SUMMER UNDERGRADUATE RESEARCH SYMPOSIUM

JULY 25—AUGUST 1, 2024

PURDUE UNIVERSITY, WEST LAFAYETTE, INDIANA

SCHEDULE OF EVENTS

JULY 25, 2024

PMU EAST & WEST FACULTY LOUNGES

9:00AM-10:00AM	**Poster Session 1**
10:30AM-11:30AM	**Poster Session 2**
12:00PM-1:00PM	**Poster Session 3**
1:30PM-2:30PM	**Poster Session 4**

GRISSOM HALL

9:00AM-5:00PM	**Research Talks**

JULY 25—AUGUST 1, 2024

Virtual presentations

*View them at **purdue.edu/undergrad-research/conferences/summer***

We encourage those with a Purdue account to provide feedback.
To submit feedback, please scan this QR code with your device.

POSTER SYMPOSIUM

Posters are delivered in the Purdue Memorial Union East & West Faculty Lounges on July 25, 2024.
Posters sorted by program (if any) and then last name of first author within each session.
Names as in OURConnect.

FIRST POSTER SESSION | 9:00AM-10:00AM

Colombian Research Scholars

1000 *Lina Milena Gomez Morales†*
Mentor(s): Yun-Fang Yang

1001 *Angee Paola Lopera Restrepo†; Wayne Wheeler Kottkamp‡*
Mentor(s): Douglas R Schmitt

Summer Research Opportunities Program (SROP)

1002 *Deanna Durben†*
Mentor(s): Daniel J Foti; Lisa Ann Brown

1003 *Hannah Kim†*
Mentor(s): Yk Hei Franki Kung

1004 *Niah Nieuwenhuis†*
Mentor(s): Francoise Brosseau-Lapre

1005 *Sebastian Rosario Torres†; Monika Malik‡*
Mentor(s): Kavita Shah; Asha Parveen Sakkarai Mohamed

Summer Undergrad Research Fellowship (SURF)

1006 *Spasko Aleksov†; Paige Alicia Greenfield*; Xu Lu**
Mentor(s): Logan Jacob Melican

1007 *Rishika Bera†*
Mentor(s): Karthik Ramani; Asim Unmesh; Runlin Duan; Mayank Harendra Patel

1008 *Reed G Brzezinski†*
Mentor(s): Ilya Slizovskiy

1009 *Marie Emilie Charbonnier†*
Mentor(s): Rusi P Taleyarkhan; Stepan Ozerov

1010 *Hannah Y Chun†*
Mentor(s): David Neal Halbrooks

1011 *Atin Dewan†*
Mentor(s): Fiona Kolbinger

1012 *Sofia Victoria Duran Quiroga†*
Mentor(s): Tyler Renee Pikes

1013 *Marzuk Hasan†*
Mentor(s): Ethan P Wissmann

1014 *Anja Hribljan†; Daniel Sich‡*
Mentor(s): Brett Savoie; Andrew Bartlett Schofield

1015 *Joyce Hu†*
Mentor(s): Waqas Alam; David Warsinger

1016 *Saloni Jajoo†*
Mentor(s): Fiona Kolbinger

1017 *Adib Kabir†; Arun Arjunakani**
Mentor(s): Arnab Banerjee

1018 *Ali Kalmagambetov†*
Mentor(s): Alberto Castillo; Jan Olek; Maria Mirian Velay Lizancos

1019 *Hanhyun Kwak†*
Mentor(s): Harry Kangseok Lee; Garam Kim; Eduardo Barocio Vaca

1020 *Jai Nanda Lakamsani†*
Mentor(s): Yu She

1021 *Morgan Grace Laskowski†*
Mentor(s): Angeline M Lyon; Elisabeth E Garland

1022 *Aaryan Sachin Lath†*
Mentor(s): Shirley J Dyke; Oscar Daniel Forero velez

1023 *Ian Laudo†*
Mentor(s): Leifur Thor Leifsson

1024 *Ilhoon Lee†*
Mentor(s): Madeleine Shuhn Tsua Yuh; Neera Jain

1025 *Matthew S Leight†; Eleanor Captola Hostetler‡*
Mentor(s): Joseph S Jewell; Siddharth Bhatnagar

1026 *Chenyu Li†*
Mentor(s): Jeonghui Kim; Letian Dou

1027 *En-tsz Liu†*
Mentor(s): Mehrnoosh Afshang; Kelly Schultz

1028 *Emma Lombardo†*
Mentor(s): Yung-Hsiang Lu

1029 *Lionel Yek-Yau Loo†*
Mentor(s): David M Umulis

1030 *Uyen Linh Ly†*
Mentor(s): Isabelle Kathryn Schaekel; Jonathan J Wilker

1031 *Matthew William Margraf†*
Mentor(s): Evelyn Marie Nonamaker; Luis Solorio

1032 *Jax Patrick Marrone†; Andres Navarro‡; Sahil Vijay Desai‡; Emily Le Bell‡*
Mentor(s): Edward L Bartlett; Meredith Christine Ziliak

1033 *Joseph Mayer†*
Mentor(s): You-Yeon Won; Samruddhi Moreshwar Patil; Sung-Ho Shin

1034 *Aishwarya Menon†*
Mentor(s): Shrivatsa Shrirang Korde; Gintaras Reklaitis; Zoltan Nagy

1035 *Tyler Merrill†*
Mentor(s): Kevin J Webb; Abdelrahman Salem; Paula-Marie Ivey

1036 *Logan Mick†*
Mentor(s): Kendra A Erk; Akul Seshadri

1037 *Tomas Montoya†*
Mentor(s): Shivam Sharma

1038 *Luisa Valentina Mora Perez†*
Mentor(s): Bruce M Applegate

1039 *Andy Nguyen†*
Mentor(s): Philip Eugene Pare

1040 *Michelle Perez Aguilar†*
Mentor(s): Zahra Ghodsi

1041 *Kayla Renae Phillips†*
Mentor(s): Cristian Eduardo Vargas Ordonez; Yash Ajay Garje

1042 *Ankita Prasad†*
Mentor(s): Saloni Darji; Marissa Elaine Henager; David Thompson

1043 *Eliana Saavedra†*
Mentor(s): Zachary Kristopher Beickman; Julie C Liu

1044 *Luisa Sanchez†*
Mentor(s): Feng Zhu

1045 *Neelesh Sarathy†*
Mentor(s): Mohit Verma; Bibek Raut

1046 *Nistha Shrestha†*
Mentor(s): Sathish Rajendran

1047 *Daniel Sich†; Anja Hribljan‡*
Mentor(s): Brett Savoie; Andrew Bartlett Schofield

1048 *Shreya Sinha†*
Mentor(s): Deva Chan; Mikayla Angelique Roach

1049 *Pedro Daniel Soto Rodriguez†; Ludvik Mathis Fjeld**
Mentor(s): Eduardo Barocio Vaca

1050 *Drake William Strait†*
Mentor(s): Sandro Matosevic; Xinyu Wu; Tyler Parker Fritsch; Kumar Rishabh

1051 *Vihaan Vajpayee†; Andrew Joseph Thompson**
Mentor(s): Enrique Daniel Saldivar Carranza; Darcy M Bullock

1052 *Edward Vane†*
Mentor(s): Dheeraj Govindrao Waghmare

1053 *Nishant Vasan†; Haddy Elie Alchaer‡*
Mentor(s): Karthik Ramani; Dizhi Ma

1054 *Lily Avery Waterman†*
Mentor(s): David Warsinger; Md Ashiqur Rahman

1055 *Thomas B Wooldridge†*
Mentor(s): Li Qiao; Holman Lau

Vet Med Summer Scholars

1056 *Rubyleane Linton†; Scott A Gentry*; Amy R Witman*; Gabriela Gambirazio*; Farren E Osborn**
Mentor(s): Rebecca P Wilkes; Craig L Bowen

1057 *Allison Grace Schimpf†; Alexander W Enstrom**
Mentor(s): Meaghan M Broman

1058 *Sophie Kaitlyn Stahl†*
Mentor(s): Leanne Nieforth

Vertically Integrated Projects (VIP)

1059 *Connor Bradley Frey†; Ryan Thomas Jordan*; Edward Falcon Navarro*; Caasi Nketiah Boakye*; Minsoo Oh*; Tim Nadolsky*; Ping-Hung Nick Ko*; Brian Mingyang Qi*; Anthony Wang**
Mentor(s): Yeon Ji Yun; Yung-Hsiang Lu

1060 *Edward Falcon Navarro†; Ryan Thomas Jordan*; Tim Nadolsky*; Ping-Hung Nick Ko*; Caasi Nketiah Boakye*; Minsoo Oh*; Brian Mingyang Qi*; Anthony Wang*; Connor Bradley Frey**
Mentor(s): Yeon Ji Yun; Yung-Hsiang Lu; Purvish Jatin Jajal

Non-Program

1061 *Ava Grace Barnes†*
Mentor(s): Leonor Maria de Fatima Chagas Boavida

1062 *Lane Bell†; Bryan Reyes‡*
Mentor(s): Daniel B Raudabaugh; Mary Aime; Terry Jarianna Torres Cruz; Mark Thomas Anderson

1063 *Bea Olivia Cabot†*
Mentor(s): Jonathan Pasternak; Alyssa Smith; Dayeon Jeon

1064 *Christian A Durbin†*
Mentor(s): Yang Yang; Shivam Kant

1065 *Deniz Eksioglu†*
Mentor(s): Hyowon Lee; Jae Young Park

1066 *Michael David Gardner†*
Mentor(s): Brian Patrick Ha Metzger

1067 *Royalty Hightower†*
Mentor(s): Javier M Gonzalez

1068 *Rachel Marie Isaac†*
Mentor(s): Brian Patrick Ha Metzger

1069 *Dia Dipen Jhaveri†*
Mentor(s): Jason R Cannon

1070 *Alexander G Kelley†*
Mentor(s): Kaitlyn T. Hood

1071 *Rachel Elizabeth Kuhn†; Abbilynne Nicole Elder†; Dylan Wade Seets†*
Mentor(s): Darrin M Karcher; Sara Elizabeth Cloft

1072 *Kathryn P McCauley†*
Mentor(s): John Tesmer

1073 *Isabel M Owens†*
Mentor(s): Severin Thomas Schneebeli; Bazil Muhammed Sathar

1074 *Twesha Ray†*
Mentor(s): Daniel Suter

1075 *Dylan Wade Seets†; Carl Anthony Kroger‡*
Mentor(s): Darrin M Karcher; Sara Elizabeth Cloft

1076 *Lev Titov†*
Mentor(s): Yoon Yeo; Sota Shishikura

SECOND POSTER SESSION | 10:30AM-11:30AM

Advancing Sustainability through Powered Infrastructure for Roadway Electrication (ASPIRE REU)

1200 *Aspen Arnold†*
Mentor(s): Brandon Chase Myke Allen; Chiara Cervini; Quayannah Lane

1201 *Daisey Briggs†*
Mentor(s): Kaitlyn Nicole Allen; Chiara Cervini; Quayannah Lane

1202 *Scott Edwards†*
Mentor(s): Brandon Chase Myke Allen; Chiara Cervini; Quayannah Lane

1203 *Kaydence Hall†*
Mentor(s): Brandon Chase Myke Allen; Chiara Cervini; Quayannah Lane

1204 *Angelic Harris†*
Mentor(s): Brandon Chase Myke Allen; Chiara Cervini; Quayannah Lane

1205 *Jarrett Harris†*
Mentor(s): Brandon Chase Myke Allen; Chiara Cervini; Quayannah Lane

1206 *Francisco Hurtado†*
Mentor(s): Brandon Chase Myke Allen; Chiara Cervini; Quayannah Lane

1207 *Olivia J Kurtz†*
Mentor(s): Nadia Gkritza; Zainab Imran; Ricardo Chahine

1208 *Quayannah Lane†*
Mentor(s): Brandon Chase Myke Allen; Chiara Cervini

1209 *Emma Mast†*
Mentor(s): Shan Zhou

1210 *Tiara Thomas†*
Mentor(s): Brandon Chase Myke Allen

1211 *Daniel White†*
Mentor(s): Brandon Chase Myke Allen; Chiara Cervini; Quayannah Lane

Bernal REU

1212 *Yu-Wei Cheng†*
Mentor(s): Ximena Bernal; Richa Singh

1213 *Chloe Elizabeth Greco†*
Mentor(s): Ximena Bernal; Richa Singh

1214 *Eavan Sohr†*
Mentor(s): Ximena Bernal; Richa Singh

Biochemistry REU

1215 *Hillary English†*
Mentor(s): Andrew D Mesecar; Beinan Yang

1216 *Laila Fortson†*
Mentor(s): Mark C Hall; Emily Lynae Danzeisen; James D Forney

1217 *Juan Alberto Gomez-Solis†; Isaiah K Mensah**
Mentor(s): Humaira Gowher; Sameer Ullah Khan

1218 *Sara Bethany Victoria Haber†*
Mentor(s): Makayla Nicole Marlin; Vikki Marie Weake

1219 *Emma Litzelman†*
Mentor(s): Andrew D Mesecar; Kratika Singhal

1220 *Andres Moran†; Shelby Sliger‡; Joshua Paul Kaluf‡*
Mentor(s): Joseph P Ogas; Jiaxin Long; Jacob Ryan Fawley

1221 *David Stanciel Onishile†*
Mentor(s): Kyle Aaron Cottrell

1222 *Matthew Tabrisky†; Krishna P Patel‡*
Mentor(s): Scott D Briggs; Smriti Hoda

Colombian Research Scholars

1223 *Mateo Colorado Zapata†*
Mentor(s): Enrico Martinez Sainz; Rajdeep Deka

1224 *Alejandro Daza Gallo†*
Mentor(s): Hinayah Rojas de Oliveira; Henrique Alberto Mulim; Gabriel Soares Campos; Juan D Velasquez De Bedout; Deborah Hannah

1225 *Ana Milena Espinosa Jimenez†*
Mentor(s): Kwang Taik Kim; Cheng Chen

Discovery Undergraduate Interdisciplinary Research Internship (DUIRI)

1226 *Katie Wing-See Chan†*
Mentor(s): Brenna Vaughn

1227 *Joslyn Renee Ferguson†; Niharika Narra‡; John Patrick Salvas**
Mentor(s): Cortland Hannah Johns; Alyssa Marine Richards; Craig Goergen

1228 *Alexander Harman†*
Mentor(s): Qingchun Li

1229 *Joon Kang†*
Mentor(s): James Tanoos; Yi Gao

1230 *Daniel Ethan Kelley†; Natalie Elizabeth Romick‡*
Mentor(s): Craig Goergen

1231 *Cora Jane Reynolds†; Lail Shaw†; Hallie Grace Jackson‡*
Mentor(s): Tyler D Hoskins; Maria Soledad Sepulveda; Nathan Timothy Mak; Youn jeong Choi; Deise Cruz Santos

Physics REU

1232 *Ana Colliton†; Bryan Borosky‡*
Mentor(s): Michael Earl Reppert

1233 *Erin Duell†*
Mentor(s): Laura J Pyrak-Nolte

1234 *Isabella Freitas†; Monique Mariae Morse†*
Mentor(s): Andreas Jung; Osama Ragab Ahmed Dawood

1235 *Alexis Nicole Hensley†*
Mentor(s): David D Nolte; Laura J Pyrak-Nolte

1236 *Reagan John Thompson†*
Mentor(s): Laura J Pyrak-Nolte; Alexandra Blair Clark

Purdue Undergrad Research Experiencs for Plant Biology & Data Science (PURE-PD)

1237 *Elizabeth Agyei†*
Mentor(s): Leonor Maria de Fatima Chagas Boavida

1238 *Elise Bennett†*
Mentor(s): Abigail Keelin Rogers

1239 *Anasofia Carrillo†*
Mentor(s): Yun Zhou; Xi Yang; Chong Xie

1240 *Holly Gustavsen†*
Mentor(s): Daniel Park; Jaein Choi

1241 *Niki Hamraei†*
Mentor(s): Natalia Doudareva; Matthew Edward Bergman

1242 *Molly Kubal†*
Mentor(s): Gyeong Mee Yoon; Hye Lin Park; Yuan-Chi Chien

1243 *Samantha Lares†*
Mentor(s): Frederick Isaac Mildenhall; Xiaojin Wang; Kranthi Varala

1244 *Jeremy Ledesma Vicioso†; Abigail Grace Smith**
Mentor(s): Tesfaye D Mengiste; Pascal Chukwuebuk Okoye

1245 *Adrian Muñoz†*
Mentor(s): Jianxin Ma; Chancelor Bart Clark; Leonie Marie Trabert

1246 *Diallo Thomas†; Jing Huang*; Ana Maria Orjuela Rodriguez**
Mentor(s): Cankui Zhang; Hannah Elizabeth Levengood

1247 *Demi White†*
Mentor(s): Stanton B Gelvin

1248 *Esperanza Zambrano†*
Mentor(s): Joshua R Widhalm; George W Meyer

Summer College of Agriculture Research Fellowship (SCARF)

1249 *Minghao He†*
Mentor(s): Senay Simsek

SROP

1250 *Sarah Hong†*
Mentor(s): Patricia Marie Wolf; Jellie Moore Snyder

Structural & Comp. Biology & Biophysics REU

1251 *Jesus Noriega†*
Mentor(s): Nicholas Noinaj; Nourin Ferdausi

1252 *Angel Ortiz†*
Mentor(s): Ramaswamy Subramanian

1253 *Nicholas Paredes†*
Mentor(s): Danzhou Yang

1254 *Shaye Ross†*
Mentor(s): Seema Mattoo; Ben G Watson

SURF

1255 *Ozan Altuntas†*
Mentor(s): Laura J Pyrak-Nolte; Alexandra Blair Clark

1256 *Ishaan Breinig†*
Mentor(s): Li Qiao; Afaque Alam

1257 *Piyush Dnyaneshwar Chhallare†*
Mentor(s): Arnab Banerjee; Bishnu Prasad Belbase

1258 *Jacob Daniel†*
Mentor(s): Gaurav Somnath Chobe

1259 *Rishipreet Singh Dhir†*
Mentor(s): Sean Yenyu Lai; David Neal Halbrooks

1260 *Jack Rearden Ferlazzo†*
Mentor(s): Anwarul Islam Akash; Xianfan Xu; Jason Johnson; Ishat Raihan Jamil

1261 *Nicolas Giesemann†*
Mentor(s): Andrea Vacca; Timir Rajendra Patel

1262 *Kyle Jeffery Heaton†*
Mentor(s): Taimoor Hasan Qazi

1263 *Liam Q Johnson†; Lokesh Sriram*; Benjamin Garrett Drillings*; Levi Darian Reyes Premer**
Mentor(s): Elias Nikolaos Pergantis; Kevin James Kircher

1264 *Xu Lu†; Spasko Aleksov*; Benjamin Charles Miller**
Mentor(s): Logan Jacob Melican

1265 *Jiawen Lyu†*
Mentor(s): Amy R Reibman; Manu Ramesh

1266 *Karla Erendira Obermeier Velazquez†*
Mentor(s): Santiago Torres Arias

1267 *Vidit Hemal Patel†*
Mentor(s): Martin Byung-Guk Jun

1268 *Carolyn Sun†*
Mentor(s): Kevin J Webb; Adam Winston Behnke; Thomas J Pollei

1269 *Andrew Joseph Thompson†; Vihaan Vajpayee**
Mentor(s): Enrique Daniel Saldivar Carranza; Darcy M Bullock

1270 *Evan R Williams†*
Mentor(s): Matthew Kaboolian; Kendra A Erk

Non-Program

1271 *Alexander Douglas Carlson†*
Mentor(s): Eduardo Barocio Vaca

1272 *Keeley Vonne Farmer†*
Mentor(s): Jeffrey Edward Dick; Dane Christophe Wagner; Mobina Masdari

1273 *Sadie A Poirier†; Yashvi Choudhary‡; Megan Leigh Hill*; Keeley Vonne Farmer**
Mentor(s): Vanshika Gupta; Samuel Patrick Nortz; Dane Christophe Wagner

1274 *Bryan Reyes†; Lane Bell‡*
Mentor(s): Daniel B Raudabaugh; Jeffery Kirk Stallman; Mary Aime

1275 *Janessa M Rieser†; Chaoyi Hu†*
Mentor(s): William Hutzel; Ivan Arturo Nunez ferro

1276 *Shawn Saturday†*
Mentor(s): Javier M Gonzalez

THIRD POSTER SESSION | 12:00PM-1:00PM

Center for Innovative and Strategic Transformation of Alkane Resources (CISTAR)

1400 *Errol B Alden†*
Mentor(s): Joanna Marie Rosenberger; Christina W Li

1401 *Kirshaun McGhee†*
Mentor(s): Rajamani P Gounder

1402 *Zachary Rasmussen†*
Mentor(s): Can Li; Hao Chen

1403 *Joyce M Rivera Sanchez†*
Mentor(s): Wei-Ling Huang; Jeffrey T Miller

DUIRI

1404 *Bethany Faber†*
Mentor(s): Ellen M Wells; Aaron James Specht

Scalable Asymmetric Lifecycle Engagement (SCALE)

1405 *Johan Martinez†*
Mentor(s): Ritwik Vijaykumar Kulkarni

1406 *Dania M Zein†*
Mentor(s): Allen L Garner; Lorin Irene Breen; Cameron James Buerke; Samera Hossain; Alexander Gregory Sinelli; Reagan LiPing McCafferty

SCARF

1407 *Jamie Kim Bryan†*
Mentor(s): Elizabeth J Tran; Subhadeep Das; Maria Paula Zea Rojas

1408 *Lauren Rose Connors†*
Mentor(s): Scott D Briggs; Justin Bradley Gregor

1409 *Samantha Teal Fairchild†*
Mentor(s): Jonathan Pasternak; Alyssa Smith

1410 *Anagha Gaitonde†*
Mentor(s): Simerdeep Kaur; Mohit Verma

1411 *Gage Ryan Edward Gottman†*
Mentor(s): Jacob Mark Olson; Brian Dilkes

1412 *Nathan Michael Henderson†*
Mentor(s): Mark C Hall; Kevin Gabriel Velazquez-Marrero

1413 *Madolyn Marie Jarrett†*
Mentor(s): Vikki Marie Weake; Sarah Caroline Stanhope

1414 *Molly Elizabeth Kosiba†*
Mentor(s): Sharon A Kessler; Sienna Tsuruko Ogawa

1415 *Joel Jenson Kuriakose†*
Mentor(s): Karthik Sankaranarayanan

1416 *Maxine Katya Kushner†*
Mentor(s): Ann L Kirchmaier; Ronard Kwizera

1417 *Erica Ann Long†*
Mentor(s): Tingting Ju

1418 *Jonathan Michael Lu†*
Mentor(s): Scott McAdam

1419 *Eleanore Margaret Malinowski†*
Mentor(s): Clint C S Chapple; Chase Taylor Hearn

1420 *Nathaniel Merrick Miller†*
Mentor(s): Weiguo Andy Tao; Yi Kai Liu

1421 *Anja Chloe Owens†*
Mentor(s): Andrea M Liceaga

1422 *Katie Nicole Smith†*
Mentor(s): Caitlin Rose Proctor

1423 *Grace Anne Stanton†*
Mentor(s): D. Marshall Porterfield

1424 *Elysia Marlena Uggen†; Joshua Paul Kaluf‡; Shelby Sliger‡*
Mentor(s): Joseph P Ogas; Jacob Ryan Fawley; Jiaxin Long

1425 *Rieko Simone Wilford†; Alejandro Daza Gallo*; Jihyo Park**
Mentor(s): Hinayah Rojas de Oliveira; Upinder Kaur

SURF

1426 *Gianna Marie Arnone†; Matthew William Vaughn**
Mentor(s): Diane Collard

1427 *Apoorva Bahl†; Stella Mae Betts‡*
Mentor(s): Hitesh Bindra; Broderick Michael Sieh

1428 *Stella Mae Betts†; Apoorva Bahl‡*
Mentor(s): Hitesh Bindra; Broderick Michael Sieh

1429 *Trisha Boodhoo†*
Mentor(s): Bairav Sabarish Vishnugopi; Partha P Mukherjee; Arpan Kumar Sharma

1430 *Ryan L Bottini†*
Mentor(s): Cagri Un

1431 *Zarif Cabrera†*
Mentor(s): Philip Eugene Pare

1432 *Pablo Cambra Valcarcel†*
Mentor(s): Davide Ziviani; Feng Wu; Panagiota Karava

1433 *Rafael Casas Lozano†*
Mentor(s): Xingshan Cui

1434 *Zhiyuan Chen†*
Mentor(s): Taimoor Hasan Qazi

1435 *Rem Quintin Villanueva David†*
Mentor(s): Christopher J Staiger; Weiwei Zhang

1436 *Luke DeLion†*
Mentor(s): Sophia R Dasaro; Kurt Ristroph

1437 *Martin Detloff†*
Mentor(s): James C Davis

1438 *Victor Alexander Dossin†*
Mentor(s): Seyedmehdi Sharifian; Nien-hwa L Wang

1439 *David S Estrella†*
Mentor(s): R Edwin Garcia; Haiyan Wang

1440 *Bryan Gong†*
Mentor(s): Monique Suzanne McClain; Andrew Stephen Bok

1441 *Solomon J Houchen†*
Mentor(s): Daniel Quinn

1442 *Chi-En Huang†*
Mentor(s): Isaac Stonewall Wheeler; Vivek Narsimhan; Alina Alexeenko

1443 *Nathan Joseph†; Edward Vane†*
Mentor(s): Margaritis Tonidis

1444 *Shreya Joshy†; Brooke Allison Pilkey‡; Silas Henry Buchanan‡*
Mentor(s): Rebecca Lynn Leuschen-kohl; Stephen R Lindemann; Rwivoo Baruah; Anjali Iyer-Pascuzzi

