scarce. The purpose of this literature review aims to compile studies that contain a collection of data on construction costs for electrified roadways to get an accurate estimate on implementing this technology. This literature review is the catalyst in developing an estimating tool that can be used to accurately price the cost to build electrified roadways. This tool will also utilize a City Cost Index which adjusts the roadway prices based on the 30 largest cities in the United States and the national average. Construction projects are often influenced by the cost, thus a tool like such would be critical to the widespread adoption of the roadways.

Keyword(s):

Electric Vehicles, Cost Estimating, Electrified Roadways, Wireless Power Transfer

Mentor(s):

Adeeba Raheem (College of Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 711
Presentation Time: 7/26-7/31

ASPIRE REU

Assessing Impacts and Strategies for Financing Transportation in the Age of Electric Vehicles: A Python-Based Simulation Approach

Author(s):

Agustina Peck† (Science, JMHC)

Abstract:

Many states are grappling with a crucial decision: how to finance roads and new transportation projects with the absence of gas taxes from electric vehicles. The United States heavily relies on gas taxes for transportation investments, but the rising adoption of electric vehicles is reducing this revenue source. Policymakers face the task of selecting road-use financing strategies such as EV registration fees, alternative fuels tax, sub-metering electric charging facilities, mileage-based tax, or a general tax on all constituents. These policies will inevitably impact people, altering driving behavior and electric vehicle adoption rates. This REU project develops a Python-based simulation engine to assess the impacts of transportation financing policies, considering adoption trends, household incomes, and state-specific EV price trends. The project also addresses the significance of EV adoption and its financial implications for at-risk and disadvantaged communities.

Keyword(s):

Simulation, Financing Infrastructure, Adoption, Affordability, Taxes

Mentor(s):

Mario Harper (Utah State University); Brandon Allen (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 712
Presentation Time: 7/26-7/31

Colombian Research Scholars Program

An innovative approach for controlling hydraulic systems using mixed reality

Author(s):

Gina C. Baquero† (Engineering)

Abstract:

The goal of this project is to explore the application of Mixed Reality (MR) technology for controlling hydraulic systems. The proposed system uses a combination of virtual and physical elements to provide users with an interactive and immersive experience with the HoloLens 2, a head-mounted device, that overlays digital information onto the real-world environment allowing them to control components in real-time through a computational model developed through the Unity game engine. Visual Studio 2022, and Windows 11 SDK are the other tools implemented to generate a digital twin that can be used to manipulate a hydraulic system.

In this system the user can receive immediate feedback from the actions performed by the system while displaying process variables (e.g., pressure, flow, and acceleration). The project includes a physical component in the form of a hydraulic cylinder, which serves as the output of the mixed reality control system. In this system it is required to establish a bilateral connection between the HoloLens 2 and the microcontroller, for example an Arduino board. Therefore, the electronic hardware will communicate wirelessly using Wi-Fi network connection (APIs). Additionally, the proposed interface is designed to be intuitive, easy to use, and versatile, allowing for a wide range of hydraulic system applications (e.g., manufacturing, mobile, industrial and robotics). project demonstrates the potential of mixed reality technology for enhancing the way humans interact with machines and equipment in the real world. The inherent traditional risks of using hydraulic technology will be mitigated by allowing the user to work in a safe and controlled environment.

Keyword(s):

Mentor(s):

Jose Garcia-Bravo (Polytechnic Institute)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 713
Presentation Time: 7/26-7/31

Colombian Research Scholars Program

A Geographer’s Perspective on Storm Chasing

Author(s):

Julián Andrés Navarrete Urrego† (Science)

Abstract:

In this presentation, I will describe a week-long storm chasing field trip through a geographer's eyes. I attempt to understand community practices, culture and economic activities while interpreting the geographical space. I anticipate potential risks and hazards considering general infrastructure, socioeconomic circumstances and exposure to extreme weather phenomena. Additionally, I will discuss the academic research potential of this course with an interdisciplinary approach.

The Students of Purdue Observing Tornadic Thunderstorms for Research (SPOTTR) course (EAPS 59100), led by Profs. Robin Tanamachi and Daniel Dawson is offered once each summer term. In it, students learn how to interpret meteorological data, utilize weather tools and plan itineraries to effectively track storms in the field. The significance of this course lies in its practical nature, as it allows students of any field of knowledge to experience how it is to be a storm chaser for a week across several states, typically in or around the U. S. Great Plains.