1445 *Basil Khwaja†*
Mentor(s): Yuan-Yao Lou; Kwang Taik Kim

1446 *Nils Kiefer†*
Mentor(s): Nina Mahmoudian

1447 *Manila Kunwar†; Ruey-Bin Tsai‡; Junyeong Ahn‡*
Mentor(s): Jeffrey P Youngblood; Michael Titus; Ching-Chien Chen; David R Johnson

1448 *Qi Heng Law†*
Mentor(s): Rusi P Taleyarkhan; Stepan Ozerov

1449 *Craig Liu†*
Mentor(s): Jenna L Wise DiVincenzo

1450 *Ismael A Luna†*
Mentor(s): David J Cappelleri; Ki Tae Kim; Aarya Deb

1451 *Minh An Nguyen Luu†*
Mentor(s): Brandon Boor; Satya Sundar Patra; Nusrat Jung

1452 *Ellen Ma†*
Mentor(s): Ismar Leonel Chew; Monique Suzanne McClain

1453 *Louden James Maciag†*
Mentor(s): David Thompson; Marissa Elaine Henager

1454 *Nicole Marie Maneatis†*
Mentor(s): Zherui Martinez-Guo; Cody Dean Kirk

1455 *Rafael Monteiro Martins Pinheiro†*
Mentor(s): Ivan C Christov

1456 *Nicolas Miguel Murillo Cristancho†; Nicolas Rendon Arias‡; Sehyeon Lim‡*
Mentor(s): Walter Daniel Leon-Salas

1457 *Angie Catalina Parra Ovelencio†; Pedro Daniel Soto Rodriguez‡*
Mentor(s): Andreas Jung; Sushrut Karmarkar

1458 *Hemisha Shardul Patel†*
Mentor(s): Yash Ajay Garje; Cristian Eduardo Vargas Ordonez

1459 *Milan Edward Rahmani†; Sota Yanagisawa‡*
Mentor(s): Abhijnan Dikshit; Pavankumar Channabasa Koratikere; Leifur Thor Leifsson

1460 *Paula Sanchez Ulloa†*
Mentor(s): Xiwei Shan; Tian Li

1461 *Paul William Swift†*
Mentor(s): Bruno Tesini Roseguini; Bohyun Ro; Luke Schepers; Craig Goergen; Qifan Song

1462 *Julia Janina Szela†*
Mentor(s): Barrett Freeland Davis; Tamara L Kinzer-Ursem

1463 *Andres Uzcategui†*
Mentor(s): Krishna Jayant

1464 *Kartavya Vashishtha†*
Mentor(s): Anmol Sahoo; Suresh Jagannathan

1465 *Gaurav Vermani†*
Mentor(s): Aravind Machiry; Shashank Sharma; Ayushi Sharma

1466 *William Yau†; Weijian Zhang‡*
Mentor(s): Stanley H Chan

1467 *Matthew T Zegarski†*
Mentor(s): Barrett Freeland Davis; Tamara L Kinzer-Ursem

1468 *Bryan Zhang†*
Mentor(s): James C Davis

1469 *Mohammed Abdul Gani Zilani†*
Mentor(s): Mohseu Rashid Subah; Rachel Kathleen Surowiec

1470 *Jiying Zou†*
Mentor(s): Carlos J Martinez; Nicole Lin Franklin

Non-Program

1471 *Brett Andrew Anderson†*
Mentor(s): Emily Dykhuizen; Brayden Paul Strohmier

1472 *Armando David Galicia Huerta†; Thomas Edgardo Schmitz‡*
Mentor(s): Eduardo Barocio Vaca; R Byron Pipes

1473 *Race Ethan Medema†; Alexandra Cynthia Marlene Britto‡*
Mentor(s): Keith A Cherkauer

1474 *Lindsey Renee Peterson†; Owen Ray Rahman†; Maliyah Ann Smith†*
Mentor(s): Robin L Tanamachi

1475 *Amanda Renee Schoonmaker†; Joshua T Stephenson‡*
Mentor(s): Joseph P Ogas; Jacob Ryan Fawley; Jiaxin Long

1476 *Betsy Biju Varghese†*
Mentor(s): Dongseok Kim

FOURTH POSTER SESSION | 1:30PM-2:30PM

SCALE

1600 *William Rowan Cunningham†; Maxwell Frank Michalec*; Om Gupta*; Fahad Aloufi**
Mentor(s): Mark Johnson; Cole Aaron Nelson

1601 *Jessica Andrea Gray†*
Mentor(s): Linda Nie

1602 *Riley James Robert Madden†*
Mentor(s): Stylianos Chatzidakis; Peter Bermel; William Stephen Richards; Hannah Pike

1603 *Nicodemus M O'Brian†*
Mentor(s): Allen L Garner; Cameron James Buerke

1604 *Evan N Reid†*
Mentor(s): Titiksha Singh

1605 *Abhiram Saridena†*
Mentor(s): Cole Aaron Nelson; Mark Johnson

1606 *Alexander Gregory Sinelli†; Sree Harsha Naropanth Ramamurthy‡; Allison M Komrska‡*
Mentor(s): Allen L Garner

1607 *Parker Smith†*
Mentor(s): Hannah Pike; Allen L Garner; Stylianos Chatzidakis

1608 *Kailyn D Steed†*
Mentor(s): Allen L Garner; Stylianos Chatzidakis; Hannah Pike; Samera Hossain

1609 *Jayla N Wilcox†*
Mentor(s): Aaron James Specht; Christopher W Smith

SURF

1610 *Junyeong Ahn†; Manila Kunwar‡; Ruey-Bin Tsai‡*
Mentor(s): Jeffrey P Youngblood; Michael Titus; David R Johnson

1611 *Alex James Alonzo†; Jennifer Caraballo‡*
Mentor(s): Shalini T Low-Nam; Joy Wu; Vinay K Menon

1612 *Sho Amagai†; Levi M Johnson†*
Mentor(s): Severin Thomas Schneebeli; Kyle Timothy Faivre

1613 *Arjun Singh Bhadoria†*
Mentor(s): Rajamani P Gounder; Enrique Iglesia; Ryoh-suke Sekiya

1614 *Jose Abraham Bolanos Vargas†*
Mentor(s): Dimitrios Peroulis; Alex David Santiago Vargas

1615 *Riley N Brown†*
Mentor(s): Abram J Axelrod

1616 *Nicholas Herschel Burris†*
Mentor(s): Awadh Mubarak M Al Hawwash; Ken Yoshida

1617 *Yuyuan Cao†*
Mentor(s): Denny Yu; Jingkun Wang

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement
Additional faculty/staff acknowledgements listed in the online abstract booklet.

1618 *Belen Noemi Carrasco Grandes†*
Mentor(s): Manni Zhang; Ana Estrada Gomez

1619 *Daniel Matthew Chambers†*
Mentor(s): Chang Ding

1620 *Ethan Chieng Chiao†*
Mentor(s): Jason Dwight McKinney; Lucas Michael Cohen

1621 *Hyunsang Cho†; Christopher Li Gou‡; Aditya S Hebbani‡*
Mentor(s): Richard M Voyles

1622 *Owen J Cochell†*
Mentor(s): Paschal Chukwuebuk Amusuo

1623 *Wyatt Paul Crain†*
Mentor(s): Julia Laskin; Xilai Li

1624 *Miles T Davis†*
Mentor(s): Morgan Renee Broberg; Sean Dankoski; Kaitlyn Amber Kondos

1625 *Haozhen Dong†*
Mentor(s): Huiyang Li

1626 *Abigail J Dressman†*
Mentor(s): Sunghee Park

1627 *Samuel Duprey†*
Mentor(s): Yi Wu; Lin Tan

1628 *Defne Ekici†*
Mentor(s): Deva Chan; Janice Perry Evans

1629 *Alan Fu†*
Mentor(s): Junjie Luo; Qi Guo

1630 *Zhichen Guan†*
Mentor(s): Mateo Roldan Carvajal; David Warsinger; Davide Ziviani

1631 *Priyam Gupta†*
Mentor(s): Jenna L Wise DiVincenzo

1632 *Ana S Hernandez†; Stephanie Maureen Poore†*
Mentor(s): Luis Solorio

1633 *Hsin-Wei Hsieh†*
Mentor(s): Sivaranjani Seetharaman

1634 *Ricardo Andrews Huertas†*
Mentor(s): Xiulin Ruan; Andrea Lorena Felicelli; Ioanna Katsamba

1635 *Junwoo Jang†*
Mentor(s): Neil Ghosh; Xianfan Xu

1636 *William P Jiang†; Shrinand Perumal*; Shivam Hemal Trivedi**
Mentor(s): Yeon Ji Yun; Yung-Hsiang Lu; Purvish Jatin Jajal

1637 *Hina Leilani Kadono†*
Mentor(s): Yang Yang; Manasi Suchit Halurkar

1638 *Jake Kim†*
Mentor(s): Dina Wael Samir Khattab; Xiaoling Shen

1639 *Mason J Kramer†*
Mentor(s): Demetrius Gulewicz; Neera Jain

1640 *Shreya Krishnan†*
Mentor(s): Jianing Li; Talon Hicks

1641 *Elan Landau†*
Mentor(s): Yung-Hsiang Lu

1642 *Ahhyun Lee†*
Mentor(s): Craig Goergen; Elnaz Ghajar-Rahimi; Felix Dinklage

1643 *Richard Li†*
Mentor(s): Hojun Lee

1644 *Madison Sarah Loiselle†*
Mentor(s): Fiona Kolbinger

1645 *Mallory A Luse†*
Mentor(s): Jeffrey P Youngblood; Roland Conrad Wilhelm; Caitlin Rose Proctor; Xilong Wang; Arval Viji Elango

1646 *Maria Macias†; Angelica Sofia Gonzalez-Ng**
Mentor(s): Madison Mckensi Howard; Luis Solorio

1647 *Lillian Grace Maldia†*
Mentor(s): Caitlin Rose Proctor

1648 *Nashe Bumi Mucharambeyi†*
Mentor(s): Jay Gore; Dileepan Velu

1649 *Siddharth Murali†*
Mentor(s): Stanley Yung-Ping Chien

1650 *Jihyo Park†*
Mentor(s): Upinder Kaur

1651 *Brooke Allison Pilkey†; Shreya Joshy‡; Silas Henry Buchanan‡*
Mentor(s): Rebecca Lynn Leuschen-kohl; Anjali Iyer-Pascuzzi; Stephen R Lindemann; Rwivoo Baruah

1652 *Gayatri Pradeep†*
Mentor(s): Rachel Kathleen Surowiec

1653 *Abhishek Raj†*
Mentor(s): Rusi P Taleyarkhan; Bailey Alexander Christensen; Stepan Ozerov

1654 *Sidney Evan Ryan†; En-Hua Chang‡*
Mentor(s): Amy M Marconnet; Piyush Mani Tripathi

1655 *Thomas Edgardo Schmitz†; Armando David Galicia Huerta‡*
Mentor(s): Eduardo Barocio Vaca; Harry Kangseok Lee

1656 *Audrey Ye-Ning Schuster†*
Mentor(s): Rebecca Ciez

1657 *Alexander Joseph Spilotro†*
Mentor(s): Riley Bradley Barta; Joshua Michael Cox

1658 *Madeline Jane Stevenson†; Luhao Xu*; Shlok Rajesh Kulkarni**
Mentor(s): Arezoo Ardekani; Harsa Mitra

1659 *Maitreyee Panini Telang†*
Mentor(s): GuangJun Zhang; Ziyu Dong

1660 *Ilene Trach†; Case T Vandevelde†*
Mentor(s): Yu Wang

1661 *Case T Vandevelde†; Ilene Trach†*
Mentor(s): Yu Wang

VIP

1662 *Richard Joseph Von Tersch†; Samantha Sudhoff†; Vinay Sai Meda‡*
Mentor(s): Yung-Hsiang Lu; Yeon Ji Yun

Non-Program

1663 *Akila Abeyaratna†*
Mentor(s): Purba Mandal; Yang Yang

1664 *Bevan Mathew Ambrose†*
Mentor(s): Humaira Gowher

1665 *Indrayudh Chowdhury†*
Mentor(s): Mark Johnson; Maxwell Frank Michalec

1666 *Chiara Isabella Gibboney†*
Mentor(s): Jonathan Pasternak; Alyssa Smith

1667 *Emmanuel Monda Gichaba†; Gaurav Sharma‡*
Mentor(s): Tasneem Sharma

1668 *Jacob Gold†*
Mentor(s): Jean-christophe Rochet

1669 *Alexander Higgins†*
Mentor(s): Caitlin Elizabeth Dunlap; Gwendylan Ariel Aura Turner; Garth J Simpson

1670 *Xinwan Hu†*
Mentor(s): Joaquin Goni Cortes; Mintao Liu

1671 *Philo Jeremy Kaulkin†; Andrew R Fox†; Baquero Sanchez Gabriel Alejandro‡*
Mentor(s): Walter Daniel Leon-Salas

1672 *Maggie Kim†*
Mentor(s): Khai Quynh Tien Pham; Cuong Duc Calvin Nguyen

1673 *Clark Lay†; Songhao Wu‡*
Mentor(s): David Warsinger; Anand Balaraman

1674 *Marcelo Marcos†; Payten Marley Whitfield‡; Josh Michael Youngblood‡*
Mentor(s): Andrew Whelton

1675 *Ian Quan†*
Mentor(s): Tiwei Wei; Ketankumar Jayantkuma Yogi

1676 *Payten Marley Whitfield†; Marcelo Marcos‡; Josh Michael Youngblood‡*
Mentor(s): Andrew Whelton

SUBMISSION PORTAL OPENS IN SEPTEMBER. ABSTRACTS DUE OCTOBER 17.

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement
Additional faculty/staff acknowledgements listed in the online abstract booklet.

Poster Presentation Abstract Number: 1000
Presentation Time: Session 1: 9:00am-10:00am

Colombian Research Scholars Program

Analysis of charge transportation behavior

Innovative Technology / Entrepreneurship / Design

Author(s):

Lina Milena Gomez Morales†

Abstract:

The influence of the 2,2,6,6-tetramethylpiperidin-1-oxyl (TEMPO) radical on the conductivity of a mixed system containing polyethylene glycol (PEG) and the radical at different concentrations was experimentally evaluated. For this, 7 solutions with different proportions of PEG and TEMPO were prepared and dissolved in chloroform at a concentration of 25 mg of solute per 1 mL of solvent. These solutions were applied to an indium tin oxide (ITO)-coated glass plate using spin-coater equipment. Subsequently, silver was deposited as an electrode with the help of a thermal evaporator. Finally, an oscilloscope was used to obtain the current vs. voltage graph and calculate the conductivity. From the collected data, it was concluded that while the conductivity of PEG improves with the addition of TEMPO, it does not vary significantly with an increased proportion of added radicals. The obtained conductivities are on the order of around 10?7 S cm?1, which is lower compared to radical polymers and combined systems previously studied, indicating that the material may not be suitable for application in electronic devices.

Keywords: Conductivity; Blended System; Devices; Charge Transportation; Polymer

Mentor(s):

Yun-Fang Yang (Engineering)

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

Poster Presentation Abstract Number: 1001
Presentation Time: Session 1: 9:00am-10:00am

Colombian Research Scholars Program

Constraining tectonic stresses in the scandinavian caledonides

Life Sciences

Author(s):

Angee Paola Lopera Restrepo†; Wayne Wheeler Kottkamp‡ (Science)

Abstract:

Continents and rocks provide critical insights into Earth's geological history. Through targeted drilling, we investigate fundamental geological processes preserved in the historical record. The COSC project focuses on studying the mid-Paleozoic Caledonide Orogeny in Scandinavia to enhance understanding of mountain-building dynamics across both historical and modern active mountain ranges. Our research involves analyzing 30 samples recovered from COSC-2, which reached a depth of 2276 meters. Our objectives include evaluating their physical properties under pressures ranging from 5 to 200 MPa in a pressure vessel to determine P-wave and S-wave velocities. Additionally, UCS testing will be conducted to ascertain stress orientations, quantify stress magnitudes, and correlate findings with plate tectonics, fault systems, isostatic rebound, seismic hazard assessment, and other geophysical parameters. The ultimate aim is to extrapolate these insights to develop a

comprehensive borehole strength model. Methodologies include borehole breakout mapping, core characterization, UCS testing for rock strength determination, and seismic velocity measurements to establish Vp and Vs correlations with rock properties.

Keywords: Geophysics; Stresses; Strength; Rocks; COSC Project

Mentor(s):

Douglas R Schmitt (Science)

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

Poster Presentation Abstract Number: 1002
Presentation Time: Session 1: 9:00am-10:00am

SROP

Effects of PFAS exposure on reward sensitivity, cognition, and psychiatric symptomology

Life Sciences

Author(s):

Deanna Durben†

Abstract:

Per- and polyfluoroalkyl substances (PFAS) are man-made “forever chemicals” which frequently accumulate in the brain. These neurotoxic substances can alter various brain functions to negatively impact learning and memory, motor function, and mental health, but these mechanisms and effects are not fully understood. Our study aims to examine potential links between PFAS exposure and measures of psychiatric symptomology, cognition, and reward sensitivity, a neural measure that has been linked to depression. We recruited 20 participants, with 10 at-risk for psychosis and 10 control subjects, and measured PFAS exposure using blood concentration levels. For each participant, we administered the Mini-International Neuropsychiatric Interview, which screens for 19 DSM disorders, and the NIH Toolbox Cognition Battery, which measures executive function, memory, language, and processing speed. Reward sensitivity was measured using EEG recordings during a guessing task with monetary rewards. We plan to choose 2-3 PFAS compounds and evaluate the effects of blood concentration on the three outcome measures. We will correlate PFAS to reward sensitivity and cognition task performance, then test whether PFAS exposure affects psychiatric diagnoses and symptoms. PFAS exposure is ubiquitous in our environment, making it imperative that we work to fully understand its effects on brain functioning and mental health in a multifaceted manner.

Keywords: EEG; PFAS

Mentor(s):

Daniel J Foti (HHS); Lisa Ann Brown (HHS)

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

Poster Presentation Abstract Number: 1003
Presentation Time: Session 1: 9:00am-10:00am

SROP

Racial Differences in Perceived Passion and Motivation: Exploring Antecedents for Asian and Asian American Dehumanization at Work

Social Sciences / Humanities / Education

Author(s):

Hannah Kim†

Abstract:

[Abstract Redacted]

Keywords: Perception; Intrinsic Motivation; Passion; Race; Dehumanization

Mentor(s):

Yk Hei Franki Kung (HHS)

Other Acknowledgement(s):

Rick Yang

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

Poster Presentation Abstract Number: 1004
Presentation Time: Session 1: 9:00am-10:00am

SROP

Speech Perception and Production Variability in Preschoolers With and Without Speech Sound Disorders

Social Sciences / Humanities / Education

Author(s):

Niah Nieuwenhuis†

Abstract:

Children with speech sound disorders (SSD) struggle to produce and perceive speech due to various causes (motor planning, articulation, speech perception, etc.), but a large subgroup of children are diagnosed with a phonological disorder. The ability to manipulate and process sounds of a language is called phonological processing. Lexical variability is measured across multiple repetitions of the same word and is thought to reflect the instability of a child’s phonological representations for words (Macrae et al., 2014). However, lexical variability occurs in both typically developing (TD) children and children with SSD (Sosa & Stoel-Gammon, 2006, 2012). Previous research also indicates that speech error types may account for differences in phonological processing skills; namely, omissions and atypical speech errors have been identified as indicators of poor phonological awareness (Brosseau-Lapre? & Roepke, 2019). To investigate the relationship between speech production variability and phonological processing, we measured segmental variability, lexical variability, types of speech errors, and speech perception in children with TD and with SSD. Twenty-four 4- and 5-year-olds, 12 with TD and 12 with a phonological SSD, were included in the study. Participants completed a battery of speech, language, oral-motor and phonological awareness tests, a speech perception task, and the Word Inconsistency subtest of the Diagnostic Evaluation of Articulation and Phonology Test. Results indicate that after accounting for receptive vocabulary, segmental variability explains the most variance in phonological processing. Our results offer insight as to why children with SSD are variable in their speech production and how this differs from TD children.

Keywords: Speech Production; Speech Perception; Variability; Phonological Awareness

Mentor(s):

Francoise Brosseau-Lapre (HHS)

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

Poster Presentation Abstract Number: 1005
Presentation Time: Session 1: 9:00am-10:00am

SROP

Anti-Cancer Potential of NR07: A Novel Indole-based chalcone Derivative Targeting ROS-Mediated Apoptosis and Tubulin Dynamics

Life Sciences

Author(s):

Sebastian Rosario Torres†; Monika Malik‡

Abstract:

Indole-based chalcones are a class of organic compounds that combine the chalcone structure with an indole moiety. These compounds are significant in medicinal chemistry due to their diverse biological activities, including anti-inflammatory, anti-cancer, anti-microbial, and antioxidant properties. Derivatives of indole-based chalcones can be synthesized through various chemical modifications, which can enhance their biological activities or alter their chemical properties for specific applications. Among the prepared N-arylated indolylsulfoXimines, the compound NR07 showed potent and selective cytotoxicity against 22Rv1, C4-2 and MCF7 cells, respectively. IndolylsulfoXimine derivative NR07 displayed a broad spectrum of activity (?M) against the tested cancer cell lines. These compounds were found to be non-cytotoxic to normal HEK293 cells, indicating their potential selectivity for cancer cells. We analyzed the impact of NR07on various cellular assays to uncover its mechanism of action. Cellular assay shows that NR07 increases the endogenous level of ROS, inducing apoptosis. NR07 also induced mitochondrial dysfunction, further promoting apoptotic pathways. Besides, NR07 also restricts cell invasiveness, indicating that it could serve as an effective anti-metastatic agent. As oxidative stress severe F actin causing tubulin depolymerization, we examined the impact of NR07 on tubulin dynamics. Accordingly, NR07treatment decreased the levels of polymerized tubulin in 22Rv1 and C4-2 cells. Although future studies are needed to determine their exact molecular target(s). The IC 50 values of NR-07 in HEK293 is 1.9549 and in MDAMB-231 is 0.7865, our data shows that N-aryl indolylsulfoXimines could serve as effective anti-cancer agents.

Keywords: [no keywords provided]

Mentor(s):

Kavita Shah (Science); Asha Parveen Sakkarai Mohamed (Science)

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

Poster Presentation Abstract Number: 1006
Presentation Time: Session 1: 9:00am-10:00am

SURF

Machine Learning for Semiconductor Nanodevice Design

Innovative Technology / Entrepreneurship / Design

Author(s):

Spasko Aleksov† (Engineering); Paige Alicia Greenfield* (Engineering); Xu Lu* (Polytechnic)

Abstract:

This paper presents a method for developing a machine learning model, which will reduce the computation costs for modeling semiconductor nanodevices. Modern semiconductor advancements have resulted in transistors being as small as a few nanometers. As a result, there is an increased need for software capable of simulating new designs. We use Purdue's Nanoelectronics Modeling Tools (NEMO5) software on the RCAC computing clusters to model these devices. The mode space method is used to create approximate band structures for several devices. This method has enabled previously impossible simulations to be run, such as accounting for electron scattering due to phonons and crystal impurities. A large data set of these band structures is created by varying parameters such as device size, device geometry, and material type. The approximate band structures are compared to the true band structures and assessed by creating a metric of fit for the model. The data set will then be used to develop and train the model so the simulations can be done more efficiently.

Keywords: Machine Learning; NEGF; Nanoelectronics; Mode Space

Mentor(s):

Logan Jacob Melican (Engineering)

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

Poster Presentation Abstract Number: 1007
Presentation Time: Session 1: 9:00am-10:00am

SURF

PrimerCurator: An LLM Powered Multimedia Educational Content Design and Creation Tool

Innovative Technology / Entrepreneurship / Design

Author(s):

Rishika Bera†

Abstract:

[Abstract Redacted]

Keywords: Educational Content; Multimedia; Large Language Models

Mentor(s):

Karthik Ramani (Engineering); Asim Unmesh (Engineering); Runlin Duan (Engineering); Mayank Harendra Patel (Engineering)

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

Poster Presentation Abstract Number: 1008
Presentation Time: Session 1: 9:00am-10:00am

SURF

Antimicrobial Resistance and Fecal Microbiota Transplantation

Life Sciences

Author(s):

Reed G Brzezinski†

Abstract:

[Abstract Redacted]

Keywords: Antimicrobial Resistance; Fecal Microbiota Transplantation; Metagenomics; Microbiome

Mentor(s):

Ilya Slizovskiy (Veterinary Medicine)

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

Poster Presentation Abstract Number: 1009
Presentation Time: Session 1: 9:00am-10:00am

SURF

Radon Detection : A novel method using Centrifugally Tensioned Metastable Fluid Detector

Physical Sciences

Author(s):

Marie Emilie Charbonnier†

Abstract:

[Abstract Redacted]

Keywords: Radon; Alpha Radiation; Alpha Detectors; Tension Metastability; Non-Condensable Gasses

Mentor(s):

Rusi P Taleyarkhan (Engineering); Stepan Ozerov (Engineering)

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

Poster Presentation Abstract Number: 1010
Presentation Time: Session 1: 9:00am-10:00am

SURF

Micro- and Nano-Precision Testing on Low-Temperature Solders

Physical Sciences

Author(s):

Hannah Y Chun† (Engineering)

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

David Neal Halbrooks (Purdue University)

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

Poster Presentation Abstract Number: 1011
Presentation Time: Session 1: 9:00am-10:00am

SURF

Surgical task classification using deep learning

Mathematical/Computation Sciences

Author(s):

Atin Dewan† (Engineering|JMHC)

Abstract:

Surgical complications make a major contribution to global death rates, and surgical proficiency has a direct impact on postoperative outcomes. This study aims to develop computational models identifying and classifying surgical tasks such as knot tying and suturing in open surgery. In this study, we will apply advanced deep learning and computational video analysis techniques to over 2,000 video-based technical skill assessment clips from the IU School of Medicine, including YOLO (You Only Look Once) CNN (Convolutional Neural Network) versions. The video dataset comprises four frequently occurring surgical tasks (Two Handed Square Knot, One-handed Half-hitch Slip Knot, Simple Interrupted with Instrument Tie and Deep Dermal Suture with Instrument Tie) and are, on average, around 70 seconds in duration. For task classification, we will use YOLO models to detect and classify the various surgical actions. The preprocessing steps include background rejection, and we will investigate model performance at varying frame rates as well as spatial and temporal analysis of video clips to highlight particularly informative video sections and areas in frames. These steps are essential to enhance model accuracy by ensuring relevant features are highlighted and irrelevant information is minimized. Overall, we expect this research to facilitate automatic, scalable task detection and classification, enabling future development of intraoperative decision support models. We expect this work to provide a basis for intraoperative surgical decision support models with potential applications across patient care and residency training.

Keywords: Surgical Task Classification; Deep Learning; Video Analysis; Intraoperative Decision Support

Mentor(s):

Fiona Kolbinger (Engineering)

Other Acknowledgement(s):

Muhammad ibtsaam Qadir

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

Poster Presentation Abstract Number: 1012
Presentation Time: Session 1: 9:00am-10:00am

SURF

THE EFFECTS OF IL-17/ACT1 SIGNALING ON INNATE IMMUNE CELLS

Life Sciences

Author(s):

Sofia Victoria Duran Quiroga†

Abstract:

The human body is continuously battling bacteria and pathogens. In order to protect itself, the body must activate pathways to maintain homeostasis. The IL-17/Act1 signaling pathway is crucial in initiating inflammatory responses and protecting the host body from pathogens. Due to illnesses in humans caused by Act1 deficiency and, to broad knowledge about this pathways involvement in innate immunity, we intend to investigate the effect that can be caused by the Act1/IL-17 system on innate immune cells. Our laboratory has employed the zebrafish model to create a whole-body knockout of the Act1 gene, thereby disrupting the IL-17 complex. By eliminating Act1, we have observed the protein's significance in IL-17 signaling during bacterial infections. Our knockout transgenic line shows a significant difference in survival when infected with P. aeruginosa when compared to the wild-type line. In order to confirm that the Act1 gene was knocked out we will perform a rescue using mRNA. Once the gene is rescued with mRNA, we will perform a blood infection with Pseudomonas aeruginosa and monitor survival. We anticipate that this will restore the phenotype to wild-type. Understanding the role of IL-17/Act1 and how it affects innate immune cell signaling could lead to a better understanding of certain immune diseases.

Keywords: Innate Immune System; Act1; Mutations; mRNA; Phenotype

Mentor(s):

Tyler Renee Pikes (Office of the Provost)

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

Poster Presentation Abstract Number: 1013
Presentation Time: Session 1: 9:00am-10:00am

SURF

Purdue RDE Thrust Calibration System

Innovative Technology / Entrepreneurship / Design

Author(s):

Marzuk Hasan†

Abstract:

A common thrust stand calibration system for the Rocket-Application Modular RDE (RAMR) and the High-flow Air-breathing Modular RDE (HAMR) test stands at the Maurice J. Zucrow Laboratories at Purdue University is designed to accurately calibrate thrust measurements up to 4000 pounds of force using a ground-truth calibration load cell. When conducting engine testing, it is valuable to understand thrust output in conjunction with combustion data in the RDE to better correlate how properties of combustion affect the engine's efficiency, specific impulse, and other thrust-based performance parameters. However, the force measured by the load cell is an inaccurate representation of thrust. On a voltage – force graph, when no force is applied, the voltage may be non-zero (y-intercept) and the slope of this graph depends upon thrust as well as extraneous factors related to the test stand design, such as thermal expansion of the 1000K air feed system and internal mechanical stresses, all leading to inaccurate force measurements. The calibration system is designed to measure these inaccuracies at a range of force magnitudes representative of possible thrust values and correct hot-fire thrust data for more accurate thrust measurements. This document details the design of a modular calibration system which incorporates considerations for rapid set-up/tear-down, rapid calibration execution, and remote operation. A configurable pneumatic system is selected to provide the most versatility within a compact footprint. Two swappable configurations are used, allowing for any desired force output within 50 lbf accuracy between 188 lbf and 4790 lbf. The system connects to the aft end of the RDE using variable-length turnbuckles attached to the static portion of the test stand, which accommodate a wide range of engine sizes. To calibrate the thrust stand, a range of forces will be applied using the pneumatic cylinders. The force measured by the ground truth load cell will be compared to the measurement load cells, any delta represents force losses from mechanical stresses in the stand. After hot-fire testing, force measurements will be corrected by adding this delta, resulting in more accurate thrust data for RDE performance analysis.

Keywords: Calibration; Rocket; Testing; Pneumatic

Mentor(s):

Ethan P Wissmann (Engineering)

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

Poster Presentation Abstract Number: 1014
Presentation Time: Session 1: 9:00am-10:00am

SURF

Spectral Deconvolution Models for Interpreting Reaction Outcomes

Mathematical/Computation Sciences

Author(s):

Anja Hribljan†; Daniel Sich‡

Abstract:

[Abstract Redacted]

Keywords: NMR; Spectral Deconvolution; Machine Learning

Mentor(s):

Brett Savoie (Engineering); Andrew Bartlett Schofield (Engineering)

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

Poster Presentation Abstract Number: 1015
Presentation Time: Session 1: 9:00am-10:00am

SURF

Hydrophobic Carbonized Wood Membranes: A Suitable Alternative for Membrane Distillation

Physical Sciences

Author(s):

Joyce Hu†

Abstract:

The rapid increase in global population has led to an escalating demand for fresh water, a resource predominantly sourced from freshwater bodies. However, climate change is disrupting weather patterns and depleting groundwater reserves. This highlights the need for sustainable alternative water sources, such as desalinating ocean water. Membrane distillation (MD) is a key thermal desalination technique, but existing polymeric membranes, though effective, often utilize environmentally harmful fluoropolymers and pose disposal challenges. In this work, we introduce a first-of-its-kind hydrophobic carbonized wood-based membrane tailored specifically for membrane distillation. Our tests showed that this carbonized wood membrane has a vapor permeability of 914 GPU, a porosity of 90%, and a contact angle of 136°, indicating its superhydrophobic nature and potential as a sustainable replacement for traditional polymeric membranes. Initial experiments conducted using an air gap membrane distillation (AGMD) module yielded promising permeate flux performance. Moving forward, we aim to integrate these membrane properties into a comprehensive numerical model to predict and optimize performance at larger scales. This work not only highlights the viability of carbonized wood as a sustainable alternative in MD processes but also sets the stage for future advancements in eco-friendly desalination technologies.

Keywords: Sustainability; Membrane Distillation; Carbonized Membranes; Wood Membranes

Mentor(s):

Waqas Alam (Engineering); David Warsinger (Engineering)

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

Poster Presentation Abstract Number: 1016
Presentation Time: Session 1: 9:00am-10:00am

SURF

Pre-interventional complication risk stratification in patients undergoing percutaneous cardiac interventions

Mathematical/Computation Sciences

Author(s):

Saloni Jajoo† (Science)

Abstract:

Although percutaneous coronary intervention (PCI) can save lives by restoring blood flow to the myocardium, it is associated with post-interventional complications such as bleeding, myocardial infarction, stent thrombosis, and stroke. This study aims to use machine learning to stratify patients with regard to complication risk based on routine clinical data available prior to PCI. The study makes use of a large registry dataset from the COAP quality improvement initiative in the state of Washington comprising data on demographics, clinical conditions, procedures, and outcomes. Data from 91,000 patients who underwent PCI between 2000 and 2023 were preprocessed to account for missing values via mean imputation, to standardize and categorize data, and to balance class distribution using Synthetic Minority Oversampling Technique (SMOTE). A Column Transformer, an effective preprocessor for both numerical and categorical data, was used.

We develop and validate individual XGBoost-based prediction models for ten different postinterventional complications including distal coronary artery perforation, stroke, and stent thrombosis, using a random 60-20-20 train-validation-test split and a 5-fold cross validation scheme. To maximize performance, model hyperparameters are adjusted using randomized search. An independent test set is used to validate the final model, which is trained using optimized parameters on the whole training dataset. We report model performance using confusion matrices and metrics including precision, recall, and F1-score. Our preliminary results indicate that XGBoost-based machine learning models can predict distal coronary artery perforation after PCI (precision = 0.75, recall = 0.62, F1-score = 0.68).

In summary, this work aims to enhance patient care by highlighting the potential of machine learning in preinterventional risk stratification prior to PCI and initiating steps towards their clinical translation.

Keywords: Percutaneous Coronary Intervention; Machine Learning; Biomedical Engineering

Mentor(s):

Fiona Kolbinger (Engineering)

Other Acknowledgement(s):

Muhammad ibtsaam Qadir

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

Poster Presentation Abstract Number: 1017
Presentation Time: Session 1: 9:00am-10:00am

SURF

Ultra-sensitive Heat Capacity Measurements of Quantum Spin Liquid Materials in Cryogenic Temperatures

Physical Sciences

Author(s):

Adib Kabir†; Arun Arjunakani*

Abstract:

Precise measurements of heat capacity are crucial for constructing ultra-sensitive thermometers on the mesoscopic scale to study the contributions from fermions, bosons, and anyons, and to identify the presence of a spin gap in quantum spin liquid (QSL) materials at low temperatures. This research aims to develop an ultra-sensitive heat capacity measurement platform for use within a dilution refrigerator, particularly at temperatures below 1.8 K under high magnetic fields, where traditional technologies like PPMS are less effective. The puck is constructed by placing two gold-coated optical fibers parallel on a circular PEEK washer, with a bare Cernox CX-1010 sensor positioned between the fibers. Initially, we aim to measure the heat capacity of the CX-1010 sensor as the addenda, capturing background and noise effects. Subsequently, we place the QSL crystal on the sensor and determine the total heat capacity. By subtracting the addenda measurement from the heat capacity of the entire system, we can determine the material’s heat capacity with high sensitivity. This heat capacity measuring system will provide insights into the release of entropy for different quasiparticles and will serve as a platform for testing various thermometry methods.

Keywords: Heat Capacity; Quantum Spin Liquid (QSL); Cernox CX-1010; Dilution Refrigerator; PPMS

Mentor(s):

Arnab Banerjee (Science)

Other Acknowledgement(s):

Joseph Todd Klomp; Luis Henrique Vilela Leao; Jhinkyu Choi; Bishnu Prasad Belbase; Hakan Salihoglu; Neil R Dilley

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

Poster Presentation Abstract Number: 1018
Presentation Time: Session 1: 9:00am-10:00am

SURF

Utilizing alternative air-entraining methods to enhance freeze-thaw durability of concrete with incorporated nanomaterials.

Physical Sciences

Author(s):

Ali Kalmagambetov† (Engineering)

Abstract:

Concrete is the number one material chosen in the construction field. The main reasons for its widespread usage are its mechanical properties and ease of formwork during construction, which allows the creation of a diverse range of structures.

However, concrete also has its limitations, including relatively high CO2 emissions (primarily from the cement used) and susceptibility to damage from freeze-thaw cycles in the presence of moisture.

This project aims to explore innovative concrete mixture designs incorporating nanosilica admixtures to enhance overall strength as well as to investigate unconventional air-entraining methods in comparison to traditional designs. In comparison to traditional methods of stabilization of air bubbles created by using surfactant-type of admixtures, unconventional air-entraining methods involve introducing miniature hollow plastic spheres that serve as a replacement for the air bubbles. This method holds a promise of creating a more robust air void system as our research shows that surfactants are less effective in the presence of nanomaterials.

In this project the experimental program contains the following tests: compressive and tensile strength, formation factor, water absorption and freeze-thaw resistance. Each test is important in determining the concrete's mechanical properties. The compressive and tensile strength test showcases the maximum loading conditions and other tests showcase concrete's resistance to erosion due to water, temperature or other environmental factors.

The study showed that there are no immediate incompatibilities associated with alternative air-entraining methods and nanomaterials. On the contrary, the new mixes on average perform comparable to unmodified mixes in mechanical tests and resistivity to erosion caused by chemicals or water.

Keywords: Concrete; Nanomaterials; Air-Entertaining; Alternative Methods; Freeze-Thaw

Mentor(s):

Alberto Castillo (Engineering); Jan Olek (Engineering); Maria Mirian Velay Lizancos (Engineering)

Poster Presentation Abstract Number: 1019
Presentation Time: Session 1: 9:00am-10:00am

SURF

Closed-Loop Sustainability of 3D Printed Carbon Fiber Reinforced Composite Tooling.

Innovative Technology / Entrepreneurship / Design

Author(s):

Hanhyun Kwak† (Engineering)

Abstract:

Additively manufactured carbon fiber reinforced composite tool for thermoset composite layup is growing in demand due to the reduced cost and time, especially for large scale prototyping and small production runs compared to traditional metal tooling. Like other carbon fiber composite applications, it raises significant environmental concerns due to their end-of-life disposal in landfills. Despite their initial superior mechanical properties, recycled carbon fiber composites often exhibit degraded performance compared to virgin fibers. This research addressed the gap in understanding the performance of additively manufacturing recycled short carbon fiber thermoplastic composites, specifically their mechanical and thermal degradation over multiple reuse cycles. Extrusion Deposition Additive Manufacturing (EDAM) process was used to manufacture test specimens from pristine and recycled PESU-1810 pellets. The recycled pellets were fabricated through shredding and palletization. Throughout multiple artificial reuse cycles, dynamic mechanical analysis (DMA) was used to observe changes in viscoelastic behavior and digital scanning calorimetry (DSC) was used to observe any abnormalities in polymer crystallization. The fiber length distribution, tensile strength, and coefficient of thermal expansion (CTE) were also measured to quantify changes in mechanical properties. This research highlights the viability of recycling short carbon fiber thermoplastic composites. The results have significant implications for reducing environmental impact, enhancing material efficiency, and guiding industry standards for recycling practices.

Keywords: Fiber Length; Composite Recycling; Extrusion Deposition Additive Manufacturing

Mentor(s):

Harry Kangseok Lee (Engineering); Garam Kim (Polytechnic); Eduardo Barocio Vaca (Engineering)

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

Poster Presentation Abstract Number: 1020
Presentation Time: Session 1: 9:00am-10:00am

SURF

Tactile-based reactive control for robotic manipulation

Innovative Technology / Entrepreneurship / Design

Author(s):

Jai Nanda Lakamsani† (Polytechnic)

Abstract:

Improving robotic grasp capabilities via tactile sensing is crucial for enhancing interaction and minimizing potential damage. This research project focuses on achieving dexterous manipulation using a robotic hand. The primary objective is to enable the robotic hand to adapt its grip in real time based on tactile feedback. The research project involves integrating Force Sensing Resistor and Digit tactile sensors into a robotic hand(LEAP Hand). Initial testing will involve using objects of various shapes, sizes, and materials to demonstrate the robotic hand's capability to maintain stable and secure grasps by responding to tactile information. Future research will explore teleoperation of the robotic hand through motion capture gloves, as well as the implementation of imitation learning techniques. This work will contribute to advancing robotic manipulation capabilities, particularly in scenarios where precise and gentle handling of objects is critical.

Keywords: Robotics; Dextrous Manipulation; Tactile Sensing

Mentor(s):

Yu She (Engineering)

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

Poster Presentation Abstract Number: 1021
Presentation Time: Session 1: 9:00am-10:00am

SURF

Structural Studies of Phospholipase C Enzymes

Physical Sciences

Author(s):

Morgan Grace Laskowski† (Science)

Abstract:

Cardiovascular disease is the leading cause of death among adults in the United States and worldwide. Phospholipase C (PLC) enzymes such as PLCb are important for healthy cardiovascular funcIon. These enzymes hydrolyze the membrane phospholipid phosphaIdylinositol-4,5-bisphosphate (PIP2) to generate the second messengers diacyclglycerol (DAG) and inositol-1,4,5 triphosphate (IP3), which acIvate PKC and release intracellular calcium stores, respecIvely. DysregulaIon of these second messenger pathways can lead to disease and heart failure. PLCb is regulated by the heterotrimeric G protein subunits Gaq and Gbg, but exactly how PLCb is recruited to and interacts with the plasma membrane requires further study. In this project, we aim to generate a HaloTag-PLCb3 construct for use in future microscopy studies with model membranes. We are using cloning, baculovirus producIon, and protein purificaIon techniques to work toward this goal. A PLCb3 construct in the baculoviral expression vector, pFastBac-HTA was linearized by PCR, and a Halo-7 Tag was added on the N- terminus of the protein via ligaIon-independent cloning. This construct will be used to produce baculovirus to express this fusion protein in insect cells, and purificaIon will be performed via affinity and size-exclusion chromatography. Following purificaIon, we will covalently label the protein with a fluorescent ligand via the HaloTag to further invesIgate how PLCb interacts with membranes in vitro. These findings will give insights into the kineIc behavior of PLCs on model membrane systems and increase our understanding of these criIcal enzymes.

Keywords: Phospholipase C (PLC); Cloning; PLCB3

Mentor(s):

Angeline M Lyon (Science); Elisabeth E Garland (Science)

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

Poster Presentation Abstract Number: 1022
Presentation Time: Session 1: 9:00am-10:00am

SURF

Lunar Habitat Resilience: Vibration Isolation and Fatigue Study

Innovative Technology / Entrepreneurship / Design

Author(s):

Aaryan Sachin Lath† (Engineering)

Abstract:

Lunar habitats, as a payload are often overlooked during design for their susceptibility to low-frequency, long-duration vibrations from moonquakes, and require robust mitigation strategies. This study proposes a novel vibration isolation system designed to enhance the resilience and integrity of lunar structures against these chronic vibrations. This isolator operates by using a bladder system to transfer vibrational forces to surrounding Vectran straps, effectively absorbing tensile loads and mitigating the impact of vibrations. This study analyses the mechanical fatigue induced by the current Apollo Moonquake data through a case study and presents the characterization of the fatigue damage to the Vectran straps, a key component of the isolation device. The results show the potential vulnerabilities of current design practices when including fatigue as a potential failure mode. Furthermore, fatigue degradation patterns in the Vectran straps over time are presented, contributing to the development of the isolation device that addresses the challenges posed by long-duration vibrations in the lunar environment.

Keywords: Vibrations; Fatigue; Dynamics; Moonquake

Mentor(s):

Shirley J Dyke (Engineering); Oscar Daniel Forero velez (Engineering)

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

Poster Presentation Abstract Number: 1023
Presentation Time: Session 1: 9:00am-10:00am

SURF

Optimal Climb Trajectory of a Reusable Testbed for Hypersonic Flight

Mathematical/Computation Sciences

Author(s):

Ian Laudo† (Engineering)

Abstract:

A critical component in a multi-disciplinary design analysis and optimization (MDAO) framework for an aircraft is the mission analysis, which seeks to optimize the vehicle's flight trajectory profile. This is particularly true when evaluating hypersonic vehicles, which are highly interconnected systems that often fly unconventional, high-speed trajectories. The objective of this work is to create an open-source tool which is capable of being incorporated into pre-existing MDAO frameworks that optimizes a flight trajectory for a reusable hypersonic testbed vehicle. The proposed approach uses the conceptual Talon-P reusable hypersonic testbed vehicle for a climb-cruise-descent mission profile where the vehicle is dropped from an altitude of 9 km at a speed of Mach 0.7 and has to achieve an altitude of 26 km and a cruising speed of Mach 6. Aerodynamic models for the vehicle were built using machine learning methods and computational fluid dynamics (CFD) data to characterize the physics of the vehicle's motion. The algorithm was successfully evaluated using the optimal control package Dymos to discretize the proposed trajectory into pseudospectral points to be implicitly solved via collocation methods. These results were then passed into an optimizer built using the Python package OpenMDAO to minimize the amount of time needed to arrive at the end conditions. The next steps of this work include extending the vehicle trajectory to incorporate a powered maximum-time-to-cruise segment and an unpowered maximum-time-to-glide descent segment, as well as comparing the results to a minimum-fuel-to-climb segment.

Keywords: Aerospace Engineering; Design Optimization; Hypersonics; Multidisciplinary Design Analysis and Optimization; Systems Engineering

Mentor(s):

Leifur Thor Leifsson (Engineering)

Other Acknowledgement(s):

Abhijnan Dikshit

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

Poster Presentation Abstract Number: 1024
Presentation Time: Session 1: 9:00am-10:00am

SURF

Online Updating of Cognitive State Models in Human-Automation Interaction

Mathematical/Computation Sciences

Author(s):

Ilhoon Lee† (Science)

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Madeleine Shuhn Tsua Yuh (Engineering); Neera Jain (Engineering)

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

Poster Presentation Abstract Number: 1025
Presentation Time: Session 1: 9:00am-10:00am

SURF

Shock Tube Experimentation and High-Speed Shock Wave Imaging of Atmospheric-Like Particles

Physical Sciences

Author(s):

Matthew S Leight† (Engineering|JMHC); Eleanor Captola Hostetler‡ (Engineering)

Abstract:

Within the field of hypersonics, predicting the interactions of particulates with vehicle surfaces and intakes during atmospheric flight is key in design. However, the shock around supersonic vehicles breaks up these particles, and current research on shock interaction with the micro-scale particles that occupy the upper atmosphere is limited. This research aims to classify the breakup behavior of micrometer-scale ice and water particles through use of Purdue's 3-inch Shock Tube (P3IST). The effects of changing surface tension on droplet breakup were examined initially. Water and isopropyl alcohol mixtures were created, dispensed into the P3IST, and shattered with a shock. Schlieren and Shadowgraph optical systems were used in combination with high-speed cameras to capture the break-up. Shock strength and breakup regime were determined through the video and data from pressure sensors, and variations in breakup patterns were observed. To improve characterization efforts, a Z-Schlieren optical system was assembled and lenses were implemented to zoom in on the test section. These efforts have improved the sensitivity and field of view of the camera, allowing for more descriptive droplet break-up classification. Project results describe regimes of various break-up patterns for atmospheric particles in a shock, which can be used to better predict damage in the supersonic-regime. Methods for optimizing shock tube operations and optical zoom within Schlieren systems were also explored. Further research aims to explore ice particle break up, break-up patterns at higher shock speeds, and examine the lifetime of particles within the shock.

Keywords: Shock Tube; Droplet Breakup; Schlieren Videography; Atmospheric Particles

Mentor(s):

Joseph S Jewell (Engineering); Siddharth Bhatnagar (Engineering)

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

Poster Presentation Abstract Number: 1026
Presentation Time: Session 1: 9:00am-10:00am

SURF

Bulky phenylethyl-ammonium organic ligand for 2D perovskite nanowire growth

Physical Sciences

Author(s):

Chenyu Li†

Abstract:

Two-dimensional (2D) lead halide perovskite nanowires have emerged as promising materials for advanced optoelectronic applications due to their unique structural, optical, and electronic properties. Compared to their traditional 3D counterparts, 2D lead halide perovskite nanowires (lead halides encapsulated within organic ligands growing in one direction) are known for their durability, tunability, and high photoluminescence efficiency. However, achieving well-defined nanowire crystal structures that can be stable for over a few minutes still remains challenging. In this study, a bulky phenylethyl-ammonium-based ligand with two carboxylic acid side groups named 2P-5IPA3 was explored to address this issue. Strong hydrogen bonding induced by carboxylic acid groups restricts crystal growth in one direction, forming well-defined nanowire structures, while the hydrophobic bulky phenyl groups protect the perovskite from moisture degradation and enhance stability. The ligand was successfully synthesized, with its identity and structure confirmed by NMR. Various methods, including fast cooling, slow cooling, and anti-solvent diffusion, were employed to grow 2D lead halide crystals with this ligand for optimal morphology. Optical microscopy and photoluminescence spectroscopy were applied to the resulting crystals to determine their morphology and relevant optical properties. The crystal structure of the nanowires was studied by XRD. The perovskite nanowires fabricated from 2P-5IPA3 have demonstrated superior dimensional confinement and stability compared to the ones made with BrCA3 and 5IPA3 as reported in the previous studies. This study expands the ligand database for 2D hybrid halide perovskite nanowires and provides insights into improving their structural and optical properties by tuning the ligands.

Keywords: 2D Perovskite; Nanowire; Ligand Design; Lasing; Stability

Mentor(s):

Jeonghui Kim (Engineering); Letian Dou (Engineering)

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

Poster Presentation Abstract Number: 1027
Presentation Time: Session 1: 9:00am-10:00am

SURF

Molecular Release Experiments from Micro-fibrillated Cellulose

Physical Sciences

Author(s):

En-tsz Liu† (Engineering)

Abstract:

Cellulosic nanomaterial, a renewable, biodegradable, and versatile polymer derived from diverse sources. This study focuses on microfibrillated cellulose (MFC), which can be obtained from paper industry waste, effectively repurposing waste stream for other use. MFC has gained significant attention due to its potential to overcome inherent limitations in various industrial fields, including consumer products, cosmetics, food, painting and biomedical industries. Among its promising applications, MFC's potential as a rheological modifier in complex fluids stands out as an area of particular interest. In this project, we investigate the phase transition behavior of MFC using multiple particle tracking microrheology (MPT) as the primary characterization technique. MPT involves tracking the Brownian motion of fluorescent probe particles embedded in a sample, providing insights into the rheological properties of the sample. Specifically, we measure the impact of fiber entanglement concentration on the sol-gel transition. When the fiber entanglement concentration (C**) is exceeded, the fibers form a tightly associated network resulting in a gel structure. Conversely, diluting the sample below C** leads to degradation and a transition to liquid state. This suggests that water dilution facilitates the dispersion of MFC fibers, allowing particles to move more freely due to increased pore size. This study characterizes the critical role of C** in inducing phase transitions, providing a framework for designing products that require specific structures and properties at various stages. The gel-sol transition property of MFC through water dilution can be applied in pharmaceutical and consumer products. Further research explores how other driving forces, such as temperature and pH levels, influence the gel-sol transition, broadening the potential applications of MFC.