Taught with an atmospheric science perspective, the course includes a short but robust theory of atmospheric dynamics and training to deploy meteorological measurement tools safely, but primarily focuses on hands-on fieldwork. The opportunity to travel, observe and immerse ourselves in different landscapes opens the door for other types of appreciation associated with atmospheric subjects. Through connecting and correlating the several aspects that construct the landscape, I bring forth the geographer’s point of view to the whole experience.

Keyword(s):

Geography, Storm Chasing, Landscape, Meteorology

Mentor(s):

Robin Tanamachi (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 714
Presentation Time: 7/26-7/31

Digital Ag REEU

Affect of weather patterns on Soybeans production

Author(s):

Yu Mo† (Science)

Abstract:

Create a Climate change map to demonstrate the changes in soybean season. Use Excel and R to clean and calculate the productivity of the soybean. Also perform graphs to examine to overall profit of the soybeans in each states.

Keyword(s):

Climate Change, Soybean Yield, R

Mentor(s):

Mark Ward (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 715
Presentation Time: 7/26-7/31

DUIRI

CryoVR - Virtual Reality Augmented CryoEM Hands-on Training

Author(s):

Tansi Zhang† (Science, Polytechnic Institute)

Abstract:

Cryo-electron microscopy (CryoEM) has revolutionized the approach to high-resolution structure determination and the study of macromolecular complexes and viruses in near-native states. However, the accessibility of the equipment, along with the time and cost required for training, significantly limit opportunities for skill acquisition. To address these issues, we are developing a comprehensive virtual reality (VR) based training system – CryoVR, preparing trainees to handle real-world CryoEM equipment. CryoVR facilitates learning of the CryoEM experimental procedure in a virtual environment, offering immersive step-by-step training through vivid visual, auditory, and textual guidance. CryoVR enables users to familiarize themselves with practical operation procedures through various training modules and receive a certificate upon passing the in-built examination mode, serving as a preparatory step before novices interact with costly real-world CryoEM equipment.

According to the timeline of the CryoVR project, our team is set to complete the entire module for the Aquilos2 CryoEM sample preparation tool and integrate multi-user VR feature into the project this summer.

Currently, We have completed the Aquilos2 module, added practice mode, and improved the exam mode on the basis of the existing Aquilos2 tutorial mode. Users can now practice operating the Aquilos2 equipment in the VR environment and attempt to pass the exam. They can also replay their operation process to understand any missteps or oversights. The Aquilos2 module is now ready for release. Beyond refining the Aquilos2 module, we are currently developing multi-user VR capabilities, which would allow multiple VR devices in a LAN environment to simultaneously enter the same training scenario. This feature is expected to be completed this summer.

Qualitative evaluation and feedback from users with varying levels of CryoEM experience indicate the significant value of CryoVR as a comprehensive training tool for CryoEM procedures. The completion of the Aquilos2 module and the development of multi-user VR features will further aid CryoVR users in their training.

Keyword(s):

CryoVR, CryoEM, Human-Computer Interaction, Structural Biology, Virtual Reality Training

Mentor(s):

Yingjie Chen (Polytechnic Institute)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 716
Presentation Time: 7/26-7/31

SURF,ANVIL

Data Analysis on Purdue's Anvil HPC

Author(s):

Ved Arora† (Case Western Reserve University), Nayeli Gurrola‡ (University of Texas Rio Grande Valley), Oluwatumininu Oguntola (The University of North Carolina at Chapel Hill)

Abstract:

The remarkable expansion of high performance computing (HPC) in handling vast amounts of data has highlighted the importance of high computational power in various fields of research, spanning from quantum physics simulations to cancer research. To meet this demand, Purdue University has established an advanced HPC cluster named "Anvil," which serves as a valuable resource for thousands of researchers nationwide. With the goal of providing the best experience for users, Anvil's administration began to ask questions about how Anvil has been utilized and how they can provide better user support as well as minimize cost while optimizing performance and reliability. With these questions in mind, my partner and I decided to develop a live, interactive dashboard that could deliver real-time answers to these inquiries. With the help of XALT, a powerful tool designed to track usage on a computing cluster, we harnessed millions of data points encompassing usage on Anvil. Equipped with this extensive dataset, we applied sophisticated analytical techniques and Python workflows to generate visual responses to any questions posed by Anvil's users. To present our findings in an appealing manner, we seamlessly integrated our analytical workflows with Plotly Dash, a framework for building fully customizable data applications in Python. With the successful deployment of our comprehensive dashboard, Anvil's administrative team will gain valuable insights into the supercomputer's usage patterns, empowering them to fine-tune the cluster's performance and drive advancements in research productivity. The synergy between cutting-edge tools, analytical workflows, and live visualizations holds great potential for streamlining resource allocation, reducing costs, and maximizing Anvil's computing capabilities.