Keywords: Cellulose Nanofibers; Nanocellulose; Microrheology

Mentor(s):

Mehrnoosh Afshang (Engineering); Kelly Schultz (Engineering)

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Poster Presentation Abstract Number: 1028
Presentation Time: Session 1: 9:00am-10:00am

SURF

AI in Music: Computer Transcription

Mathematical/Computation Sciences

Author(s):

Emma Lombardo†

Abstract:

Automatic music transcription (AMT) is a powerful tool that can help musicians in many ways. It can aid music education, creation, and production while also eliminating the time and resources needed to transcribe music by hand. But difficulties arise when considering all the pieces that make AMT models work. Datasets are often low resource, sounds and harmonies in audio overlap in frequency making separation difficult, musical attributes such as pitch and velocity are hard to infer from polyphonic music, and there are storage, network, and memory complexity constraints. The initial stage of research aimed to explore what AMT models exist through literature. We then tested different models to examine how they worked and observe their transcribed MIDI files. We also researched neural networks as they are common techniques for AMT. Utilizing the Multi-Task Multitrack Music Transcription (MT3) model, various simple and complex pieces were used to test the capabilities of the model. We found that the quality of the transcribed sheet music to be better in terms of note correctness and instrument identification when there were less instruments and when the piece was simple. Future work involves continuing our literature research and then taking and improving an existing model.

Keywords: Music Transcription; Automatic Music Transcription; Polyphonic Music; Artificial Intelligence; Machine Learning

Mentor(s):

Yung-Hsiang Lu (Engineering)

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

Poster Presentation Abstract Number: 1029
Presentation Time: Session 1: 9:00am-10:00am

SURF

Segmenting EVL cell and tracking individual cell movement in Zebrafish Epiboly

Life Sciences

Author(s):

Lionel Yek-Yau Loo† (Science)

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

David M Umulis (Office of the Provost)

Other Acknowledgement(s):

Linlin Li

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

Poster Presentation Abstract Number: 1030
Presentation Time: Session 1: 9:00am-10:00am

SURF

Development of Water-Resistant Adhesives by Adding Proteins to a Bio-Based Epoxy System

Physical Sciences

Author(s):

Uyen Linh Ly†

Abstract:

[Abstract Redacted]

Keywords: Epoxy; Bio-Based Adhesives; Zein; Proteins; Lap Shear

Mentor(s):

Isabelle Kathryn Schaekel (Science); Jonathan J Wilker (Science)

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

Poster Presentation Abstract Number: 1031
Presentation Time: Session 1: 9:00am-10:00am

SURF

Quantitative Characterization of Cerebrospinal Fluid Electrolytes in Animal Models of Intrathecal Delivery

Life Sciences

Author(s):

Matthew William Margraf† (Engineering)

Abstract:

Intrathecal injection is a promising alternative delivery method for nanoparticle based gene therapies as it provides greater access to the central nervous system and does not require the drug to cross the blood-brain barrier, a previously identified barrier to transport. In intrathecal administration, therapeutic is injected into the cerebrospinal fluid (CSF) contained within the subarachnoid space. Once injected, however, dynamics between the CSF itself and the therapeutic may limit transport, necessitating a deeper understanding of the CSF composition. While human CSF has been extensively studied, there is a lack of information regarding the composition of commonly used animal models. This research aims to develop a protocol for the cross-species characterization of electrolytes found in CSF (Na, Cl, K, Ca, Mg), to enhance our understanding of the environment in which nanoparticles are injected. The protocol incorporated test strips to determine initial dilution factors and estimate the concentrations. Colorimetric assays for chloride and potassium were performed for precise analysis of those electrolytes in CSF in a Yucatan minipig model. Preliminary results assess the variability between individuals of the same species. Additionally, the effects of centrifugation during the sample preparation were investigated. This research provides a characterization of electrolyte levels in the CSF of the Yucatan minipig model. Furthermore, it establishes a protocol that can be utilized for future studies involving other animal models and cross-species analysis of CSF components.

Keywords: [no keywords provided]

Mentor(s):

Evelyn Marie Nonamaker (Engineering); Luis Solorio (Engineering)

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

Poster Presentation Abstract Number: 1032
Presentation Time: Session 1: 9:00am-10:00am

SURF

Fast Auditory Brainstem Responses as a Method of Hidden Hearing Loss Detection

Life Sciences

Author(s):

Jax Patrick Marrone† (Engineering); Andres Navarro‡ (Science); Sahil Vijay Desai‡ (Engineering|JMHC); Emily Le Bell‡ (Science)

Abstract:

Current clinical hearing tests mainly assess hearing sensitivity, rendering them unable to detect damage to brain regions responsible for interpreting sounds. This causes many forms of hearing loss to be undiagnosed and untreated. Prior studies have shown that auditory brainstem responses (ABRs) to pure tone stimuli at varying frequencies can identify noise-induced brain damage and hearing loss. However, this method relies on manual threshold identification, allowing for subjectivity in result interpretation. The recording process for traditional ABRs is also time-consuming and labor-intensive, making it suboptimal for use in a clinical setting. This research aims to validate an alternative diagnostic stimulus, referred to as a piptrain, as a faster and more descriptive method of eliciting ABRs with a key focus on developing an automated threshold-detecting algorithm. Eight rodent subjects were exposed to small arms fire (SAF) like noise to induce hearing loss, and ABRs were measured over an 8-week period. The ABRs were collected in response to pure tone stimuli and piptrain stimuli (four 2 ms pure tone frequencies every 5 ms). The thresholds for pure tone ABRs and piptrains were manually determined and compared; 58% of thresholds were within 10 decibels of each other, supporting the piptrains as a diagnostic method. An algorithm for automatic piptrain threshold identification will be developed using template matching. Implementation of this diagnostic method will allow for timely identification of hearing damage, including variations of hidden hearing loss previously undetectable.

Keywords: Central Auditory System; Hearing Loss; Auditory Brainstem Response; Noise Exposure; Hearing Threshold Detection

Mentor(s):

Edward L Bartlett (Science); Meredith Christine Ziliak (Science)

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

Poster Presentation Abstract Number: 1033
Presentation Time: Session 1: 9:00am-10:00am

SURF

The Effect of Statistical Sequence Control on PLGA Degradation in Langmuir Monolayers

Innovative Technology / Entrepreneurship / Design

Author(s):

Joseph Mayer† (Engineering)

Abstract:

Poly(lactic-co-glycolic acid) (PLGA) is a biodegradable polymer widely used in controlled drug delivery systems. However, current formulations suffer from burst release, where a large amount of the drug is released initially leading to overdose and toxicity, due to the degradation kinetics of the polymer encapsulating the drug. Monomer sequence control, where the order of the monomers is controlled as opposed to being in a gradient (arising due to the monomers' differences in reactivity) or blocky sequence, has been suggested as a powerful technique to reduce the initial burst release effect since sequence-controlled polymers have been shown to degrade more uniformly than their gradient analogues. Uniform and gradient PLGA polymers have been synthesized by our lab group. To determine how monomer sequence control affects degradation behavior, the polymers are studied in a Langmuir monolayer on an aqueous subphase, and the change in surface pressure over time is measured to determine the extent of degradation, as degraded oligomers will dissolve into the subphase. The change in surface pressure over time is plotted and compared for a commercial PLGA, gradient PLGA, and uniform PLGA at pHs of 3, 7, and 11. This study seeks to provide evidence that uniform PLGA can reduce the burst release effect when used in biodegradable drug delivery devices by degrading more slowly and uniformly than other PLGA polymers. Further research can focus on actual drug delivery devices to confirm that uniform PLGA does in fact mitigate the burst release effect.

Keywords: PLGA; Degradation; Sequence Control; Drug Release; Langmuir Monolayer

Mentor(s):

You-Yeon Won (Engineering); Samruddhi Moreshwar Patil (Engineering); Sung-Ho Shin (Engineering)

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Poster Presentation Abstract Number: 1034
Presentation Time: Session 1: 9:00am-10:00am

SURF

Recovering Active Pharmaceutical Ingredients from Expired Drugs

Innovative Technology / Entrepreneurship / Design

Author(s):

Aishwarya Menon† (Engineering)

Abstract:

Author(s): Aishwarya Menon(Engineering)

Mentor(s): Dr. Gintaras Reklaitis(Engineering), Shrivatsa Shrirang Korde(Engineering),Dr.Zoltan Nagy(Engineering)

Abstract: Around 50% to 66% of adults in the US use prescription drugs, meticulously regulated for safe use but potentially harmful if concentrated or misused. Improper disposal of expired medications into municipal waste and water systems poses significant environmental and public health challenges. This includes impacting marine life's reproductive health and behavior, threatening ecosystems, and costing billions annually for waste disposal. Additionally, efforts to collect unused medications have been insufficient. This study proposes a circular economy approach to tackle these issues by reintegrating expired medications into the supply chain. The focus is on recovering active pharmaceutical ingredients (APIs) from expired drugs for reprocessing into new dosages. The research method involves experimentally analyzing excipient solubility, crucial for effective API recovery. Initial attempts using Crystalline equipment faced issues with API encrustation, leading to a shift to gravimetric analysis. This method accurately measures solubility by monitoring mass changes in solid and liquid phases under controlled conditions. The results indicate that certain excipients like Microcrystalline Cellulose (MCC) and Magnesium Stearate (MgSt) are insoluble in common solvents, facilitating easier API isolation. However, water-soluble excipients such as polyethylene glycol and Hydroxypropyl Methylcellulose (HPMC) present challenges due to their tendency to pass through filters during extraction. This study provides a foundational framework for sustainable pharmaceutical practices, highlighting the importance of environmentally responsible medication disposal and the potential of circular supply chains to mitigate pharmaceutical waste.

Keywords: API; Circular Economy; Solubility

Mentor(s):

Shrivatsa Shrirang Korde (Engineering); Gintaras Reklaitis (Engineering); Zoltan Nagy (Engineering)

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

Poster Presentation Abstract Number: 1035
Presentation Time: Session 1: 9:00am-10:00am

SURF

Membrane-Less Protein Condensates

Life Sciences

Author(s):

Tyler Merrill† (Engineering)

Abstract:

Parkinson's disease (PD) is a common neurodegenerative disease classified by dopaminergic cell loss within the region of the brain that controls motor outputs, the substantia nigra (SN). In neurons, presynaptic protein aggregation is prevalent in PD and observed in aggregate deposits called Lewy bodies. Namely, proteins such as alpha-synuclein (aSyn) and synapsin1 are key players in presynaptic signaling pathways and contribute heavily to aggregated protein deposits in the cytoplasm. Though these aggregates have been observed in PD pathology, the pathway by which the aggregation occurs is not understood. One potential mechanism involves liquid-liquid phase separation (LLPS), a physical phenomenon in which proteins with long disordered regions (such as aSyn or synapsin1) can form condensates or droplets, similar to a drop of oil in water. Furthermore, synaptic vesicles (SVs) can also undergo LLPS to produce SV clusters in the presynaptic neuron, though the effect of these phase transitions on protein aggregation and dysfunction is still unknown. In this project, fluorescence lifetime imaging microscopy (FLIM) and fluorescence/Forster resonance energy transfer (FRET) are investigated as a means to image the effects of concentration and protein modifications (phosphorylation, mutation, etc.) on aSyn-synapsin1-SV interactions in live neurons. In addition, a molecular dynamics simulation using GROMACS to predict protein behavior is considered. A deeper understanding of the mechanism by which protein aggregation occurs could revolutionize the way neurodegenerative diseases are understood, diagnosed, and treated in the future.

Keywords: Liquid Liquid Phase Separation; Parkinson's Disease; Protein Aggregation; Alpha-Synuclein; Fluorescence Imaging

Mentor(s):

Kevin J Webb (Engineering); Abdelrahman Salem (Engineering); Paula-Marie Ivey (HHS)

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

Poster Presentation Abstract Number: 1036
Presentation Time: Session 1: 9:00am-10:00am

SURF

The Influence of a Novel Hydrogel Composition on Mechanical Properties of High-Performance Mortar

Physical Sciences

Author(s):

Logan Mick† (Engineering)

Abstract:

Hydrogels act as an internal curing agent within high performance mortar by absorbing water large amounts of water during mixing and releasing this water during curing to improve strength and reduce shrinkage. Past work focuses on the use of super absorbent polymer (SAP) hydrogels for this purpose, while this work intends to explore the use of a new novel hydrogel composition, composed of cross-linked acrylic acid, and its effects on the mechanical properties and microstructure of mortar. To test this high-performance mortar samples of varying hydrogel concentrations were made to test the compressive strength along with the flexural strength, after multiple time intervals of curing. These tests showed an increase in mechanical properties within the hydrogel samples, with a 20% increase in compressive strength. Fragments from these tests were analyzed with SEM and other microscopy methods, to better understand the interactions between the cement matrix and the crosslinked polymer, and how the intertwined network can better improve flexural and compressive strength in the mortar. This research begins the study of a new hydrogel additive in concrete to classify its effectiveness, where future research will center around the internal effects on thermal properties, shrinkage, and absorptivity in concrete.

Keywords: Concrete; Hydrogels; Internal Curing

Mentor(s):

Kendra A Erk (Engineering); Akul Seshadri (Engineering)

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

Poster Presentation Abstract Number: 1037
Presentation Time: Session 1: 9:00am-10:00am

SURF

Steel Bridge Inspection, Assessment, Repair, and Management under FIRE

Physical Sciences

Author(s):

Tomas Montoya† (Engineering)

Abstract:

[Abstract Redacted]

Keywords: Hydrocarbon Fire; Heat Flux; Fire Dynamics Simulator

Mentor(s):

Shivam Sharma (Engineering)

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

Poster Presentation Abstract Number: 1038
Presentation Time: Session 1: 9:00am-10:00am

SURF

Phage-based detection of Escherichia coli O157:H7 in leafy greens

Life Sciences

Author(s):

Luisa Valentina Mora Perez†

Abstract:

Contamination of fresh food with pathogens is a significant global public health risk. Escherichia coli O157:H7, due to its low infectious dose and severe symptoms like hemolytic uremic syndrome, is particularly dangerous. Detecting pathogens in foods such as lettuce, a common contamination vehicle, requires a faster, more sensitive method than conventional techniques. This project proposes a bioluminescence-based detection method using a modified phage specific for E. coli O157:H7, ?V10, by inserting the luxCDABE operon and Kanamycin resistance gene. The infection and genome insertion of ?V10lux into O157:H7 generate luciferase and its substrate, producing light proportional to the number of viable E. coli cells. The kanamycin gene allows the selection of successfully modified cells. Concentration techniques and food conditions will be applied to evaluate phage performance, determining the minimum bacteria required to produce detectable light and the minimum phage needed to ensure E. coli detection. Laboratory assays expect detection limits of less than 10^3 CFU/ml of cells and 10^5 CFU/ml of phage. Various temperatures, concentrations, and incubation times will be evaluated before adding kanamycin, with no significant differences in bioluminescence detection expected. In food matrices like lettuce, detection is anticipated to be comparable to lab conditions. This method aims to be easily implemented at critical points in the food supply chain to enhance pathogen detection and food safety.

Keywords: Bacteriophage; Bioluminescence; Detection; E. coli O157:H7; Foodborne

Mentor(s):

Bruce M Applegate (Agriculture)

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

Poster Presentation Abstract Number: 1039
Presentation Time: Session 1: 9:00am-10:00am

SURF

Autonomous Taxiing System

Physical Sciences

Author(s):

Andy Nguyen†

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Philip Eugene Pare (Engineering)

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

Poster Presentation Abstract Number: 1040
Presentation Time: Session 1: 9:00am-10:00am

SURF

Compromising Machine Learning Systems via Data Loader Manipulation

Mathematical/Computation Sciences

Author(s):

Michelle Perez Aguilar†

Abstract:

Securing the machine learning supply chain is crucial due to the increasing reliance on these systems across various sectors and safety-critical applications. Vulnerabilities within the machine learning supply chain can lead to attacks that compromise the entire system, leading to devastating effects such as performance degradation or leakage of private data. In this work, we introduce a novel and covert attack targeting the data loader in machine learning frameworks. By maliciously manipulating the training data sampler, specific class samples can be excluded during the training process, resulting in class imbalance. We demonstrate the feasibility of such an attack and its potential to significantly degrade model performance while remaining difficult to detect. Our implementation reveals that an attacker can undermine model quality and fairness by modifying data loader covertly. Additionally, we discuss security measures that can be implemented to prevent the proposed attack and similar compromises of machine learning systems.

Keywords: Cryptographic Protocols; Supply Chain; Life Cycle; Attack; Vulnerable

Mentor(s):

Zahra Ghodsi (Engineering)

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

Poster Presentation Abstract Number: 1041
Presentation Time: Session 1: 9:00am-10:00am

SURF

The PITCH Semiconductors Summer Program: What High School Students Learned?

Social Sciences / Humanities / Education

Author(s):

Kayla Renae Phillips† (Engineering|JMHC)

Abstract:

As the United States makes an effort to manufacture all its semiconductors domestically, thousands of semiconductor industry technician and engineer positions will likely remain unfilled due to a national talent shortage. To offset this shortage, the Regional Economic Acceleration & Development Initiative (READI) aimed to create a high school program, of which the Purdue-Ivy Tech Chips Program (PITCH) is an initiative. Purdue University's FaceLab and Ivy Tech Community College designed and implemented spatial reasoning, circuits, robotics, semiconductors lifecycle, and sustainability activities. This study aims to understand the competencies (Attitudes, Skills, and Knowledge) that Indiana junior and senior high school students developed about semiconductors during the 2024 PITCH summer program activities designed by Purdue University. For each completed activity, the participants reflected on their competencies and interests through free listing, pictures, and written reflections. For this paper, we analyze the free lists through AnthroTools to produce salience and frequency diagrams that describe a possible structure of the student's semiconductor knowledge after implementing the activities. The results of this analysis suggest that participants highlighted the social aspect of semiconductor manufacturing and use and saw each activity as a combination of technical knowledge and collaborative teamwork. These results can support future analysis of the other data and inform future versions of the program and other semiconductor workforce development projects.

Keywords: Semiconductors; Freelisting; Salience; Knowledge; Attitude

Mentor(s):

Cristian Eduardo Vargas Ordonez (Engineering); Yash Ajay Garje (Engineering)

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

Poster Presentation Abstract Number: 1042
Presentation Time: Session 1: 9:00am-10:00am

SURF

Development of Elastin-Like Polypeptide Based Nucleic Acid Delivery System for Treatment of Bladder Cancer

Life Sciences

Author(s):

Ankita Prasad† (Engineering|JMHC)

Abstract:

The development of elastin-like polypeptide-based nanoparticles has been shown to have potential in various therapeutic applications, specifically in the delivery of drugs to cancer cells as a mechanism of treatment. This research aims to utilize an ELP (Elastin-Like Polypeptide) fused with a polycation component and mRNA to formulate a self-assembling nanoparticle and test its efficacy for bladder cancer treatment. The ELP, isolated from a bacterial pellet by organic solvent extraction, is attached to the CDPLR has a positive charge, is complexed with negatively charged mRNA, which therefore promotes the self-assemblage of spherical nanoparticles. The mRNA encodes for the functional protein that is being delivered to cells. Initial characterization techniques involved determining the size of the nanoparticles using DLS (dynamic light scattering), determining stability by zeta potential, and using a luminescence reporter to test its performance in T24 human bladder cancer cells. The results of characterization indicate the formation of nanoparticles with different sizes upon varying amounts of polycation. An encapsulation efficiency test indicated successful entrapment of mRNA within the self-assembly. Testing the nanoparticles in cancer cells also showed the successful transfection of mRNA and the ability to deliver the gene of interest. This research aims to develop individualized treatment of bladder cancer using self-assembling nanoparticles that rely on an ELP-based delivery system. Further testing can help indicate the viability of the nanoparticles in a clinical setting.

Keywords: Elastin-Like Polypeptide; Drug Delivery; Nanoparticles; Bladder Cancer

Mentor(s):

Saloni Darji (Science); Marissa Elaine Henager (Science); David Thompson (Science)

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

Poster Presentation Abstract Number: 1043
Presentation Time: Session 1: 9:00am-10:00am

SURF

Synthesis Hydrogels with Chondroitin Sulfate and GQLY Peptide to Prevent Cartilage Degradation in Osteoarthritis

Life Sciences

Author(s):

Eliana Saavedra†

Abstract:

Osteoarthritis (OA) is a degenerative joint disease characterized by the deterioration of cartilage covering the ends of bones within the joints. Previous studies have shown that cytokines enhance inflammatory effects, contributing to cartilage degradation by promoting matrix-degrading enzymes and reducing the synthesis of essential cartilage components. Therefore, methods are needed to protect stem cells and promote their regeneration in inflammatory conditions.

Chondroitin sulfate (CS) within hydrogel matrices enhances the retention of essential components through covalent bonds, improving the stability and functionality of the gels. This provides a supportive structure for stem cells to adhere to and proliferate within. Additionally, research has shown that small synthetic peptides, such as GQLY, protect cartilage tissue from degradation, highlighting their potential to enhance cartilage regeneration.

This study fabricated five gels using combinations of type I collagen and different numbers of peptide attachment with the peptide GQLY (5, 10, 15 peptides per CS molecule). The study compares the microscopic structural characterizations of these gels to determine which percentage of attachment has the greatest impact on the retention of biomolecules.

The results demonstrated how increasing the number of GQLY attachments to CS can enhance the retention of CS within the hydrogel matrix by providing more anchoring points. This results in CS being more securely bound to the hydrogel structure, reducing the likelihood of premature release or diffusion out of the gel, offering insights into optimizing the hydrogel matrix for improved cartilage regeneration.

Keywords: Cartilage; Tissue Engineering; Hydrogels; Glycosaminoglycans; Collagen

Mentor(s):

Zachary Kristopher Beickman (Engineering); Julie C Liu (Engineering)

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

Poster Presentation Abstract Number: 1044
Presentation Time: Session 1: 9:00am-10:00am

SURF

Enhancing a Machine Learning Model for Lithofacies Prediction Using Well Log Data From The Illinois Basin

Life Sciences

Author(s):

Luisa Sanchez†

Abstract:

Precise construction of stratigraphic columns is essential for geological interpretations, especially in identifying potential CO_2 reservoirs, which are crucial for mitigating climate change by sequestering carbon dioxide. A detailed record of rock layers is critical for understanding subsurface geology and making informed decisions about resource extraction and reservoir monitoring. The lack of detailed data on rock arrangements presents a substantial challenge for the geological characterization of potential CO_2 reservoirs. This project addresses these challenges by employing machine learning techniques to enhance lithofacies classification and prediction using well logs from the Illinois Basin. Lithofacies are rock units characterized by specific combinations of lithologic and sedimentologic properties that distinguish them from other units. To identify the lithofacies within the well, the model utilizes a Multilayer Perceptron to integrate data such as effective porosity, permeability, shear wave velocity, compressional wave velocity, density, and the Vp/Vs ratio. By detecting significant changes in the well log parameters, the model classifies these variations into specific lithofacies. The project aims to create a 2D map simulating the stratigraphic column of the area, providing valuable insights for CO_2 storage site identification. To ensure model accuracy, cross-sections from existing maps of Illinois will be used to validate the presence of at least four of the ten identifiable facies. The comparison of experimental and simulation results supports the integration of these techniques into geological workflows. Further research is recommended to explore additional geological attributes and machine learning algorithms to enhance model robustness and applicability in various geological settings, with a particular focus on identifying suitable CO_2 reservoirs.

Keywords: Lithofacies Classification; Stratigraphic Column; Machine Learning

Mentor(s):

Feng Zhu (Science)

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

Poster Presentation Abstract Number: 1045
Presentation Time: Session 1: 9:00am-10:00am

SURF

Pig Behavior Recognition using Machine Learning

Life Sciences

Author(s):

Neelesh Sarathy† (Science|Graduate|JMHC)

Abstract:

Monitoring pig behavior effectively is essential for ensuring animal well-being and improving farm operations. Traditional manual observation methods are labor intensive and prone to error. Recent advancements in computer vision and deep learning offer opportunities to automate behavior recognition enhancing efficiency and accuracy in managing livestock. This study aims to create an automated system for identifying pig behaviors such as resting, eating, drinking and aggressive actions using a YOLOv8 based model trained on video data of nursery pigs. Video data was gathered from cameras mounted on the ceiling of pig pens. YOLOv8, known for its object detection capabilities, was used to train the model to detect pigs and recognize their behaviors. Preprocessing of data involved annotating and enhancing videos to train the model. The model is projected to achieve an accuracy of 95 percent. This suggests that automating behavior recognition can greatly improve pig welfare management by providing data. Future research will concentrate on automatic monitoring of farrowing pigs and refining the model for increased accuracy and expanding its use to monitor animal behaviors across species.

Keywords: Pigs; Machine Learning; Animal Monitoring

Mentor(s):

Mohit Verma (Engineering); Bibek Raut (Engineering)

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

Poster Presentation Abstract Number: 1046
Presentation Time: Session 1: 9:00am-10:00am

SURF

Efficient and Selective Removal of Arsenic Variants from Drinking Water

Physical Sciences

Author(s):

Nistha Shrestha†

Abstract:

Arsenic, a naturally occurring element in the earth's crust, is widely distributed in the environment, including air, water, and soil. It exists in various oxidation states, with +5 (arsenate) and +3 (arsenite) being the most toxic and posing significant health risks. There are various techniques for arsenic removal from water including oxidation, precipitation, reverse osmosis, nanofiltration, and adsorption. Nanomaterials-based adsorption and filtration have gained substantial attention due to their excellent physical and chemical properties. Additionally, there is growing interest in developing sensors that exhibit selective visual changes upon interaction with arsenic. This study investigates nanomaterial-based arsenic adsorbents for selective colorimetric sensing. Specifically, Zeolitic Imidazolate Frameworks (ZIFs), a subclass of Metal-Organic Frameworks (MOFs) comprising cobalt centers coordinated with imidazolate linkers, are explored for their potential in sensing, adsorbing, and filtering arsenic from drinking water. ZIFs offer high surface area, thermal and chemical stability, adjustable pore structure, and water resistance, making them ideal for this application. The interaction of ZIFs with arsenic is analyzed through visual changes, FT-IR, and ICP-MS. Significant visual changes were observed upon reacting with arsenic, and the interactions were confirmed by FT-IR through peak shifting and broadening. ICP-MS will be employed to determine arsenic concentration, aiding in characterizing ZIFs and understanding adsorption kinetics. Further selectivity studies with common metals present in water are necessary to refine the catalyst. This research offers a comprehensive, efficient, and sustainable solution to arsenic contamination in drinking water, with potential for industrial-scale application.