Keyword(s):

Big Data, Data Science, Analysis, Visualization

Mentor(s):

Guangzhe Jin; Amiya Maji

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 717
Presentation Time: 7/26-7/31

SURF,ANVIL

JupyterHub Deployment through Anvil

Author(s):

Aneesh Chakravarthula† (Science)

Abstract:

The purpose of this project is to provide educators and researchers with an easy way to deploy customized JupyterHub instances for other users or students through the Anvil Cloud. This will allow users to access a hosted web server so that students can simply use a browser to access it, instead of having to install Jupyter individually on each participant's computer. Several methods have been employed to achieve this goal, including easy web-based customization tool, allowing users to choose the URL for the files they want to upload, providing them with a CILogon that utilizes various authentication options, and granting special privileges to admins. CILogon enables users to log in using their regular university usernames and passwords. All JupyterHub instances are deployed in the Anvil Cloud, a Kubernetes-based composable infrastructure in the NSF-supported Anvil supercomputer. The overarching objective of this project is to enhance the user experience for both instructors and students needing to run Jupyter-based workflows. The execution of this project has been successful thus far, and further customizations options are planned to enhance the user experience. Ultimately, this approach will provide simple and practical means of deploying flexible customized JupyterHub instances to multiple users.

Keyword(s):

JupyterHub, Anvil, Delpoyment, Kubernetes, CILogon

Mentor(s):

Christopher Thompson (Information Technology); Lev Gorenstein (Research Computing)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 718
Presentation Time: 7/26-7/31

SURF,ANVIL

Data Analytics: Instrument and perform analysis of scientific application workloads on the Anvil system

Author(s):

Nayeli Gurrola† (University of Texas Rio Grande Valley), Ved Arora‡ (Case Western Reserve University)

Abstract:

Effective collecting, management, and analysis of performance data on Purdue University's Anvil supercomputer is crucial for system administrators to gain valuable insights into software usage and performance metrics. XALT is an instrumental tool in capturing data related to software dependencies and execution on the Anvil system. In this project, we leveraged XALT alongside Python and web-based visualization frameworks to develop an interactive dashboard. The dashboard empowers system administrators to explore and analyze the Anvil software ecosystem, facilitating data-driven decision-making for optimizing system resources and enhancing user experiences. We extracted and transformed relevant data from XALT using SQL and Python, revealing valuable insights. These insights were presented interactively using Dash, a Python framework for building interactive web applications. By integrating XALT, SQL, Python, and Dash, our project enables system administrators to comprehensively understand software usage patterns and system utilization of the Anvil supercomputer. Our project showcases the potential of XALT and modern technologies in analyzing and visualizing performance data. It contributes to system administration, system optimization as well as better user support in high-performance computing (HPC) environments, specifically on Purdue University's Anvil supercomputer.

Keyword(s):

XALT, Anvil, Python, SQL, Dash

Mentor(s):

Guangzhe Jin; Amiya Maji

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 719
Presentation Time: 7/26-7/31

SURF,ANVIL

Cloud Bursting from the Anvil Composable Subsystem

Author(s):

Oluwatumininu Oguntola† (The University of North Carolina at Chapel Hill)

Abstract:

Anvil is a high-performance computing (HPC) cluster at Purdue University, more commonly known as a supercomputer, built in partnership with Dell and AMD to cater to the increasing computational requirements of researchers across the nation. Funded by the National Science Foundation under the Advanced Computing Systems & Services program, Anvil is a large capacity system, comprising 1000 nodes connected via a 100Gbps interconnect; making it capable of 5.3 petaflops peak performance and performing complex calculations and simulations that would otherwise be difficult, if not impossible, through the use of conventional computing resources. Apart from being a typical supercomputer, Anvil also contains an innovative Kubernetes-based academic cloud composable subsystem for the deployment of persistent custom services like Jupyter notebooks, databases, and science gateway applications to match the diverse needs of researchers. The system's flexibility allows researchers to deploy and manage these services to complement their workflows and run containerized applications without any external assistance. This research project aimed to expand the subsystem's capabilities by extending workflows from the academic cloud to the commercial cloud (specifically Azure) through the use of cloud-based Kubernetes clusters while preserving the user experience. This will enable users to utilize some of the most notable advantages of scaling their workflows into the commercial cloud without the use, or complexity, of additional tools or interfaces. For instance, users will be able to employ a larger range of cloud node configurations than available on Anvil, support the elastic scaling of workloads with fluctuating demand, and utilize cloud-hosted datasets.

Keyword(s):

Computing, HPC, Kubernetes, Cloud

Mentor(s):

Erik Gough (Information Technology); Rajesh Kalyanam (Research Computing)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 720
Presentation Time: 7/26-7/31

SURF,ANVIL

Extending the Anvil Supercomputer to the Azure Cloud

Author(s):

Henry Olson† (Science, JMHC)

Abstract:

Anvil is a high performance computing (HPC) resource at Purdue University that is used by researchers from around the country for science and engineering applications across a variety of disciplines. Public cloud providers such as Microsoft, Amazon and Google offer a wide range of computing resources at almost unlimited scale. This project will extend Anvil's capabilities by allowing researchers to seamlessly burst scientific workflows from Anvil to the Microsoft Azure cloud. Through this hybrid cloud integration, we can support researchers with cloud credits, provide researchers access to additional compute resources to meet deadlines and utilize alternative accelerators such as FPGAs not provided directly by Anvil. In this project, we created the infrastructure that will allow Anvil to operate in a hybrid cloud environment. This includes a way for Microsoft Azure to deploy virtual machines based on Anvil compute nodes, a way for Slurm (Anvil's resource manager) to communicate between on-prem and Microsoft Azure resources, and a way to keep track of credit usage.

Keyword(s):

HPC, Anvil, Azure

Mentor(s):

Erik Gough (Information Technology); Ryan DeRue (Research Computing)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 721
Presentation Time: 7/26-7/31

VIP

Integration and Testing of I/O MUX on AFTx07

Author(s):

Yunhao Lan† (Engineering)

Abstract:

This project aimed to integrate the digital input/output multiplexer (I/O MUX) onto the AFTx07, a system-on-chip (SoC) design by Purdue SoCET Team. To be specific, this project did the integration of I/O MUX on the top-level chip, I/O MUX's connection with the advanced peripheral bus (APB), and the interconnection between IO MUX and the three integrated APB peripherals in the current branch of AFTx07: general-purpose input/output (GPIO), pulse width modulation (PWM), and serial peripheral interface (SPI). I/O MUX, acting as a digital multiplexer, allows for configuring the pins to be used for specific functions. It achieves this by having a function select register, direction signals, and data signals. In AFTx07, each pin is multiplexed by GPIO corresponding with the pin number and a signal needed by another peripheral. In this project, C-code tests were written that exercise the functionality of the I/O MUX. Thus, simulation was conducted in a way of configuring both I/O MUX and a peripheral to fulfill the peripheral's functionality and verified it through the outputs of the I/O MUX (both to input/output pad (I/O PAD) and to peripherals). Finally, the simulation of the I/O MUX passed for GPIO, PWM, and SPI, showing that I/O MUX's integration with these three APB peripherals on the top-level chip is well functioning.

Keyword(s):

SoC, Integration, Design Test, Digital Design, Logic Design

Mentor(s):

Mark Johnson (Engineering); Cole Nelson (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

SYMPOSIUM NOTES

SAVE THESE DATES:

SEPTEMBER 7, 2023: Undergraduate Research Roundtable

NOVEMBER 14 & 15, 2023: Fall Undergraduate Research Expo

APRIL 9 & 11, 2024: Spring Undergraduate Research Conference

JULY 25, 2024: Summer Undergraduate Research Symposium

UNDERGRADUATE RESEARCH

ABSTRACT BOOK

PURDUE UNIVERSITY | Office of Undergraduate Research