Keywords: Arsenic Removal; Adsorption; Membrane Filtration; Zeolitic Imidazolate Frameworks

Mentor(s):

Sathish Rajendran (Engineering)

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

Poster Presentation Abstract Number: 1047
Presentation Time: Session 1: 9:00am-10:00am

SURF

Spectral Deconvolution Models for Interpreting Reaction Outcomes

Mathematical/Computation Sciences

Author(s):

Daniel Sich†; Anja Hribljan‡

Abstract:

[Abstract Redacted]

Keywords: Mass Spectra; Machine Learning; Spectral Deconvolution

Mentor(s):

Brett Savoie (Engineering); Andrew Bartlett Schofield (Engineering)

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

Poster Presentation Abstract Number: 1048
Presentation Time: Session 1: 9:00am-10:00am

SURF

Alterations in Extracellular Matrix Gene Expression Resulting from Nonequibiaxial Cyclic Stretch of Synoviocytes

Life Sciences

Author(s):

Shreya Sinha† (Engineering)

Abstract:

Cells are constantly subject to various levels of mechanical stimulation in the body which can alter their cytoskeleton and govern the expression or suppression of genes involved in maintaining the extracellular matrix. Synoviocytes are connective tissue cells found in the inner lining of joint cavities that are responsible for production of synovial fluid components to ensure healthy and smooth joint movement. Excessive strain on these cells can lead to injurious states and contribute to conditions like osteoarthritis (OA), a degenerative joint disease. Therefore, it is important to understand what changes are occurring to affect components of the synovial fluid to eventually make strides in mitigating the harmful consequences of this disease. To address this, a cell stretching device that was previously developed depends on the magnitude and frequency of air pressure applied to the polydimethylsiloxane membrane on which the SW982 cell line is cultured. Using this device, sinusoidal mechanical stimulation at 1 Hz frequency will be applied uniaxially, equibiaxially, and non-equibiaxially at magnitudes between 5% to 15% under a live cell imaging microscope to measure morphological changes. Cell layer will be tested using quantitative reverse transcription polymerase chain reaction for gene expression, and surrounding growth media will be tested with a hyaluronan enzyme-linked immunosorbent assay to measure hyaluronan concentration. Preliminary results have shown an overall transformation in shape and branching of cells after 1 hour of stretching. Future work can specifically analyze signaling pathways of the studied genes to find areas to target for OA relief and prevention.

Keywords: Synoviocyte; Cell Stretch; Gene Expression; Extracellular Matrix; Osteoarthritis

Mentor(s):

Deva Chan (Engineering); Mikayla Angelique Roach (Engineering)

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

Poster Presentation Abstract Number: 1049
Presentation Time: Session 1: 9:00am-10:00am

SURF

In-situ characterization of the rheological behavior that makes a polymer composite printable

Physical Sciences

Author(s):

Pedro Daniel Soto Rodriguez† (Engineering|JMHC); Ludvik Mathis Fjeld* (Engineering)

Abstract:

Carbon fiber polymer-matrix composite materials have become crucial for fabricating structural parts and molds across various applications and industries. Extrusion deposition additive manufacturing (EDAM) systems have introduced 3D printing abilities with these materials. Due to the shear-thinning nature of flows in these systems, rheological properties like viscosity change with shear rates. These variations can impact the mechanical properties of the printed pieces, which motivates this study. To describe these effects, Newtonian (Hagen-Poiseuille) and non-Newtonian viscosity models (Power law and Carreau) are applied to a fully developed pipe flow in the cylindrical nozzle of the EDAM system, examining its transient response to pressure and flow rate changes. A constrained, nonlinear optimization tool is employed in MATLAB to characterize the behavior of the material throughout the print. This approach is validated through a representative geometry printed at the Composites Additive Manufacturing Research Interface (CAMRI) with varying printing speeds that subject the flow to different shear rates. Future work includes developing a model that accounts for melt temperature and thermal history for more accurate viscosity predictions.

Keywords: Composites; Additive Manufacturing; Rheology

Mentor(s):

Eduardo Barocio Vaca (Engineering)

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

Poster Presentation Abstract Number: 1050
Presentation Time: Session 1: 9:00am-10:00am

SURF

Characterization and immunotherapeutic targeting of the tumor microenvironment

Life Sciences

Author(s):

Drake William Strait† (Engineering|JMHC)

Abstract:

Natural Killer (NK) cells are immune cells that have the capacity to target and eliminate cancer cells. Research done over the last decade has brought about significant progress in the use of NK cells in immunotherapy, particularly as we have begun to understand and exploit NK cell biology and their effector responses in tumors. NK cells are sourced from consenting donors, but this process is laborious and invasive. Alternative sources include umbilical cord blood, cell lines and induced pluripotent stem cells (iPSCs), which represent novel, and potentially allogeneic sources of NK cells. While multiple novel sourcing options exist, our understanding, as well as a direct comparison of the cytotoxicity of each source is lacking. An analysis on how effective NK from each source is at targeting tumors can provide insight on the importance of the cell's expression. In addition, how these cells perform in immunosuppressive tumor environments is unknown and is a major reason for therapy failure. This study will compare cytotoxicity of NK cells sourced from the NK-92 cell line, peripheral blood, and iPSCs genetically engineered to express chimeric antigen receptors (CARs). Cytotoxicity assays will provide a measure of the rate at which NK cells target cancer cells, allowing for a quantitative comparison between NK sources. We will, in addition, evaluate the role of oncometabolites on the proliferation of cancer cells. This research will contribute to our understanding of NK cells as immune effectors as they target difficult to kill solid tumors and inform the development of future immunotherapies.

Keywords: Natural Killer Cells; Tumor Microenvironment; Oncometabolites; Induced Pluripotent Stem Cells; Chimeric Antigen Receptors

Mentor(s):

Sandro Matosevic (Pharmacy); Xinyu Wu (Pharmacy); Tyler Parker Fritsch (Pharmacy); Kumar Rishabh (Pharmacy)

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

Poster Presentation Abstract Number: 1051
Presentation Time: Session 1: 9:00am-10:00am

SURF

Evaluating Intersection Safety through Hard Braking Events: A Comparative Analysis of Signalized Intersections, Roundabouts, and All-Way Stops Using Connected Vehicle Data

Mathematical/Computation Sciences

Author(s):

Vihaan Vajpayee† (Science); Andrew Joseph Thompson* (Science)

Abstract:

[Abstract Redacted]

Keywords: Connected Vehicle; Hard Braking; Trajectory Data; Analysis of Variance (ANOVA); Intersection

Mentor(s):

Enrique Daniel Saldivar Carranza (Engineering); Darcy M Bullock (Engineering)

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

Poster Presentation Abstract Number: 1052
Presentation Time: Session 1: 9:00am-10:00am

SURF

Extension of Concrete Elements Using Post-Installed Rebar Technology

Physical Sciences

Author(s):

Edward Vane† (Engineering)

Abstract:

A challenge commonly posed to civil engineers is the expansion of preexisting concrete structures, such as adding lanes to bridges. This generally requires exposing the rebar reinforcement already present in the structure through destructive action, which is often an inefficient use of both time and resources. This research aims to develop robust standards for the implementation of post-installed (PI) bonded rebar anchors, which would drastically lower the cost and time required to expand these preexisting concrete structures. To develop such guidelines a parametric study was conducted using the specialized finite element analysis (FEA) software MASA, with the findings being confirmed via laboratory testing. The failure load for PI bonded rebar anchors in tension was simulated while varying parameters such as concrete cover, rebar spacing, embedment depth, and failure mode. These initial simulations were recreated in Bowen Laboratory using multiple true-to-size concrete specimens, with pull-out tests being performed using hydraulic actuators while measuring the various loads on the specimen. Using this data, a relationship between the spacing between the PI bonded anchors and the failure load will be determined. This relationship will be for the pull-out failure mode, as it is expected that concrete cone failures as well as mixed failure modes will behave differently. Future work on this topic includes developing comparative models for PI bonded rebar anchors under these different failure modes.

Keywords: [no keywords provided]

Mentor(s):

Dheeraj Govindrao Waghmare (Engineering)

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

Poster Presentation Abstract Number: 1053
Presentation Time: Session 1: 9:00am-10:00am

SURF

Tracking the Trajectory and Spin Dynamics of a Table Tennis Ball

Physical Sciences

Author(s):

Nishant Vasan†; Haddy Elie Alchaer‡ (Engineering)

Abstract:

With the rise of Artificial Intelligence, there is a constant pursuit in sports to enable Computer Vision techniques to assist in training and umpiring. Table Tennis, being an extremely fast sport with ball speeds reaching up to 70mph, presents a significant challenge in tracking the ball's dynamics. Ball tracking could revolutionize training and umpiring. For instance, integrating the technology into a Virtual Reality setup could provide players with unique insights to accelerate the learning process. The objective is to build a system to estimate the 3D location of the ball. The data for the model was gathered from videos by two cameras. The ball is detected in 2D from the videos using a Blob Detection Algorithm and the hyperparameters are tuned to detect a white ball. The cameras are then calibrated and the projection matrices are estimated. Using Linear Triangulation, we then reconstruct its 3D position from 2D position. The results indicate that the system can estimate the 3D location of the ball and provide visualizations for its trajectory. Additionally, we implemented a marker based spin tracking algorithm as well. We use convolutional neural networks to locate the markers and use Bayesian Geometric Hashing to estimate the orientation of the ball. The relative orientation between consecutive frames helps us find the spin of the ball.

Keywords: Table Tennis; 3D Position Triangulation; Object Detection

Mentor(s):

Karthik Ramani (Engineering); Dizhi Ma (Engineering)

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

Poster Presentation Abstract Number: 1054
Presentation Time: Session 1: 9:00am-10:00am

SURF

Fabrication of Thermally Insulative Membranes for Dehumidification

Physical Sciences

Author(s):

Lily Avery Waterman† (Engineering)

Abstract:

A large percentage of energy use of traditional air conditioning systems is from dehumidification, necessitating the development of more energy-efficient dehumidification systems to combat climate change. Passive membrane-based dehumidification (PMD) is a promising solution as it does not require the condensation of water and can operate above the dew point, unlike conventional dehumidification. However, PMD requires membranes with high thermal insulation to avoid heat loss, which don't currently exist. In this work, thermally insulative support layers of polyvinylidene difluoride (PVDF) with varying concentrations of reduced graphene oxide (RGO) were fabricated through casting and phase inversion. Pebax with graphene oxide (GO) solution was cast on one side of the membrane to create an active layer to allow water vapor to pass through the membrane while rejecting the air molecules. The thermal conductivity of the support layer was 0.04 W/m-K for 0.5% of RGO in PVDF compared to 0.11 W/m-K for PVDF without RGO. The water vapor permeance was measured using the ASTM E96 wet cup method and permeance range was 3000-3500 GPU, varying with concentration of RGO. The nitrogen permeance varied from 2-5 GPU with RGO concentration using ISO 15101-1 and thus the selectivity (water vapor/nitrogen permeance) range was 550 – 1330. The membranes were characterized by capillary flow porometry (CFP) and scanning electron microscopy (SEM). These tests gave a further understanding of how the RGO fillers impact performance in dehumidification applications. Further research will test the membranes in a PMD setup and investigate other thermally insulative materials for the support layer.

Keywords: Membrane; Dehumidification; Thermal Conductivity

Mentor(s):

David Warsinger (Engineering); Md Ashiqur Rahman (Engineering)

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

Poster Presentation Abstract Number: 1055
Presentation Time: Session 1: 9:00am-10:00am

SURF

Clean and Efficient Hybrid Propulsion System for Drones

Innovative Technology / Entrepreneurship / Design

Author(s):

Thomas B Wooldridge† (Engineering)

Abstract:

Data collection in remote areas of ocean airspace has been significantly enabled by advances in drone technology, and improvement of flight times for modern-day battery-powered drones can greatly benefit flight campaigns. Current lithium-ion batteries used in drones have low energy densities (around 0.25 kWh/kg corresponding to a flight time of one hour or less), when compared with hydrogen fuel cells, which have an energy density of around 40 kWh/kg and average flight times of 5-10 hours. The dramatically higher energy density makes hydrogen-based solutions attractive for drone operations, but hydrogen-refueling places other constraints on drone operations. The objective of this research is to provide a proof-of concept for a completely autonomous hydrogen fuel cell powered drone docking and refueling station in remote parts of the ocean. The docking station will consist of a water pump which pumps sea water into a reverse osmosis water filter that then leads into an electrolysis stack that produces clean hydrogen. Next, the hydrogen will enter a high-volume low-pressure tank that stores the hydrogen in preparation to be boosted to higher pressures. After the hydrogen has been compressed, it will be transferred to a low-volume high-pressure storage tank where it will remain until the drone docks for refueling. Before assembling into a single unit, preliminary experiments are conducted to check the performance and quality of each component, particularly in terms of power requirements, component size and efficiency, and other important design parameters for remote operations. The preliminary experiments are used to calculate the actual working pressure and hydrogen flow rates, as well as to test any potential problems that might arise. Performance metrics, such as hydrogen production per cycle, energy efficiency, and noise are quantified based on the integration of the components. This demonstration work will estimate values for the metrics and areas of improvement for the next design iteration. The overall goal of the project is to transfer the proof-of-concept design to an actual autonomous environment.

Keywords: Clean Hydrogen; Docking Station; Ocean Data Collection; Fuel Cell Drone; Forever Flying Drone

Mentor(s):

Li Qiao (Engineering); Holman Lau (Engineering)

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

Poster Presentation Abstract Number: 1056
Presentation Time: Session 1: 9:00am-10:00am

Vet Med Summer Research

Investigating suspected mosquitos for the presence of Cache Valley Virus in Indiana

Life Sciences

Author(s):

Rubyleane Linton†; Scott A Gentry*; Amy R Witman*; Gabriela Gambirazio*; Farren E Osborn*

Abstract:

Cache Valley Virus (CVV) is a rare but dangerous orthobunyavirus that causes abortions and congenital disabilities in small ruminants, such as goats and sheep. The virus is zoonotic, having implications for human health as well. Mosquitoes are considered the primary vector of CVV. It is an emerging pathogen in the U.S and recent serologic testing of small ruminants suggests this virus is present in Indiana. This study aimed to identify CVV in Indiana by testing mammal-biting mosquito species collected from different parts of the state. A previously published real-time reverse transcriptase PCR was verified for use in the lab and utilized to detect target sequences of CVV within nucleic acids extracted from mosquito pools collected in 2023-2024. The mosquito species that were analyzed include Aedes albopictus, Aedes canadensis, Aedes j.japonicus, Aedes vexans, Anopheles punctipennis, Anopheles quadrimaculatus, Coquillettidia perturbans, and Culex pipiens (mixed). While the study is ongoing, no CVV was detected in the 45/324 pools of mosquitoes tested to date. Detection of positive pools would confirm the presence of CVV in the state. Additionally, testing various species of mosquitoes from different parts of the state would provide information regarding the location of the virus and the species of mosquitoes responsible. Traps that collect these mosquitoes mimic preferred hosts and environments to attract particular species. Infected mosquito species knowledge is essential in determining which traps will be the most effective in Indiana to increase the possibility of detecting this virus in the mosquito vector.

Keywords: Cache; Valley; Virus; Mosquitoes; Indiana

Mentor(s):

Rebecca P Wilkes (Veterinary Medicine); Craig L Bowen (Veterinary Medicine)

Other Acknowledgement(s):

Angela S Chan

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

Poster Presentation Abstract Number: 1057
Presentation Time: Session 1: 9:00am-10:00am

Vet Med Summer Research

Identification of mast cells within the tumor immune microenvironment of canine urothelial carcinoma

Life Sciences

Author(s):

Allison Grace Schimpf† (Agriculture); Alexander W Enstrom*

Abstract:

There are over 80,000 reported cases of human urothelial carcinoma (UC) each year within the United States which contributes to about 17,000 deaths. Human UC research has shown that the tumor immune microenvironment can contain a variable number of mast cells whose presence may be a prognostic indicator for the response to treatment. Certain breeds of dogs such as Scottish and West Highland White terriers have a high incidence of UC which share many histological, morphological and treatment response similarities with human UC. However, little is known about the number and role of mast cells in canine UC. The goal of this project is to classify mast cell involvement within the tumor immune microenvironment of canine UC while determining mast cell association with prognosis for possible subsequent immunotherapy studies. Canine UC samples obtained from patients of the Purdue University Veterinary Hospital were evaluated by histology and immunohistochemistry. Visiopharm AI assisted technology was utilized for mast cell count, location, and structural distances. The recruitment of mast cells into the tumor microenvironment is governed in part by chemokines secreted by tumor cells. Five different canine UC cell lines were propagated in vitro and evaluated by PCR for chemokine expression. This project will establish foundational data validating the use of canine cancer patients as an invaluable model for human cancer immunological research leading to future immunotherapy studies benefiting both people and veterinary patients.

Keywords: Mast Cells; Tumor Immune Microenvironment; Urothelial carcinoma

Mentor(s):

Meaghan M Broman (Veterinary Medicine)

Other Acknowledgement(s):

Abigail D Cox; Alison S.L. Clauser; Deborah W Knapp; Deepika Dhawan; MacKenzie J McIntosh; Mario F Sola; Erin R Lane

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

Poster Presentation Abstract Number: 1058
Presentation Time: Session 1: 9:00am-10:00am

Vet Med Summer Research

Pets at the desk: a systematic review on pets in the workplace

Social Sciences / Humanities / Education

Author(s):

Sophie Kaitlyn Stahl† (Science|JMHC)

Abstract:

Pets can have physical, mental, and social benefits for their owners. Studies have shown that these benefits might further be applied for owners that bring their pets to the workplace or interact with their pets while working from home. However, to date, there are no systematic reviews that name the positive, negative, and null consequences on implementation of pets into the workplace. This systematic review focuses on describing the characteristics of pets in the workplace, evaluating the methodology and risk of bias of the selected studies, and summarizing the reported outcomes of pets in the workplace. A total of 7 databases were searched resulting in 5270 articles to be screened for inclusion. A total of 20 articles were extracted to be included in the analysis. Studies show that dogs are the most common type of pet brought into the workplace. Positive findings were increased social interactions and less perceived stress among groups that brought dogs to the workplace. Negative findings included concerns relating to allergies and fear of animals, specifically dogs. Employers might consider implementing a policy that allows pets in the workplace to provide benefits to not only employee wellbeing, but also to the business itself. Future studies should consider which pet type (species, behavior, training, etc.) and policy fit the workplace best.

Keywords: Pets; Workplace; Wellbeing; Employee Benefits

Mentor(s):

Leanne Nieforth (Veterinary Medicine)

Other Acknowledgement(s):

Jane F Yatcilla

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

Poster Presentation Abstract Number: 1059
Presentation Time: Session 1: 9:00am-10:00am

VIP

User-Friendly Interface for Real-Time Musical Accompaniment

Mathematical/Computation Sciences

Author(s):

Connor Bradley Frey† (Science); Ryan Thomas Jordan* (Engineering|JMHC); Edward Falcon Navarro* (Science|JMHC); Caasi Nketiah Boakye* (Science); Minsoo Oh* (Science); Tim Nadolsky* (Science); Ping-Hung Nick Ko* (Engineering); Brian Mingyang Qi* (Science);

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

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

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

Poster Presentation Abstract Number: 1060
Presentation Time: Session 1: 9:00am-10:00am

VIP

Real-Time Voice Commands for Musical Accompaniment

Mathematical/Computation Sciences

Author(s):

Edward Falcon Navarro† (Science|JMHC); Ryan Thomas Jordan* (Engineering|JMHC); Tim Nadolsky* (Science); Ping-Hung Nick Ko* (Engineering); Caasi Nketiah Boakye* (Science); Minsoo Oh* (Science); Brian Mingyang Qi* (Science); Anthony Wang* (Science); Connor

Abstract:

Musicians practice together or alone to refine their skills; however with various scheduling conflicts and geographical distance issues, group practice can be a struggle. The development of Companion has been aimed to address these conflicts. One general problem with various other accompaniment systems is interaction with the device running the system. On the fly, changes are currently quite difficult especially considering one has to operate an instrument while performing. With that said, the development of an efficient voice commanding system has resolved this issue, enabling users to interact with the application hands-free. In the pursuit of the best possible vocal recognition library, we explored various offline and online libraries on accuracy and runtime. Our results determined the library we chose had the best balance of speed as well as accuracy for musicians to practice with. Future work could expand this robust system of user defined voice commands to various other teams inside of Artificial Intelligence for Musicians.

Keywords: Musical Accompaniment; Large Language Models; Voice Recognition; Audio Synthesis

Mentor(s):

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

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

Poster Presentation Abstract Number: 1061
Presentation Time: Session 1: 9:00am-10:00am

Evaluating the Impact of Natural Variation on Double Fertilization in Arabidopsis Thaliana

Life Sciences

Author(s):

Ava Grace Barnes† (Agriculture)

Abstract:

Natural variants of Arabidopsis thaliana harbor various genetic polymorphisms, which contribute to the phenotypic diversity observed among different ecotypes. However, little is known about how these polymorphisms impact plant sexual reproduction and fertilization success. We hypothesize that by analyzing specific variants in genes that affect reproduction, such as those that affect gamete interactions and fertilization, we can potentially uncover new molecular mechanisms underlying the establishment of reproductive barriers and hybrid incompatibility and contribute to the scientific understanding of the evolution of speciation.

DMP8 and DMP9 are membrane proteins found in the surface of plant sperm cells that serve as critical mediators of gamete interactions in double fertilization. We have selected 39 natural accessions from a wide variety of geographical locations containing moderate and high-impact polymorphisms in DMP8 and DMP9 and evaluated the effects of these in protein structure and protein-protein interactions using advanced computer modeling. In addition, we evaluated if these polymorphisms represent a meaningful selection pressure to the evolution of reproductive barriers between natural accessions. The selected ecotypes will be used in test crosses with transgenic or mutant Col-0 lines that possess noticeable phenotypes to investigate the effects of specific gene variants, with emphasis on reduced seed sets and their potential to generate haploid progeny (haploid induction).

Keywords: Plant Biology; Double Fertilization; Membrane Proteins; Protein Modeling; Genetic Analysis

Mentor(s):

Leonor Maria de Fatima Chagas Boavida (Agriculture)

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

Poster Presentation Abstract Number: 1062
Presentation Time: Session 1: 9:00am-10:00am

Examining Diversity Trends of Co-Infectious Organisms within Native Indiana Rust

Life Sciences

Author(s):

Lane Bell† (Agriculture); Bryan Reyes‡ (Science)

Abstract:

This research is a crucial component of a comprehensive global initiative aimed at mapping the distribution of understudied rusts: pathogenic fungi that greatly influence environmental diversity while wreaking havoc on global agricultural productivity, costing tens of billions of dollars annually. Despite their profound impact on agriculture, rusts remain significantly understudied in terms of diversity, distribution, and management. This is largely due to the substantial challenges involved in working with unculturable obligate parasites and the tendency for research to prioritize agricultural environments over native. To address this gap in knowledge, this study focuses on cataloging and collecting rust-infected hosts from local environments in Indiana, particularly near aquatic habitats, to better understand rust behavior within native populations and the environmental conditions conducive to their growth. An initial diversity study has been conducted statewide, involving the collection and pressing of host plants. Subsequently, rust lesion samples from five host species were selected to 1) examine mycobiome differences between normal and infected host tissues, and 2) isolate co-occurring fungi within the rust lesions. This ongoing effort has so far yielded 80 pure cultures. Additionally, samples from five different rust species (lesions and healthy tissue) have been submitted for NGS analysis. These methods are aimed at identifying co-occurring saprobes/mycoparasites and evaluating changes between healthy and host tissues. This research is important as it could uncover novel biocontrol agents to aid agricultural efforts and provide information about how rust infection alters host mycobiomes.

Keywords: Mycoparasites; Endophytes; Mycobiome; Plant Pathology

Mentor(s):

Daniel B Raudabaugh (Agriculture); Mary Aime (Agriculture); Terry Jarianna Torres Cruz (Agriculture); Mark Thomas Anderson (Agriculture)

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

Poster Presentation Abstract Number: 1063
Presentation Time: Session 1: 9:00am-10:00am

Repeatability of Cranial Morphometrics in the Pig

Life Sciences

Author(s):

Bea Olivia Cabot†

Abstract:

Swine litter size has been emphasized over piglet quality to improve productivity of sows. Greater numbers of pig fetuses in the uterus leads to insufficient surface area for nutrient transfer, causing an increase in piglets born with Intrauterine Growth Restriction (IUGR). Since pigs born with IUGR often die prematurely and surviving piglets develop poorly, identifying IUGR piglets in early life is crucial. IUGR pigs have typically been identified using brain-to-liver weight ratio, resulting in a lack of studies regarding the long-term effects of IUGR. Our objective is to validate selected parameters with images of fetuses, in order to develop non-invasive methods of assessing IUGR. A collection of 335 fetal images captured in left and right lateral recumbency was used. Images were from four distinct time points between mid to late gestation (55, 66, 76 and 86 days). A semi-automated image analysis program was used to evaluate correlation between paired images and the growth curve using 9 specific parameters including crown-rump length (CRL), linear (length between endpoints) and curved (length along curve) skull length, and skull area. As expected, the absolute value of all metrics increased with gestational age. The coefficient of variance (CV) for CRL, girth, linear and curved skull length were all less than 2.5%, while skull area exceeded 8%. Our results suggest skull linear and curved length as highly repeatable measures of cranial shape. To develop non-invasive methods for identifying IUGR, ongoing work will evaluate the relationship between these measures and standard identification methods of IUGR.

Keywords: [no keywords provided]

Mentor(s):

Jonathan Pasternak (Agriculture); Alyssa Smith (Agriculture); Dayeon Jeon (Agriculture)

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

Poster Presentation Abstract Number: 1064
Presentation Time: Session 1: 9:00am-10:00am

Deficits in nucleus accumbens activity are associated with social behavior deficits in Scn2a-deficient mice

Life Sciences

Author(s):

Christian A Durbin† (Pharmacy)

Abstract:

The Scn2a gene encodes for voltage-gated sodium channel NaV1.2, which is responsible for initiation and propagation of action potentials. Mutations in Scn2a are among the leading monogenic causes of Autism Spectrum Disorder (ASD), a neurodevelopmental disorder characterized by social deficits and repetitive behaviors. Scn2a deficiency has been proposed to be linked with ASD, which may offer another target for treating ASD symptoms. Our lab developed an Scn2a-deficient mouse model that exhibits reduced levels of NaV1.2 and social deficits, recapitulating the molecular and behavioral phenotypes in human children with ASD. To analyze deficits in neural activity associated with social deficits in our mouse model, we use in vivo calcium imaging to measure activity in the nucleus accumbens (NAc), which receives projections from the ventral tegmental area (VTA) and medial prefrontal cortex (mPFC), known regions encoding social behavior. Since the NAc is an important brain region for social behavior via VTA and mPFC circuits, we hypothesize that deficits in neuronal activity due to Scn2a deficiency like hyperexcitability will impair neuronal activity linked to social behavior in the NAc of mice, suggesting an impairment of the signal-to-noise ratio in the NAc linked to social behavior. Our results indicate that our Scn2a-deficient mice exhibit a lower signal-to-noise ratio than wild-type mice during social behavior, suggesting that deficits in NAc function are associated with social deficits in Scn2a-deficient ASD models. In future experiments, genetic rescue of Scn2a-deficient mice models may identify the NAc as a potential target for treating social deficits in ASD.

Keywords: Autism Spectrum Disorder; Nucleus Accumbens; Social Behavior; SCN2A

Mentor(s):

Yang Yang (Pharmacy); Shivam Kant (Pharmacy)

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Poster Presentation Abstract Number: 1065
Presentation Time: Session 1: 9:00am-10:00am

Electrochemical evaluation of PEDOT: PSS-coated electrodes for neural stimulation

Innovative Technology / Entrepreneurship / Design

Author(s):

Deniz Eksioglu† (Engineering|JMHC)

Abstract:

Neuromodulation involves surgically implanting stimulating electrodes into specific neural regions to modulate faulty neural circuits, treating neurological disorders such as Parkinson’s disease, essential tremors, and chronic pain. The implanted electrodes generate artificial action potentials across the axons of stimulated nerves, modulating neurological behaviors. However, implanting stimulating electrodes poses risks, such as foreign body response, corrosion, or the release of toxic substances that can harm surrounding cells. Moreover, these electrodes must deliver high levels of electrical charge, which could cause severe damage due to their high resistance and inability to store enough charge because of their size. To mitigate these risks and maximize stimulation efficiency, conducting polymers can serve as an interface between the metal substrate and biological tissue. These polymers exhibit high charge injection capacity and superior biocompatibility due to their porous structure and capacitive charge transfer mechanism under physiological conditions. In this study, we developed a poly(3,4-ethylene-dioxythiophene): poly(4-styrene-sulfonate) (PEDOT: PSS)-coated stimulating electrode and evaluated its electrochemical properties and safety limits to determine stimulus parameters using cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS), and voltage transient (VT) experiments. Cathodic charge storage capacity (CSCc), impedance at 1 kHz, and cathodic charge injection limit (CIL) were sequentially extracted as features from the experimental results. While the results indicate that PEDOT: PSS is a promising material for stimulation, the damage observed on the electrode after the voltage transient test suggests that further studies are needed to improve adhesion between PEDOT: PSS and the underlying metal electrode.

Keywords: Neuromodulation; PEDOT: PSS; Cyclic Voltammetry; Electrochemistry Impedance Spectroscopy; Voltage Transient

Mentor(s):

Hyowon Lee (Engineering); Jae Young Park (Engineering)

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Poster Presentation Abstract Number: 1066
Presentation Time: Session 1: 9:00am-10:00am

Wee Kinases, Tyrosine Phosphorylation, and what they tell us about Chance, Contingency, and Necessity in Evolution

Life Sciences

Author(s):

Michael David Gardner† (Science|JMHC)

Abstract:

A central question in evolutionary biology is what are the relative roles of chance, contingency, and necessity (CCN) on the outcomes of evolution? Since we are unable to directly observe the pertinent evolutionary changes, we don't know to what degree each component came into play. However, by comparing how traits have evolved multiple times, we can gain insight into the roles of CCN in evolution. If we see the same mechanisms, necessity likely has a strong influence since it had to evolve that way to function. If the mechanisms are different, chance and/or contingency likely have strong influence.

Throughout history, tyrosine phosphorylation has arisen a few times, meaning that we can observe the effects of CCN. Here we determined the genetic and molecular basis for tyrosine kinase (TK) activity in the Wee family of kinases. To determine when and how this family of kinases gained this function, we reconstructed a phylogeny of related kinases and determined their phosphorylation capabilities. This revealed the TK activity in the Wee family is ancient, dating to before the divergence of amoebas from obazoa. We are also constructing an accurate evolutionary history of kinases using maximum likelihood phylogenetics based on structural alignments of common kinase molecular features to better determine when this event occurred. We will then reconstruct the last common ancestor of Wee and related kinases and will compare the sequences and mechanisms against those underlying the evolution of TK activity in other kinases families to understand more about CCN in evolution.

Keywords: Kinase; Evolution; Phylogeny; Phosphorylation; Chance, Contingency, and Necessity

Mentor(s):

Brian Patrick Ha Metzger (Science)

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

Poster Presentation Abstract Number: 1067
Presentation Time: Session 1: 9:00am-10:00am

Impact of long-term best management practices on soil organic carbon in Midwest cropland

Life Sciences

Author(s):

Royalty Hightower†

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Javier M Gonzalez (Agriculture)

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Poster Presentation Abstract Number: 1068
Presentation Time: Session 1: 9:00am-10:00am

Phylogenetic Reconstruction of the Evolution of One Instance of Tyrosine Kinase Activity

Life Sciences

Author(s):

Rachel Marie Isaac† (Science|JMHC)

Abstract:

A key question in evolutionary biology is the role of chance and contingency in evolutionary processes. This question has remained unanswered because most traits evolved only once. However, tyrosine kinase (TK) activity has evolved multiple times independently, allowing for comparative analysis of the substitutions that caused TK activity in each instance. In this study, the evolutionary trajectory of TK activity was determined by constructing a phylogenetic tree of kinases with and without TK activity and then reconstructing ancestral sequences where TK activity emerged. The kinases of interest were the mitogen-activated protein kinase kinases (MAP2Ks), which exhibits tyrosine, serine, and threonine phosphorylation activities. MAP3K, a kinase with serine and threonine kinase activity, but not TK activity was used as the outgroup. This outgroup allowed for the reconstruction of an ancestral sequence without TK activity and comparison to the ancestral sequence with TK activity to determine which substitutions were responsible for the emergence of TK activity. Sequences of kinase domains were collected using the National Center for Biotechnology Information's BLAST tool and phylogenetics software was used to construct the phylogenetic tree. By identifying and comparing the substitutions responsible for TK activity in MAP2Ks to other instances of TK activity, this study provides insight into the reproducibility of the evolutionary process that led to TK activity and sheds light on evolutionary processes more broadly.

Keywords: Phylogenetics; Evolution; Reconstruction; Kinase; Chance and Contingency

Mentor(s):

Brian Patrick Ha Metzger (Science)

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

Poster Presentation Abstract Number: 1069
Presentation Time: Session 1: 9:00am-10:00am

Does M5 Muscarinic Receptors play a role in Chlorpyrifos-Induced Dopaminergic Neuron Toxicity?

Life Sciences

Author(s):

Dia Dipen Jhaveri† (Science)

Abstract:

Organophosphates like chlorpyrifos (CPF) are known for their neurotoxic effects, primarily through acetylcholinesterase inhibition, leading to acetylcholine accumulation and overstimulation of cholinergic pathways. SH-SY5Y cells, a human neuroblastoma cell line, are commonly used to study cholinergic system toxicity. This study investigates the involvement of muscarinic receptors, particularly the M5 subtype, in CPF-induced toxicity in dopaminergic neurons, which also express these receptors. The SH-SY5Y cells will be differentiated into dopaminergic neurons and that model will be utilized for the study.

We hypothesize that the M5 muscarinic receptor subtype mediates CPF-induced dopaminergic neuron toxicity. Despite previous studies on muscarinic receptors in cholinergic toxicity, the specific role of M5 receptors in dopaminergic neurons remains unexplored. Addressing this gap, we will assess CPF toxicity, evaluate muscarinic receptor expression, and use M5 receptor antagonists and genetic knockdown in SH-SY5Y cells and primary dopaminergic neurons. We will discover the mechanism of degeneration in dopaminergic neurons using different assays such as cell viability, cell death and immunoblot assays, lipid peroxidation and reactive oxygen species measurements. We will also discover whether neurotoxicity is associated with mitochondrial dysfunctions using several mitochondria-specific assays.

Antagonism of M5 receptors is expected to mitigate CPF-induced toxicity, underscoring the receptor's involvement in dopaminergic neuron damage. These findings could lead to new therapeutic strategies against organophosphate-induced neurotoxicity.

Keywords: Dopaminergic Neuron; Chlorpyrifos; Organophosphates; Dopamine; SH-SY5Y cells

Mentor(s):

Jason R Cannon (Office of the Provost)

Other Acknowledgement(s):

Reeya Tanwar; Md Jakaria

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

Poster Presentation Abstract Number: 1070
Presentation Time: Session 1: 9:00am-10:00am

Modeling Deformable Cells Using Spherical Harmonics

Mathematical/Computation Sciences

Author(s):

Alexander G Kelley† (Science)

Abstract:

Understanding the shape of deformable cells is crucial for advancements in lab-on-chip technology, which relies on precise manipulation of cellular structures. This study presents an approach to modeling the shapes of deformable cells using linear combinations of spherical harmonics. Spherical harmonics are a set of orthogonal polynomial functions that are made up of the Legendre Polynomials. A key challenge addressed in this work is ensuring the modeled cells maintain a constant volume, an essential biological constraint. To enforce this volume conservation, we derive an additional constraint on the linear combination of spherical harmonic coefficients. The volume integral in the context of spherical harmonics is derived and used to plot the shapes of deformed cells that maintain constant volume. To validate our volume integral, we employ a Monte Carlo integration method to verify that the deformed cells maintain a constant volume.

Keywords: Mathematical Modeling; Applied Mathematics; Spherical Harmonics

Mentor(s):

Kaitlyn T. Hood (Science)

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Poster Presentation Abstract Number: 1071
Presentation Time: Session 1: 9:00am-10:00am

Investigation of the yolk color differences with Orange Corn versus Yellow Corn within laying chickens.

Life Sciences

Author(s):

Rachel Elizabeth Kuhn† (Science); Abbilynne Nicole Elder† (Agriculture); Dylan Wade Seets† (Science)

Abstract:

Consumers prefer darker egg yolks, which can result from carotenoid deposition into the yolk from dietary ingredients. Carotenoids are fat-soluble micronutrients that provide various health benefits and can be found naturally in plants and algae. NutraMaize developed an Orange corn (OC) variety by selectively breeding to contain higher levels of carotenoids than traditional yellow corn (YC). A cross-over dietary study where diets containing either OC or YC was fed to 1400 Bovan Brown hens housed between 2 enriched floor and 2 aviary rooms to determine differences in the yolk color of eggs produced by chickens fed OC versus YC. As a result, there are four treatments being compared: (growing diet/lay diet) YC/OC, OC/OC, OC/YC, and YC/YC. Yolk scores were then measured using a Digital YolkFan Pro on 36 broken-out yolks collected per treatment at 70 weeks of age. These data points were analyzed at $p < 0.05$ significance using an ANOVA for treatment differences and a Tukey test for mean separation. The YC/OC was numerically higher than OC/OC treatment. Both YC/OC and OC/OC were significantly darker yolks than those of the YC/YC diet. YC/OC, OC/OC, and YC/YC were all then significantly darker yolks than that of the OC/YC diet ($P < 0.001$). This study is ongoing, but from these data points, layers fed OC show significantly darker yolk colors than YC. Thus, implementing OC into layer diets can produce the desired darker egg yolks for consumers.

Keywords: Egg Yolk; Egg; Yellow Corn; Laying Hens; Layer

Mentor(s):

Darrin M Karcher (Agriculture); Sara Elizabeth Cloft (Agriculture)

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Poster Presentation Abstract Number: 1072
Presentation Time: Session 1: 9:00am-10:00am

Development of Potent and Selective GRK5 inhibitors

Life Sciences

Author(s):

Kathryn P McCauley† (Science)

Abstract:

G-protein coupled receptor kinases (GRKs) desensitize activated GPCRs via phosphorylation at the plasma membrane, allowing beta-arrestin recruitment and internalization. There are seven human GRKs (GRK1-7) in the body. GRK2 and GRK5 are abundantly expressed in cardiovascular tissue, implicating them in cardiovascular diseases. Here we focus on GRK5. Increased activity of GRK5 has been shown to increase the risk of cardiovascular diseases. In addition, recent studies show increased GRK5 activity in relation to failing human myocardium and its over-expression in the heart leading to reduced cardiac B-AR responsiveness. Inhibitor BARKct improves failing tissue function by inhibiting GRK5 binding to the beta-gamma G-protein subunits to prevent internalization of the receptor. Other studies show that GRK5 is localized to the centrosome and involved in regulating cell cycle progression, but GRK5 can also phosphorylate cell cycle regulators such as nucleophosmin (NPM1) and p53, leading to altered cell cycle activity and higher risk of cancer. In this study we tested GRK5 inhibitors using kinase assays with radioactive phosphate isotope (P-32) to test the potency of a series of inhibitors at different concentrations to determine potency and compare to GRK2 to determine selectivity. In future we aim to obtain the structure of GRK5 bound to these inhibitors using cryo-electron microscopy to better understand their interactions. This study will aid rational based drug design for cardiovascular diseases and cancer, widening the scope of our understanding of the mode of inhibition of these inhibitors.

Keywords: GRK; Cardiovascular; Cancer; Inhibitor; Kinase

Mentor(s):

John Tesmer (Science)

Other Acknowledgement(s):

Sandali Lakmini Piladuwa Gamage

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

Poster Presentation Abstract Number: 1073
Presentation Time: Session 1: 9:00am-10:00am

Synthesizing Functionalized Pillarenes for Precision Polymer Synthesis

Life Sciences

Author(s):

Isabel M Owens†

Abstract:

[Abstract Redacted]

Keywords: Pillararenes; Rotaxanes; Mechanically Interlocked Molecule; Polymer Synthesis; Drug Delivery and Formulation

Mentor(s):

Severin Thomas Schneebeli (Science); Bazil Muhammed Sathar (Science)

Other Acknowledgement(s):

Ke Xu

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Poster Presentation Abstract Number: 1074
Presentation Time: Session 1: 9:00am-10:00am

Polyacrylamide hydrogels with defined elastic and surface properties for neurite outgrowth studies

Life Sciences

Author(s):

Twesha Ray† (Science)

Abstract:

Neuronal migration and neurite growth are crucial for forming functional neuronal circuits during brain development. While it is well established that environmental stiffness influences non-neuronal cell migration, its impact on neuronal outgrowth remains a subject of debate. Polyacrylamide (PAA) hydrogels have been extensively used as 2D substrates non-neuronal. Despite their ease of preparation and the ability to control their stiffness and thickness, PAA gels exhibit some undesirable physical characteristics, such as swelling and topographical structures, which can lead to surface instability. This is due to their physicochemical properties and preparation methods. Although these topographical features can affect neurite outgrowth in addition to stiffness, they are typically not studied and reported in mechanosensing studies. To minimize differences in surface structures and swelling in gels of different stiffness, we prepared gels of 0.3 kPa, 3 kPa, and 30 kPa using different combinations of polymerization times (14, 16, 18, and 20 minutes) with either PBS or water, respectively. Phase contrast images were captured to assess the impact of the polymerization time and solvent on the gel's structural homogeneity. Our results suggest that the gels exhibit less swelling in water than the PBS. The topographical structures, however, tend to appear in both solvents and are more uniform by shortening the polymerization time. Next, we will analyze the effects of polymerization time and solvent on the elastic properties of PAA gels and measure how these gels of defined stiffness and surface properties affect neurite outgrowth of Aplysia bag cell neurons.

Keywords: Polyacrylamide Hydrogel; Neurite Outgrowth; Polymerization; Elastic Properties; Structure

Mentor(s):

Daniel Suter (Science)

Other Acknowledgement(s):

Laura Pulido Cifuentes

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

Poster Presentation Abstract Number: 1075
Presentation Time: Session 1: 9:00am-10:00am

Investigating the application of Reference Point Indentation as a possible tool to determine quality metrics for excised keel bones.

Life Sciences

Author(s):

Dylan Wade Seets† (Science); Carl Anthony Kroger‡

Abstract:

Assessing keel bone damage (KBD) is a subjective process based upon visual observation or manual palpation. There are no standard bone quality assessment techniques as keels are remarkably fragile. Reference point indentation (RPI) is a minimally invasive method for assessing bone quality properties via microindentations, which has never been applied to keels. We wanted to develop a protocol for collecting RPI data on keels utilizing the BioDent RPI system. Visible KBD was noted then keels were trimmed of cartilage, measured, then sectioned into thirds and labeled: Tip, Middle, End. Keels were secured and indented from End to Tip. We are presenting Indentation Distance Increase (IDI) measures since IDI has been cited as an indicator of bone resistance. Statistical analyses included an ANOVA ($P < 0.05$) comparing the IDI between the 3 keel sections; a Tukey test was used for mean separation. Average IDI values in the Tip were numerically higher compared to Middle and End sections indicating more fragile bone tissue. Within 4-8 mm of a tip fracture, a higher IDI value than other Tip measures occurred. IDI decreased within the Middle with the most variability between bones and most KBD noted. One keel was measured twice: IDI was twice as large on the repeated analysis in the Middle ($P = 0.030$; t-test) but not different in others. Variance leads the RPI system to be used as a destructive test for keels. Further experimentation should focus on KBD to better grasp bone quality impact and assessing immature keel bones.

Keywords: Reference Point Indentation; Bone; Keel; Keel Bone Damage; Laying Hens

Mentor(s):

Darrin M Karcher (Agriculture); Sara Elizabeth Cloft (Agriculture)

Other Acknowledgement(s):

Thomas H Siegmund

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

Poster Presentation Abstract Number: 1076
Presentation Time: Session 1: 9:00am-10:00am

Systemic delivery of Polymyxin B by iron-tannic Acid-albumin nanocomplex for treatment of endotoxemia.

Life Sciences

Author(s):

Lev Titov† (Science)

Abstract:

Sepsis, often followed by Septic shock, is a life-threatening condition caused by Gram-negative bacterial infections. Gram-negative infection introduces pathogen-associated molecular patterns (PAMPs) such as lipopolysaccharide (LPS) into the system. Circulating LPS induces excessive release of pro-inflammatory cytokines, chemokines, and reactive oxygen species, causing hyperinflammation, immunosuppression, disseminated intravascular coagulation, and multiple organ failures. Polymyxin B, a cationic antimicrobial peptide, can adsorb to and inactivate LPS. However, the systemic use of Polymyxin B is challenged due to its dose-limiting toxicity. To mitigate the toxicity of Polymyxin B while maintaining its therapeutic efficacy, we have developed a nanoparticle consisting of albumin, tannic acid, and iron, as a carrier of Polymyxin B. The Polymyxin B-loaded nanoparticles (called TAPout) inactivated LPS endotoxicity, which is similar to unformulated PMB and a previously reported nanoparticle containing chitosan, in vitro and in vivo. TAPout particles demonstrated full survival from pre-induced sepsis by LPS injection upon intravenous injection, indicating that the TAPout particles are preventing LPS-induced sepsis, demonstrating protection against LPS-induced endotoxemia.

Keywords: Gram-Negative Sepsis; Polymyxin B; Nanoparticle; Albumin

Mentor(s):

Yoon Yeo (Pharmacy); Sota Shishikura (Pharmacy)

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

Poster Presentation Abstract Number: 1200
Presentation Time: Session 2: 10:30am-11:30am

ASPIRE REU

The New Mine: Navigating the Environmental Challenges of EV Battery Disposal

Social Sciences / Humanities / Education

Author(s):

Aspen Arnold†

Abstract:

The improper disposal of EV batteries not only releases toxic pollutants into our environment but also wastes valuable materials that could be recycled for future sustainability. This study addresses the research question Does EV battery disposal contribute to climate change? By evaluating the environmental challenges associated with EV battery disposal and exploring future methods for managing these batteries, this study aims to shed light on an overlooked issue. A comprehensive literary analysis of EV battery disposal practices between 2014-2020 was conducted to assess their environmental impacts. A coding book was developed to systematically identify common themes and inconsistencies within the literature. These themes were then grouped into categories and recorded to ensure a thorough analysis. The findings of this study will reveal what, if any, consequences of improper EV battery disposal, including the release of hazardous chemicals and the loss of recyclable materials. Furthermore, the study hopes to identify and highlight viable methods for managing EV battery disposal, such as recycling, which can significantly reduce waste and carbon emissions. By emphasizing the importance of recycling and reusing EV batteries, this study advocates for sustainable practices that not only save resources and money but also protect our environment. The research will provide recommendations that support a pathway towards a more sustainable future by encouraging the adoption of environmentally responsible practices in EV battery management. Through these efforts, we can mitigate the negative impacts on our environment and contribute to the fight against climate change.

Keywords: EV Batteries; Sustainability; Environmental Impact; EV Disposal; EV Battery Recycle

Mentor(s):

Brandon Chase Myke Allen (Engineering); Chiara Cervini (Engineering); Quayannah Lane (North Carolina A&T University)

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

Poster Presentation Abstract Number: 1201
Presentation Time: Session 2: 10:30am-11:30am

ASPIRE REU

EVs for all: How Does Indiana’sPlans for EV Charging Infrastructure Employ Equity?

Social Sciences / Humanities / Education

Author(s):

Daisey Briggs†

Abstract:

Indiana is expected to invest $100 million dollars to build EV infrastructure over the next 5 years however, there remain concerns if those infrastructure investments are equitable. The purpose of this research is to assess whether Indiana’s EV Infrastructure plans for charging stations are accessible to all communities including those who meet the disadvantaged community criteria outlined by the Justice40 Initiative. The research question guiding this study was How does Indiana’s EV Infrastructure plan employ equity in its decision-making of charging infrastructure location and benefits for EV adoption? This study used data from the EPA screening tools, Economic and Justice Tool maps, and documents from state government agencies. The different mapping tools identifies disadvantaged communities in Indiana and will be used to analyze their proximity to the new charging infrastructures built and/or planned placements. Additionally, this study will assess how equity is or is not being used within construction plans with the goal of providing recommendations that will ensure the benefits of EVs to materialize for vulnerable communities. Future considerations of promoting equity in EVs could include incentives for owners such as tax write-offs or small stipends. In Indiana specifically, there should be consideration for more short-range charging stations for owners with about 80% of the state's population constantly having access to a charging station within 5 miles. As well as an increase in EV adoption.

Keywords: EV Accessibility; Government Initiatives; EV Infrastructure; EV Equity; Justice 40

Mentor(s):

Kaitlyn Nicole Allen (Science); Chiara Cervini (Engineering); Quayannah Lane (North Carolina A&T University)

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

Poster Presentation Abstract Number: 1202
Presentation Time: Session 2: 10:30am-11:30am

ASPIRE REU

An Integrated Future: Developing Optimal EV Infrastructure in Urban Areas

Social Sciences / Humanities / Education

Author(s):

Scott Edwards†

Abstract:

This research employs a mixed-methods approach, integrating quantitative analysis with qualitative insights to create a holistic understanding of EV infrastructure planning. The quantitative component analyzes large national and regional datasets on current EV adoption, charging station locations, and usage patterns, sourced from government databases, industry reports, and EV charging network operators. The qualitative aspect includes case studies of successful infrastructure projects, determined by evaluating key performance indicators such as user satisfaction, usage rates, cost-effectiveness, and impact on local EV adoption. Additionally, stakeholder interviews and surveys will provide perspectives on economic, policy, and technological factors shaping the future of EV infrastructure. Preliminary results indicate significant regional disparities in EV infrastructure development, with urban areas showing denser networks of charging stations compared to rural regions. The study highlights the critical role of supportive policies and incentives in accelerating infrastructure deployment and ensuring widespread EV adoption. The impact of such an analysis is profound, providing policymakers and industry stakeholders with actionable insights to guide strategic planning and investment. This research can ultimately foster more efficient and equitable EV infrastructure development, supporting the broader transition to sustainable transportation.

Keywords: Electric Vehicles; Infrastructure; Urban Areas; City Planning; Urban Planning

Mentor(s):

Brandon Chase Myke Allen (Engineering); Chiara Cervini (Engineering); Quayannah Lane (North Carolina A&T University)

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

Poster Presentation Abstract Number: 1203
Presentation Time: Session 2: 10:30am-11:30am

ASPIRE REU

Breathe EV: Centering Community Health in the Pursuit of EV Adoption in Indiana

Social Sciences / Humanities / Education

Author(s):

Kaydence Hall†

Abstract:

Asthma continues to be one of the major health consequences from air pollution in these communities. Among U.S. children, 40.6% with asthma are from ethnic minority backgrounds while 7.6% of children are from non-minority backgrounds. Addressing issues related to asthma and air quality burden could provide relief to those of disadvantaged communities. Transportation remains one of the leading causes to air quality issues. A shift to electric vehicles (EVs) has a range of benefits from helping slow-down the effects of climate change to helping marginalized communities with health concerns due to air pollution from gas and diesel-powered engines. The purpose of this research is to identify the relationships of EV adoption and air quality in marginalized communities. This study will provide an overview of the issues of air pollution on vulnerable/marginalized communities and prevalence of EVs in wealthy areas and the resulting air quality. This data was collected by doing secondary data analysis, from Indiana showing the ratio between air pollution and electric vehicles. The research questions guiding this study are 1) Can EVs be used as a tool to improve Indiana Air Quality in low-income communities? 2) What are the adverse effects of air pollution on minority and marginalized communities compared to wealthy communities in Indiana? This study used data from screening tool and AFDC energy to evaluate if the prevalence of EVs is correlated with reduced carbon emissions, therefore helping those vulnerable to air pollution (marginalized communities). Data was captured showing relationships through EVs, pollution, and marginalized communities. Future considerations in infrastructure planning should take into account health impacts on disadvantaged communities.

Keywords: Health; Communities; Electric Vehicle

Mentor(s):

Brandon Chase Myke Allen (Engineering); Chiara Cervini (Engineering); Quayannah Lane (North Carolina A&T University)

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

Poster Presentation Abstract Number: 1204
Presentation Time: Session 2: 10:30am-11:30am

ASPIRE REU

Charging Indiana: A Review Into Equitable Access to EV Charging Stations in Indiana

Social Sciences / Humanities / Education

Author(s):

Angelic Harris†

Abstract:

[Abstract Redacted]

Keywords: EV with Minority Groups; Range Anxiety; EV Charging Infrastructure

Mentor(s):

Brandon Chase Myke Allen (Engineering); Chiara Cervini (Engineering); Quayannah Lane (North Carolina A&T University)

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

Poster Presentation Abstract Number: 1205
Presentation Time: Session 2: 10:30am-11:30am

ASPIRE REU

EV Innovation: Systematic review of EV battery impact in the last 20 years

Social Sciences / Humanities / Education

Author(s):

Jarrett Harris†

Abstract:

Lithium-ion batteries are commonly used in electric vehicles (EVs), but they cause many problems for the environment and people, so it is important to find better alternatives. This research , reviews the issues caused by lithium-ion batteries and lithium mining and suggests other sustainable power sources for EV batteries that are better for communities and the planet. The research question guiding this study is: What alternatives can exist for lithium-ion batteries in EVs? This study looked at previous research to find the environmental, economic, and social impacts of lithium-ion batteries and mining. Data from scientific articles, industry reports, and case studies were used and compared to different types of new battery technologies. Early results show that lithium-ion batteries harm the environment and cause problems for people living near mines. New types of batteries, like solid-state and sodium-ion batteries, seem to be safer, more sustainable, and possibly cheaper alternatives. These new battery technologies may also offer better energy storage and last longer. Future studies should focus on developing and testing these new batteries to make sure they work well and are safe for EVs. We also need policies to reduce the environmental impact of current lithium mining and to support the use of more sustainable battery options. Working together, governments, industries, and research institutions can help create these sustainable solutions. Raising awareness about the negative impacts of lithium-ion batteries is also crucial to drive change. Educating the public and stakeholders can lead to more support for sustainable battery technologies.

Keywords: Lithium-Ion Batteries; Sustainable Alternatives; Environmental Impact; New Battery Technologies

Mentor(s):

Brandon Chase Myke Allen (Engineering); Chiara Cervini (Engineering); Quayannah Lane (North Carolina A&T University)

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

Poster Presentation Abstract Number: 1206
Presentation Time: Session 2: 10:30am-11:30am

ASPIRE REU

To BEV or not BEV: Comparing EV power sources ability to reduce the US's carbon footprint

Social Sciences / Humanities / Education

Author(s):

Francisco Hurtado†

Abstract:

With the U.S. transportation industry being responsible for the most greenhouse gas emissions, electric vehicles are a strong contender for an effective solution. Recently there has been an emergence of various types of EVs, including Battery Electric Vehicle and Hydrogen Fuel Cell Electric Vehicle (HFC) which are the two most popular EVs on the market. The purpose of this research is to do a comparative analysis of BEVs and HFCs to showcase their pros and cons in the transition to a fully electrified transportation system. The research question that guided this study was what are the key differences of BEVs compared to HFCs in reducing the US transportation carbon footprint? This study used data from multiple sources including data from the US Department of Energy and previous literature analysis to evaluate the differences between BEVs and HFCs. Descriptive statistics were recorded such as the number of charging or refueling stations. The pros and cons of both EV types will be analyzed to showcase how each contributes to helping the US transportation industry reduce its carbon footprint. Converting to either of EV types would meaningfully reduce the carbon footprint of the US transportation industry which would help to reduce the impact that the transportation industry has on climate change.

Keywords: HFCEV; BEV; Carbon Emissions; US; ELT

Mentor(s):

Brandon Chase Myke Allen (Engineering); Chiara Cervini (Engineering); Quayannah Lane (North Carolina A&T University)

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

Poster Presentation Abstract Number: 1207
Presentation Time: Session 2: 10:30am-11:30am

ASPIRE REU

Techno-Economic Feasibility of Concurrent Megawatt and Dynamic Wireless Power Transfer Charging Infrastructure for Freight Vehicles along an Interstate Corridor

Innovative Technology / Entrepreneurship / Design

Author(s):

Olivia J Kurtz†

Abstract:

In the United States, the transportation sector accounts for 28% of greenhouse gas (GHG) emissions. Within the transportation sector, heavy-duty vehicles (HDVs) and medium-duty vehicles (MDVs) are responsible for 23% of GHG emissions. While MDV/HDV electrification would contribute to a significant reduction in GHG emissions, there are many challenges, namely expensive deployment costs of charging infrastructure and expensive vehicle ownership costs due to a large battery size requirement to support long-haul travel. Advanced charging technologies, such as dynamic wireless power transfer (DWPT) and megawatt charging (MWC), have been shown in the literature to be valuable charging solutions that, when deployed effectively, can support truck electrification while also decreasing the required battery size (and, consequently, cost). While economic feasibility has been assessed in the literature for the implementation of each technology separately, a coherent combined economic feasibility analysis of both technologies at a corridor level is lacking in the literature. Using vehicle data from the run on less experiment by the North American Council for Freight Efficiency (NACFE) and traffic data from a selected corridor, this study examines the economic feasibility of concurrent implementation of DWPT and MWC with infrastructure siting based on traffic demand determined by a MATLAB model simulating the state of charge of class 5-8 vehicles throughout a corridor. Further, the study assesses the economic feasibility of the system for the user (i.e., MD/HD fleets). The analysis results can be of interest to stakeholders interested in investing in DWPT and MWC infrastructure and guide policy surrounding electric MDV/HDV uptake.

Keywords: Charging Infrastructure; Commercial Vehicles; Economic Analysis

Mentor(s):

Nadia Gkritza (Engineering); Zainab Imran (Engineering); Ricardo Chahine (Engineering)

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

Poster Presentation Abstract Number: 1208
Presentation Time: Session 2: 10:30am-11:30am

ASPIRE REU

Youth Engineers in the Sustainability Program: A Case Study of a Research Program Effort to Support High School Students College Readiness

Social Sciences / Humanities / Education

Author(s):

Quayannah Lane†

Abstract:

Underserved students demonstrate a strong interest in pursuing science, technology, engineering, and mathematics (STEM) degrees. Yet, college readiness remains a critical barrier in modern higher education and a predictor of STEM enrollment. Existing policies and practices often fail to sufficiently reach underserved students or extend beyond facilitating college admissions. Notably, the role of research programs in enhancing high school students' college readiness remains underexplored in current literature. Approximately a quarter of all undergraduate students engage in research projects during their academic journey. Introducing a research program tailored for high school students has the potential to equip them with essential research skills early on and expose them to rigorous college-level experiences, thereby facilitating their transition into undergraduate education. The Youth Engineers in the Sustainability of Electric Vehicles (YES-EV) is a summer research initiative designed for students enrolled at Purdue Polytechnic High School, from sophomores to seniors. Participants engage in a comprehensive summer research project focused on electric vehicles, guided by faculty mentors. The program includes workshops dedicated to research methodologies and college readiness skill development. Notably, students collaborate on constructing an EV Grand Prix Go-Kart and culminate their experience with a concluding summer symposium. To gauge the impact of their participation, students undergo assessments evaluating the extent to which their summer experience has contributed to their academic development and perceived college readiness. Understanding the pivotal role of research experiences in enhancing student academic preparedness underscores the importance of investing in effective programs that can bolster retention rates even before college enrollment.

Keywords: [no keywords provided]

Mentor(s):

Brandon Chase Myke Allen (Engineering); Chiara Cervini (Engineering)

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

Poster Presentation Abstract Number: 1209
Presentation Time: Session 2: 10:30am-11:30am

ASPIRE REU

Analysis of language used in electric vehicle charging policies

Social Sciences / Humanities / Education

Author(s):

Emma Mast†

Abstract:

California's executive order N-79-20 and California government code 65850.7 are policies meant to streamline electric vehicle (EV) adoption and infrastructure. The transportation sector accounts for almost a third of the United State's total emissions, meaning that electric vehicles (EV) provide great potential for climate mitigation. However, there are income and racial disparity in household publicly available electric vehicle infrastructure accessibility (Lou, Shen and Niemeier, 2024). To understand how policies affect EV adoption and environmental justice in this transitional period, this study focuses on local policies and uses policy textual data analysis to answer two questions. How is EV charger permitting policy designed? How are social equity and justice considerations incorporated in the EV charging permit municipal code? Focusing on California's counties and municipalities (N = 540), four policy design components are coded, including policy goal, application format, application review processes, and streamlining processes. The results will assemble percentages of policies that focus on each theme, thus creating an idea of how EV policy is constructed and how accessible the policy is to the public.

Lou, J., Shen, X., Niemeier, D.A. et al. Income and racial disparity in household publicly available electric vehicle infrastructure accessibility. Nat Commun 15, 5106 (2024). https://doi.org/10.1038/s41467-024-49481-w

Keywords: Electric Vehicle; Charging Infrastructure; Policy Language

Mentor(s):

Shan Zhou (Liberal Arts)

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

Poster Presentation Abstract Number: 1210
Presentation Time: Session 2: 10:30am-11:30am

ASPIRE REU

Powering Equity in Louisiana Through EV Adoption

Innovative Technology / Entrepreneurship / Design

Author(s):

Tiara Thomas†

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Brandon Chase Myke Allen (Engineering)

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

Poster Presentation Abstract Number: 1211
Presentation Time: Session 2: 10:30am-11:30am

ASPIRE REU

The Hybrid Revolution: Steering the Path for EV Evolution

Social Sciences / Humanities / Education

Author(s):

Daniel White†

Abstract:

As the U.S. introduces more Electric Vehicles (EVs) the infrastructure remains insufficient for widespread adoption that includes range anxiety, timing, and costs. Alternatively, Internal Combustion vehicles (ICV) are proving their harm to air quality and other pollution effects that pose its own challenges. Hybrid vehicles can be an effective compromise that can help reduce the negative air quality effects of ICV while also eliminating some barriers attributed to EV adoption such as has incredible reliability, great fuel economy, less toxic emissions, and a great vehicle alternative to combat Climate Change. The purpose of this research was to conduct an in-depth analysis of hybrid vehicles, aiming to advocate for their role as a more environmentally sustainable transportation option. The research question that guided this research was what role can hybrid vehicles play in the pursuit of a fully electrified transportation system? This study used data from Fuel economy.gov to evaluate the emissions of hybrids in Eastern Indianapolis, against gas vehicles. Descriptive statistics were captured and recorded. Results of this study revealed that some hybrid emissions are reduced by more than half compared to an average new gasoline car emissions. The study shows the amount of emissions in grams per mile (g/mi), between a selected hybrid vehicle, versus the average new IC vehicle. Other results from this study reveal that hybrid vehicles have outstanding fuel economy, with some cars getting up 600 miles in range. Switching to hybrids can serve as a solution to lower emissions and be a great sustainable solution until transportation is completely electrified.

Keywords: Hybrid Vehicles (HVs); Emissions; Fuel Economy; Sustainable Transportation; Electric Vehicles (EVs)

Mentor(s):

Brandon Chase Myke Allen (Engineering); Chiara Cervini (Engineering); Quayannah Lane (North Carolina A&T University)

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

Poster Presentation Abstract Number: 1212
Presentation Time: Session 2: 10:30am-11:30am

Bernal REU

Understanding the mechanisms underlying host preferences in Uranotaenia lowii, a frog-biting mosquito

Life Sciences

Author(s):

Yu-Wei Cheng† (Agriculture)

Abstract:

Mosquitoes, like other organisms, have sensory filters tuned to detect and integrate ecologically relevant information. Given that female mosquitoes depend on the nutrients from blood meals for egg production, they detect and integrate relevant host-emitted cues to successfully feed. This process results in differential attractiveness to different host species. While much is known about host preferences of human-biting mosquitoes, less is known about non-human biting mosquitoes. Frog-biting mosquitoes, for instance, encounter and attack multiple anuran species but the consequences of biting different hosts are unknown. We hypothesize that female mosquitoes preferentially obtain blood from hosts that provide easier access to blood and the highest reward by maximizing egg production. To test this hypothesis, we examined the feeding behavior of Uranotaenia lowii, a frog-biting mosquito on six different frogs including species that are native, invasive, and allopatric to their geographic distribution. To examine the feeding behavior, we video recorded frog-biting mosquitoes attacking each frog species. By also examining egg production and larval development of the offspring resulting from feeding on different frog species, we evaluated the fitness consequences of such choices. This study contributes to our understanding of mosquito feeding preferences and their implications for host targeting strategies.

Keywords: Blood-Feeding; Fitness Consequences; Host-Seeking; Egg Production; Feeding Behavior

Mentor(s):

Ximena Bernal (Science); Richa Singh (Science)

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

Poster Presentation Abstract Number: 1213
Presentation Time: Session 2: 10:30am-11:30am

Bernal REU

The role of Olfactory Cues for Host Localization in Frog-Biting Mosquito, Uranotaenia lowii

Life Sciences

Author(s):

Chloe Elizabeth Greco†

Abstract:

[Abstract Redacted]

Keywords: Chemical Cues; Olfaction; Skin Secretion; Host Localization; Feeding Behaviors

Mentor(s):

Ximena Bernal (Science); Richa Singh (Science)

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

Poster Presentation Abstract Number: 1214
Presentation Time: Session 2: 10:30am-11:30am

Bernal REU

The role of visual cues in host seeking behavior in Uranotaenia lowii, a frog-biting mosquito

Life Sciences

Author(s):

Eavan Sohr†

Abstract:

[Abstract Redacted]

Keywords: Vision; Sensory Integration; Host Localization; Short-Range Cues; Mosquito Eyes

Mentor(s):

Ximena Bernal (Science); Richa Singh (Science)

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

Poster Presentation Abstract Number: 1215
Presentation Time: Session 2: 10:30am-11:30am

Biochemistry REU

Characterizing sulfotransferase 2B1a and determining its effect in drug delivery

Life Sciences

Author(s):

Hillary English†

Abstract:

Human sulfotransferase (SULTs) is a supergene family that plays a very prominent role in detoxification. These enzymes catalyze reactions crucial to the human body. This process involves attaching a polar sulfate group to a molecule, increasing its water solubility, and thus causing its excretion. Recent evidence has brought to light that increased cholesterol sulfotransferase (SULT2B1b) activity leads to an imbalance of the cholesterol to sulfonated cholesterol homeostasis, which has been seen to lead to carcinogenesis in the human colon, prostate, and ovary tissues. Moreover, bioavailability of various drugs can be impaired by SULTs. SULT2B1 has two isoforms SULT2B1a and 1b, both members have enzymatic activity towards cholesterol. Recently, the Mesecar Lab, in collaboration with the Cooks Lab, developed a label-free high-throughput DESI-MS-based enzymatic assay, which serves as a platform for in-vitro inhibitor screening and dose-response inhibition studies. We have identified and validated several hit inhibitors from the screening for SULT2B1b. However, not a lot about SULT2B1a is known, and because it has a remarkably similar structure to SULT2B1b, the selectivity of these inhibitors/analogs between the two isoforms need to be explored. To do this, I have purified 2B1a in order to obtain structural information about the protein through X-ray crystallography, and have performed various inhibitor tests to see if compounds that bind to 2B1b might also bind to 2B1a. These experiments provide fundamental insights into what SULT 2B1a does, and will potentially prevent off-targeting effects of drugs meant to inhibit 2B1b.

Keywords: Sulfotransferase; Cholesterol; X-Ray Crystallography; inhibitor; Isoform

Mentor(s):

Andrew D Mesecar (Centers & Institutes); Beinan Yang (Agriculture)

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

Poster Presentation Abstract Number: 1216
Presentation Time: Session 2: 10:30am-11:30am

Biochemistry REU

Validating and developing the AID system for anti-fungal drug discovery

Life Sciences

Author(s):

Laila Fortson†

Abstract:

Fungal infections in humans have historically been overlooked in disease research, however, they result in over 1.5 million deaths annually. Candida albicans, according to The World Health Organization, is one of four critical priority fungal pathogen species, posing a major threat to individuals. They can enter the bloodstream and invade internal organs, causing death in immunocompromised patients. Few medicines exist to treat fungal infections such as these. To address this, my project's focus is to develop and validate the auxin inducible degradation (AID) system in fungal pathogens, specifically Candida albicans, for anti-fungal drug discovery. The AID system is an effective functional genomics tool used for protein characterization. It provides rapid degradation of a protein of interest after adding the plant hormone auxin. We hypothesize that AID can also be used in the context of invasive fungal infection models to identify new anti-fungal drug targets. In this context, auxin is a surrogate for a “drug” against the target protein. C. albicans depends on hyphal growth to invade mammalian tissue for infection. The HGC1 gene is expressed in hyphae, and it is essential both for hyphal formation and infection. Hence, we are targeting HGC1 with the AID system to induce protein degradation in genetically manipulated strains of C. albicans. Initially, I confirmed that HGC1-AID strains could form hyphae in the presence of auxin normally using microscopy. I am currently testing if auxin-induced HGC1 degradation can block an invasive infection in Galleria mellonella larvae, a simple and common invertebrate infection model for Candida albicans. If successful, then AID can be used to broadly test if degradation of other proteins is sufficient to block infections and thereby identify potential new anti-fungal targets.

Keywords: AID; Candida albicans; Fungal Pathogens; Protein Degradation

Mentor(s):

Mark C Hall (Agriculture); Emily Lynae Danzeisen (Agriculture); James D Forney (Agriculture)

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

Poster Presentation Abstract Number: 1217
Presentation Time: Session 2: 10:30am-11:30am

Biochemistry REU

CTCF knockdown rescues the MAPK signaling pathway in Vezf1 null murine embryonic stem cells

Life Sciences

Author(s):

Juan Alberto Gomez-Solis†; Isaiah K Mensah* (Graduate)

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Humaira Gowher (Agriculture); Sameer Ullah Khan (Agriculture)

Other Acknowledgement(s):

Mudasir Zahoor

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

Poster Presentation Abstract Number: 1218
Presentation Time: Session 2: 10:30am-11:30am

Biochemistry REU

Investigating AD-induced Gnmt upregulation in Drosophila clock cells

Life Sciences

Author(s):

Sara Bethany Victoria Haber†

Abstract:

[Abstract Redacted]

Keywords: Alzheimer; Neurodegeneration; Epigenetics; Molecular Biology

Mentor(s):

Makayla Nicole Marlin (Agriculture); Vikki Marie Weake (Agriculture)

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

Poster Presentation Abstract Number: 1219
Presentation Time: Session 2: 10:30am-11:30am

Biochemistry REU

SHIP1 phosphatase as a Late-Onset Alzheimer's Disease therapeutic target

Life Sciences

Author(s):

Emma Litzelman†

Abstract:

Alzheimer's disease (AD) is a progressive neurodegenerative disorder characterized by memory loss and confusion. Late onset Alzheimer's Disease (LOAD), the most common type, typically begins after age 65 and lacks long-term treatment. However, recent studies identified Triggering Receptor Expressed on Myeloid Cells 2 (TREM2) transporter as a potential therapeutic target. Src homology 2-containing-inositol-phosphatase 1 (SHIP1), overexpressed in LOAD and encoded by inositol polyphosphate-5-phosphatase (INPP5D), negatively regulates TREM2 mediated signaling by dephosphorylating membrane lipid PI(3,4,5)P3 to PI(3,4)P2, ultimately blocking PI3K/Akt activation and microglial phagocytosis. However, many aspects of SHIP1, including its oligomerization state identified in Dr. Mesecar's lab, remain unclear.

The goal of this project is to understand the biological significance of SHIP1 oligomerization. The hypothesis is that one SHIP1 subunit's SH2 domain binds to the phosphorylated immunoreceptor tyrosine-based inhibitory motif (ITIM), anchoring it to help the other SHIP1 subunit interact with the immunoreceptor tyrosine-based activation motif ITAM on DAP12, the transmembrane region of TREM2. This anchor and assist mechanism stabilizes the protein near the membrane to dephosphorylate PIP3, which ultimately negatively regulating of TREM2 signaling pathway.

To test this hypothesis, a SHIP1 construct with SH2 and dimerization domains was expressed and purified from E.coli. Its molecular weight and thermal stability were analyzed using mass photometry and nanoDSF. Binding affinity with phosphorylated and non-phosphorylated ITAM and ITIM motifs was assessed with microscale thermophoresis (MST). The construct is also being screened for crystallization for structural analysis by X-ray diffraction. This data will help in understanding molecular mechanisms controlling SHIP1 expression in AD.

Keywords: LOAD; SHIP1; ITIM; ITAM; MST

Mentor(s):

Andrew D Mesecar (Centers & Institutes); Kratika Singhal (Agriculture)

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

Poster Presentation Abstract Number: 1220
Presentation Time: Session 2: 10:30am-11:30am

Biochemistry REU

Characterizing Chromatin Assembly Factor Capabilities of the ATP-dependent Chromatin Remodeler PICKLE (PKL) in Arabidopsis thaliana

Life Sciences

Author(s):

Andres Moran†; Shelby Sliger‡ (Agriculture|JMHC); Joshua Paul Kaluf‡ (Agriculture)

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Joseph P Ogas (Agriculture); Jiaxin Long (Agriculture); Jacob Ryan Fawley (Agriculture)

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

Poster Presentation Abstract Number: 1221
Presentation Time: Session 2: 10:30am-11:30am

Biochemistry REU

Evaluating the dependence of breast cancer on mitochondrial translation

Life Sciences

Author(s):

David Stanciel Onishile† (Engineering)

Abstract:

[Abstract Redacted]

Keywords: Breast Cancer; Mitochondrial Translation; Oxidative Phosphorylation; Therapeutic Targets; RNA-Binding Proteins

Mentor(s):

Kyle Aaron Cottrell (Agriculture)

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

Poster Presentation Abstract Number: 1222
Presentation Time: Session 2: 10:30am-11:30am

Biochemistry REU

The Set1 histone H3K4 methyltransferase alters Candida glabrata pathogenesis by controlling the expression of genes involved in cell wall formation.

Life Sciences

Author(s):

Matthew Tabrisky†; Krishna P Patel‡

Abstract:

The WHO designated Candida glabrata as a high-priority fungal pathogen. Notably, C. glabrata ranks as the third most isolated Candida species exhibiting intrinsic resistance to azole-antifungal drugs. Therefore, there is a critical need to understand what factors contribute to the pathogenesis of C. glabrata. Our laboratory has focused on the epigenetic factor SET1 and its role in pathogenesis. Using the Galleria mellonella larvae animal infection model, we have demonstrated that Set1 is necessary for pathogenesis. Specifically, the set1? strains significantly reduce the virulence of three different background C. glabrata strains when compared to their parental strains. Because Set1 is a known epigenetic factor, we hypothesized that Set1 directly governs the expression of genes contributing to the virulence of C. glabrata. To identify Set1-dependent virulence genes, we performed RNA-sequencing, interestingly, the most differentially expressed genes identified were involved in the formation of the cell wall. To determine if Set1 directly targets these genes, chromatin immunoprecipitation will be performed using a strain that I will construct to express a 3XFLAG-tagged Set1. Currently, I have confirmed that the selection marker and 3XFLAG tag have been integrated at the SET1 locus. Next, we will remove the selection marker and perform a western blot to confirm the expression and function of the 3XFLAG-Set1 strain. We will also generate deletions of these cell wall proteins and determine if these genes alter virulence. At the conclusion, we will have determined that Set1 directly controls the expression of novel virulence genes contributing to the pathogenesis of C. glabrata.

Keywords: [no keywords provided]

Mentor(s):

Scott D Briggs (Agriculture); Smriti Hoda (Agriculture)

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

Poster Presentation Abstract Number: 1223
Presentation Time: Session 2: 10:30am-11:30am

Colombian Research Scholars Program

Catalytic Depolymerization of Lignin of Corn Stover and Sawdust for Medium-Density Fiberboard Production

Physical Sciences

Author(s):

Mateo Colorado Zapata†

Abstract:

Abstract: Lignin is a naturally occurring polymer found in many plants. The goal of this project is to break down lignin into phenolic monomers by cleaving the ?-0-4 linkage as well as produce a clean source of cellulose with the goal of creating cleaner sourced chemicals and safer products such as formaldehyde free laminate boards. Since lignin has strong C-O-C and C-C bonds, it is extremely difficult to break it down into smaller components, and for this purpose methanol is introduced as a supercritical fluid and solvent, as it helps to break the bonds by a nucleophilic mechanism.

The reactions were carried out on both sawdust and corn stover samples with a catalyst that is Nickel on Activated Carbon, which is prepared by incipient wet impregnation using Nickel Nitrate Hexa-hydrate salt (Ni(NO3)2?6H2O). These reactions ocurred in a 100 and 600 milliliter Parr BSTR reactor, and were produced at temperatures ranging from 160 °C to 300 °C for both types of biomass. Samples from the reaction were analyzed via gas chromatography via flame ionization detection (GC-FID) as well as thermal capacitance detection, and from these results the reaction orders and activation energy for the depolymerization of lignin with nickel/activation carbon can be determined. The conclusions drawn from the data collection will allow future improvements of the depolymerization process.

Keywords: Catalytic Depolymerization; Gas Chromatography; Sustainability

Mentor(s):

Enrico Martinez Sainz (Engineering); Rajdeep Deka (Engineering)

Other Acknowledgement(s):

Juan D Velasquez De Bedout

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

Poster Presentation Abstract Number: 1224
Presentation Time: Session 2: 10:30am-11:30am

Colombian Research Scholars Program

Genomic imputation and prediction analysis: Unraveling genetic variability in dairy cattle

Life Sciences

Author(s):

Alejandro Daza Gallo†

Abstract:

[Abstract Redacted]

Keywords: Accuracy; Genotypes; Milk Production

Mentor(s):

Hinayah Rojas de Oliveira (Agriculture); Henrique Alberto Mulim (Agriculture); Gabriel Soares Campos (Agriculture); Juan D Velasquez De Bedout (Partnerships); acknowledgement Deborah Hannah (Not a Purdue Employee); Purdue University (Not a Purdue Employe

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

Poster Presentation Abstract Number: 1225
Presentation Time: Session 2: 10:30am-11:30am

Colombian Research Scholars Program

Latency, Velocity and Accuracy Evaluation of Classification Models on Edge Devices

Mathematical/Computation Sciences

Author(s):

Ana Milena Espinosa Jimenez†

Abstract:

The field of machine learning has made significant strides with the development of modern Convolutional Neural Networks (CNNs), which are designed to process data with grid-like structures, such as images. CNN-based models can be utilized to classify handwritten digits from MNIST or categorize defect types in smart manufacturing [1]. In wireless communication, such as 5G or WiFi6, latency, efficiency, and accuracy are critical metrics: latency refers to the delay for data transfer, velocity is the speed of data processing and inference, and accuracy indicates the model's prediction correctness.

While many studies have focused on training and evaluating classification models on powerful servers or cloud infrastructure, there is limited research on how these models perform when deployed on resource-constrained edge devices like the Jetson Nano, especially in the context of wireless communications with client devices.

This research gap highlights the need for comprehensive performance evaluations of classification models on edge devices, considering the constraints and requirements specific to these environments. To address this gap, this project proposes to evaluate the performance of a classification model on MNIST and ARMBench [1], deployed on a Jetson Nano, focusing on key metrics including latency, efficiency, and accuracy.

The methodology includes fine-tuning a pre-trained classification model using the MNIST handwritten digits dataset and the ARMBench defect detection dataset. This model is then deployed on the Jetson Nano, where its performance is rigorously assessed by transferring image data from a wirelessly connected client device.

This project aims to provide valuable benchmarks and practical guidelines for optimizing classification models on edge devices, thereby enhancing their deployment in real-world industrial applications.

[1] C. Mitash, F. Wang, S. Lu, V. Terhuja, T. Garaas, F. Polido, and M. Nambi, "ARMBench: An Object-centric Benchmark Dataset for Robotic Manipulation," arXiv preprint arXiv:2303.16382, 2023. [Online]. Available: http://armbench.com

Keywords: ARMBENCH; Classification Models; Wireless Networks; Convolutional Neuronal Networks (CNN); Edge Devices

Mentor(s):

Kwang Taik Kim (Engineering); Cheng Chen (Engineering)

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

Poster Presentation Abstract Number: 1226
Presentation Time: Session 2: 10:30am-11:30am

DUIRI

Implications of Beta1 Integrin in Cell Density

Life Sciences

Author(s):

Katie Wing-See Chan† (Pharmacy|JMHC)

Abstract:

Beta1 integrin is involved in cellular proliferation and drug resistance across various cancers such as glioblastoma, liver cancer and breast cancer. This integrin facilitates cell adhesion to the extracellular matrix (ECM), which promotes cell survival and proliferation through signaling pathways such as FAK, PI3K, and ERK/MAPK. Beta1 integrin's interaction with ECM components regulates cell cycle progression and apoptosis evasion, which contributes to enhanced proliferation rates. Beta1 integrin overexpression is also associated with drug resistance in cancer cells. Our findings suggest that beta 1 integrin is upregulated in more densely populated cultures, which may have implications in drug resistance. Western blot analysis was used to quantify the levels of beta 1 integrin in various cell strains associated with drug resistance.

Keywords: [no keywords provided]

Mentor(s):

Brenna Vaughn (HHS)

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

Poster Presentation Abstract Number: 1227
Presentation Time: Session 2: 10:30am-11:30am

DUIRI

The Effects of the SGLT2 Inhibition on Cardiac Function in Mice with Duchenne Muscular Dystrophy

Innovative Technology / Entrepreneurship / Design

Author(s):

Joslyn Renee Ferguson† (Engineering); Niharika Narra‡ (Engineering|JMHC); John Patrick Salvas*

Abstract:

Background: Duchenne muscular dystrophy is a genetic condition that leads to progressive muscle deterioration and heart failure, primarily in young boys. This study aims to investigate the efficacy of empagliflozin, an SGLT2 inhibitor (SGLT2i) used to treat other causes of heart failure, in improving cardiac function in a mouse model of Duchenne muscular dystrophy.

Methods: Three cohorts of mice, DMD mice treated with SGLT2i (MDX group, n=10), non-DMD mice treated with SGLT2i (DBA group, n=10), and DMD mice without treatment (MDX-ND, n=9) underwent cardiac imaging with high-frequency ultrasound at baseline, 4-, 7-, 12-, and 16-weeks. The drug was administered through the mice's food.

Results: Preliminary 2D analysis showed normal left ventricular ejection fraction at baseline for all groups (MDX: 57.8 ± 15.6%, DBA: 54.0 ± 14.1%, MDX-ND: 68.5 ± 6.1%). At 16 weeks, the ejection fraction decreased in the MDX-ND group, while ejection fraction remained similar to baseline in the MDX and DBA groups (MDX: 50.4 ± 9.9%, DBA: 56.4 ± 6.7%, MDX-ND: 43.5 ± 9.0%).

Conclusions: These preliminary results suggest that SGLT2i may slow the progression of cardiac dysfunction in DMD. These encouraging results justify further investigation with larger sample size and longer follow-up. Next steps include more in-depth analysis of cardiac function with 4D ultrasound cardiac data and/or more controlled drug delivery with injection.

Keywords: [no keywords provided]

Mentor(s):

Cortland Hannah Johns (Engineering); Alyssa Marine Richards (Student Life); Craig Goergen (Engineering)

Other Acknowledgement(s):

Adalyn Maria Fulun Meeks

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

Poster Presentation Abstract Number: 1228
Presentation Time: Session 2: 10:30am-11:30am

DUIRI

Evaluating Mobility Factors Under Extreme Heat

Social Sciences / Humanities / Education

Author(s):

Alexander Harman† (HHS|JMHC)

Abstract:

With increasing extreme heat events due to global warming, extreme heat poses a pervasive threat to various facets of life. It is important to understand the impacts of extreme heat on human behavior. This study is to explore how extreme heat events influence people’s mobility patterns. We calculated heat index values across the United States during the summer of 2023. Our sensitivity analysis identified locations that experienced extreme heat with a threshold of 48 hours of a heat index of 95 degrees during the daytime and 75 degrees Fahrenheit during the nighttime. Comprehensively, considering the social vulnerability index (SVI), hours under extreme heat, population density, and geographical location, we finally selected St. Louis, Missouri, as the area of interest for this study. Further analysis will include additional parameters such as tree canopy rates and transportation network density in a regression model to examine differences in mobility across various groups during heat waves. We also aim to explore people’s mobility needs for different points of interest (POI). This study can deepen the current understanding of how extreme heat affects urban mobility, aiding urban planners in improving accessibility for all populations, particularly those at higher risk during heat events.

Keywords: Mobility Factors; Accessibility Factors; Extreme Heat

Mentor(s):

Qingchun Li (Polytechnic)

Other Acknowledgement(s):

Tianle Duan

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

Poster Presentation Abstract Number: 1229
Presentation Time: Session 2: 10:30am-11:30am

DUIRI

Sustainable Manufacturing: An analysis of environmental impact associated with ammonia emissions in North Carolina tobacco production

Social Sciences / Humanities / Education

Author(s):

Joon Kang† (Polytechnic)

Abstract:

Tobacco manufacturing is a prominent industry in the state of North Carolina. The production of tobacco products results in air emissions of ammonia, which is used in tobacco manufacturing to “free-base” nicotine to facilitate faster absorption into the bloodstream. Ammonia is known to lead to health issues related to the cardiovascular system. It is also a major element of Particulate Matter 2.5 (PM2.5) in the atmosphere and is deemed a pollutant by the Environmental Protection Agency (EPA). This study aimed to understand the effect of tobacco manufacturing in North Carolina on ammonia air emissions released from facilities that report to the EPA’s Toxic Release Inventory (TRI). Tobacco production data from the United States Department of Agriculture was utilized as a comparison to the TRI database. The Kendall rank correlation coefficient and regression analysis were used to analyze the relationship between production and emission. It is important to consider if sustainable practices are already taking place in reducing total ammonia air emissions from the tobacco manufacturing industry. Moreover, as cigarettes are well known to cause cancer, it is important to consider the corporate social responsibility paradox and greenwashing of these facilities.

Keywords: Tobacco Manufacturing; Ammonia Air Emissions; North Carolina; Toxic Release Inventory (TRI); Agricultural Industry

Mentor(s):

James Tanoos (Polytechnic); Yi Gao (Polytechnic)

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

Poster Presentation Abstract Number: 1230
Presentation Time: Session 2: 10:30am-11:30am

DUIRI

Focused Ultrasound Driven Drug Release from Microrobot in Artificial Colon

Innovative Technology / Entrepreneurship / Design

Author(s):

Daniel Ethan Kelley† (Engineering); Natalie Elizabeth Romick‡ (Graduate)

Abstract:

Irritable bowel syndrome, which affects 25 to 45 million patients in the US alone, has limited medical treatment and often requires additional lifestyle adjustments for patients receiving such treatment. It is one example of colon related diseases that pose unique difficulties to treatment, since orally administered systemic drugs must pass through the entire digestive system to reach their target, raising the likelihood of associated side effects. A microrobot system has the potential to provide direct, targeted drug release within the colon. The microrobots can translate through the lumen of a colon by moving end-over-end in a tumbling motion. This motion is achieved with induction by using the microrobots, which contain a magnet, over a stage with a motorized spinning permanent magnet. They also have a hollow interior to carry a drug solution and a port covered in thermally sensitive paraffin wax. A newly improved artificial rat colon, modeled from 3D ultrasound images from a living rat, served as the setting for studies on the microrobot's release of a mock drug. Heating with focused ultrasound was characterized, with temperature changes up to 10°C achieved. Focused ultrasound was then demonstrated as a viable means to release the mock drug from the microrobot within the artificial colon. Next steps include quantification of release and testing the focused ultrasound-driven release in situ and in vivo.

Keywords: Microrobots; Ultrasound; Drug Delivery

Mentor(s):

Craig Goergen (Engineering)

Other Acknowledgement(s):

Diya Deepak Sakhrani; Adalyn Maria Fulun Meeks; Aaron Christopher Davis; Luis Carlos Sanjuan Acosta; David J Cappelleri; Luis Solorio

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

Poster Presentation Abstract Number: 1231
Presentation Time: Session 2: 10:30am-11:30am

DUIRI

Can Hemoglobin binding models be used to predict toxicity of mixtures of Forever Chemicals???

Life Sciences

Author(s):

Cora Jane Reynolds† (Science); Lail Shaw†; Hallie Grace Jackson‡ (Science)

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Tyler D Hoskins (Agriculture); Maria Soledad Sepulveda (Agriculture); Nathan Timothy Mak (Agriculture); Youn jeong Choi (Agriculture); Deise Cruz Santos (Agriculture)

Other Acknowledgement(s):

Jennifer L McAdams

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

Poster Presentation Abstract Number: 1232
Presentation Time: Session 2: 10:30am-11:30am

Physics REU or RET

Classical to Quantum: Two-Dimensional Acoustic Spectroscopy

Physical Sciences

Author(s):

Ana Colliton†; Bryan Borosky‡

Abstract:

This project seeks to develop an acoustic equivalent to laser-based ultrafast spectroscopy, focusing on two-dimensional infrared spectroscopy. Early experiments reveal that the anharmonic behavior of stringed instruments, like guitars, can be analyzed using pump-probe type measurements. In these measurements, phase-controlled sound pulses of different amplitudes create nonlinear acoustic excitations within the instrument. These experiments offer a quantitative measure of acoustic anharmonicities, such as the "buzzing" from a poorly adjusted guitar string. The objective is to advance this research to encompass full two-dimensional measurements, detailing the nonlinear coupling and energy transfer between strings. Additionally, we hope to demonstrate the connection between quantum and classical nonlinear response.

Keywords: Physics; Quantum; Nonlinear; Acoustic; Spectroscopy

Mentor(s):

Michael Earl Reppert (Science)

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

Poster Presentation Abstract Number: 1233
Presentation Time: Session 2: 10:30am-11:30am

Physics REU or RET

Wave Propagation in a Simple Fracture Network

Physical Sciences

Author(s):

Erin Duell†

Abstract:

A goal of geophysical monitoring of geothermal systems is to detect changes in the permeability of the network during shear stimulation. The Collab Project at the Sanford Underground Research Facility (SURF) in Lead, South Dakota performed continuous active-source seismic monitoring during an experiment to stimulate fractures at the 4100 foot level in the mine. The Collab data interpretation suggests that the fracture intersection angle varies along the intersection from 55 - 85 degrees. This raised the question of how intersections and intersection angles affect coda wave generation, i.e., late arriving energy composed of multiple internal reflections. This project aims to advance current understanding of the effect of intersecting fractures on coda wave generation. A replicate fracture system was fabricated from acrylic sheets in a water bath to create an impedance contrast that would give rise to multiple reflections. A water-coupled piezoelectric source transducer was placed at a fixed location (opposite or offset from the intersection) while the receiving transducer was translated to record coda waves at various locations. Data sets will be collected for different intersection angles, source locations and number of fractures to determine the impact on coda wave components. The results from the experiments will be presented on the poster, as data collection and analysis is currently underway.

Keywords: Geophysics; Fractures; Wave Propagation; Laboratory Experimentation

Mentor(s):

Laura J Pyrak-Nolte (Science)

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

Poster Presentation Abstract Number: 1234
Presentation Time: Session 2: 10:30am-11:30am

Physics REU or RET

Prospects for Quantum Entanglement at the High Luminosity Large Hadron Collider (HL-LHC)

Physical Sciences

Author(s):

Isabella Freitas†; Monique Mariae Morse†

Abstract:

This project investigates the prospects of quantum entanglement in top quark pair production at the high-luminosity large hadron collider (HL-LHC). Utilizing generated Monte Carlo (MC) samples, we analyze the MC data to derive kinematic variables relevant to top-antitop quark production. Event selection criteria specific to top-antitop quark production and subsequent decay in the dilepton channel are applied, followed by a kinematic top quark reconstruction, which involves identifying the decay products of the top quarks and reconstructing their momenta and other properties.

The focus is on measuring the normalized differential cross-section with respect to the opening angle (cosphi) between outgoing leptons in the transverse plane of the top quark center of mass frame. This angle is sensitive to the extend of spin correlations of the produced top quark antitop quark pair originating from the colliding particles. This quantity allows for probing entanglement in the phase space defined by the top quark-antiquark invariant mass (M_ttbar) and the scattering angle (theta). The entanglement is present for $-1 < D < -1/3$.

On a broader scale, this method of data analysis can be used to probe the capabilities of the HL-LHC collider in future experiments and advance our understanding of quantum entanglement in particle physics, while contributing to the wider field of quantum mechanics through the potential application of Bell's inequality tests.

Keywords: Quantum Entanglement; Spin Correlation Coefficients; Top Quark; High Luminosity Large Hadron Collider (HL-LHC); Spin Polarization

Mentor(s):

Andreas Jung (of Science); Osama Ragab Ahmed Dawood (Science)

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

Poster Presentation Abstract Number: 1235
Presentation Time: Session 2: 10:30am-11:30am

Physics REU or RET

Machine Learning Analysis of Seismic Coda Signals to Monitor Shear and Hydraulic Stimulation in Fractured Rock

Physical Sciences

Author(s):

Alexis Nicole Hensley†

Abstract:

Geothermal energy production from the Earth's subsurface often relies on the flow of fluids through a network of fractures to extract heat. However, these fracture networks are sensitive to engineered and natural processes that open and close fractures in response to changes in stress, fluid pressures, and geochemical interactions. A challenge is how to link information in geophysical data to changes in the network permeability to enable updates to numerical simulators to predict and control long-term energy production.

Here, we use machine learning (ML) to explore data from EGS Collab experiments at the Sanford Underground Research Facility (SURF) in Lead, South Dakota. Experiments at the 4100' level was monitored using a Continuous Active-Source Seismic Monitoring (CASSM) system. The CASSM system used 20 3-channel accelerometer sources and 72 receivers to provide near continuous observations from 2018 to 2022 during induce fracturing and shearing of known fractures. The full waveforms contained codas from multiple reflections from existing and induced fractures. A triplet loss neural network was used for signature identification of alteration of fractured rock during injection and pressurization. Shear stimulation generated a set of features that captured changes in fracture and matrix properties induced by the test. During hydraulic fracturing, the features were observed to relax over several days to a distinct new configuration reflecting the alteration of the fracture system. This analysis demonstrates that the coda signal is rich in information on the condition fracture rock and the potential for remote monitoring of subsurface geothermal fracture systems.

Keywords: Shear Stimulation; Fracture Networks; Geothermal; Machine Learning; Hydraulic Fracturing

Mentor(s):

David D Nolte (Science); Laura J Pyrak-Nolte (Science)

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

Poster Presentation Abstract Number: 1236
Presentation Time: Session 2: 10:30am-11:30am

Physics REU or RET

Shearing Fracture Networks

Physical Sciences

Author(s):

Reagan John Thompson†

Abstract:

Understanding the response of fracture networks under shear stress is crucial for applications concerning subsurface fluid flow where shear stimulation is often used to enhance fluid permeability. This study presents a laboratory method for examining the response of various pre-existing fracture topologies to vertical shearing while under constant horizontal confinement. 3D printed PMMA samples are subjected to controlled shearing with a Deben CT5000 in-situ uniaxial stress rig during X-ray microscopy (Zeiss Versa 510). 3D tomographic reconstructions are used to quantify and visualize the changes in fracture apertures as a function of loading. Data collected by these experiments will serve as a reference in the ongoing development of computational models of fracture dynamics and deformation. The combined result of this work will enable improved designs and efficiency in hydraulic fracturing systems through the optimization of shearing to enhance fluid flow.

Keywords: Geophysics; Fractures; Mechanics; Deformation

Mentor(s):

Laura J Pyrak-Nolte (Science); Alexandra Blair Clark (Science)

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

Poster Presentation Abstract Number: 1237
Presentation Time: Session 2: 10:30am-11:30am

PURE-PD

Investigating the effects of DMP9 overexpression in osmoregulation in vegetative tissue

Life Sciences

Author(s):

Elizabeth Agyei†

Abstract:

DMP8/9, membrane-associated proteins only found on the surface of plant sperm cells, were recently discovered to aid in gamete fusion in A. thaliana. DMP8/9 are part of a bigger protein complex organized by TET11/12 tetraspanins. The knockout of dmp8/9 results in improper fertilization of the egg and central cells by the sperm cells. Overexpression of DMP9 in vegetative tissues results in reduced plant growth and problems with osmoregulation. We believe this phenotype is caused by the deregulation of ion transports or localization of membrane-associated ion transporters. The first part of this project aims to investigate the biological function of DMP9 by examining how the overexpression and knockout lines respond to ABA, H2O2, organic acids, and toxic cations. The second part aims to gain more insight into stomata response to ABA, acetic acid, and various concentrations of H2O2 in the overexpression line using epidermal peels. This project aims to present a possible model of how the overexpression of DMP9 may be interfering with plant osmoregulation and further hypothesize how this directly correlates to the function of DMP8/9 on the surface of plant sperm cells.

Keywords: Osmoregulation; Double Fertilization; Sperm-Expressed Protein; Gametes; Stomata

Mentor(s):

Leonor Maria de Fatima Chagas Boavida (Agriculture)

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

Poster Presentation Abstract Number: 1238
Presentation Time: Session 2: 10:30am-11:30am

PURE-PD

Functionally Characterizing RipUK60, a Type III Effector of Ralstonia solanacearum

Life Sciences

Author(s):

Elise Bennett†

Abstract:

Ralstonia solanacearum is a highly destructive bacterial pathogen that mainly infects potatoes, tomatoes, and geranium while causing major losses for growers. This pathogen improves its virulence through the deployment of its effectors which improve the host environment for the pathogen. This project specifically focuses on RipUK60, a Type III effector that is delivered into the host cell through the Type III secretion system of R. solanacearum. While many Type III effectors manipulate the metabolism, target hormones, and inhibit DNA binding in a host plant, RipU is unique in the way it disrupts the cytoskeleton; once the cytoskeleton is damaged, R. solanacearum readily colonizes the plant. This research investigates how RipUK60 aids in the development of infection by colocalization with the cytoskeleton and suppression of the immune system. First, truncations, small parts that make up the full RipUK60 protein, were made to determine how various parts of RipU disrupt the host cell. Following this, Nicotiana benthamiana plants were infiltrated with agrobacteria containing these truncations of RipUK60 and either actin or tubulin markers. Using spinning disk confocal microscopy, the fluorescent tags mCherry or GFP were then added to cytoskeleton markers and the truncations to determine colocalization. Reactive oxygen species (ROS) assays were also completed to determine what parts of RipUK60 may be responsible for suppressing an immune response. RipUGMI1000 truncations have also been made to determine variations of this effector in a different strain. By characterizing this effector and determining where it damages a host, breeding for resistant plants is possible.

Keywords: Pathogen; Ralstonia; Effector

Mentor(s):

Abigail Keelin Rogers (Science)

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

Poster Presentation Abstract Number: 1239
Presentation Time: Session 2: 10:30am-11:30am

PURE-PD

Molecular genetic studies of candidate developmental regulators in two model species: Ceratopteris richardii and Arabidopsis thaliana

Life Sciences

Author(s):

Anasofia Carrillo†

Abstract:

Meristems and stem cells play essential and conserved roles in driving plant growth and development and determining biomass production and yields. We have been using two model species—the flowering plant Arabidopsis and the fern Ceratopteris—to characterize regulators in the control of meristem development and stem cell homeostasis. Among them, we identified and named two close homologs (the CrPER1 and CrPER2 genes). We investigated the CRISPR-Cas9 mediated mutations of CrPER1 and CrPER2 in transgenic Ceratopteris. Specifically, we designed two DNA primers, the forward primer 267-1 and reverse primer 267-2, to amplify the genomic region of each gene in individually transformed Ceratopteris plants. Following DNA extraction, PCR, and DNA purification, we analyzed Sanger sequencing results of a total of 88 samples to determine putative mutations in their respective target sequences. To date, we identified 3 heterozygous mutations in the target sequences of CrPER1 but have not yet identified any detectable editing for CrPER2. The potential morphological changes of these mutants will be examined in subsequent generations. The comparative evaluation with A. thaliana is ongoing to dissect the potentially conserved or divergent capabilities of these genes between ferns and angiosperms. This research demonstrates the capacity of the CRISPR technology in fern genetic research and suggests different efficiency for each individual target gene. It provides a foundation for further studies of meristem development in ferns, potentially offering insights into the evolution of plant developmental mechanisms.

Keywords: [no keywords provided]

Mentor(s):

Yun Zhou (Agriculture); Xi Yang (Agriculture); Chong Xie (Agriculture)

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

Poster Presentation Abstract Number: 1240
Presentation Time: Session 2: 10:30am-11:30am

PURE-PD

Modeling buffalograss phenology as a response to climate change

Life Sciences

Author(s):

Holly Gustavsen†

Abstract:

Bouteloua dactyloides, also known as buffalograss, is a dioecious short grass native to the United States, Mexico, and Canada. Known for its drought tolerance, buffalograss is an important wildlife and livestock grazing grass and is commonly used as a low-maintenance lawn grass. Previous studies have determined climate change is significantly affecting the phenology of both perennial and annual grass species. Considering its broad flowering period (May to September) and geographical range, the phenology of buffalograss should be studied to improve our understanding of grassland communities. However, few studies have included dioecious grasses like buffalograss, which provide unique opportunities to study phenological mismatch which can lead to reduced growth and reproduction, in their investigations. Using two data sources, preserved specimens and citizen science images collected between 1901 and 2022, we annotated the sex and phenophase of over 3000 images. Preserved herbarium specimens provide long-term historical data while citizen science data contains coordinates and is more abundant. This study creates a linear mixed model of buffalograss flowering time as a function of climate change. The data suggests that flowering time varies across buffalograss' wide range and between sexes. Additionally, the models will be used to predict future change in buffalograss phenology under different climate projections which could increase understanding of how climate change affects prairie and grassland ecosystems.

Keywords: Bouteloua Dactyloides; Phenology; Climate Change; Linear Mixed Modeling

Mentor(s):

Daniel Park (Science); Jaein Choi (Science)

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

Poster Presentation Abstract Number: 1241
Presentation Time: Session 2: 10:30am-11:30am

PURE-PD

Deciphering the Roles of Petunia SMAX1 Isoforms in the KAI2-Mediated Signaling Pathway

Life Sciences

Author(s):

Niki Hamraei†

Abstract:

Plants release volatile organic compounds (VOCs) to communicate with microbes, insects, and other plants as well as between different tissues within a plant. Terpenoids, one class of VOCs, act like hormones to influence reproductive organ development. Specifically, the sesquiterpene (-)-germacrene D is emitted from developing tubes of petunia flowers and accumulates in the stigma where it is perceived by a member of the intermediate clade of karrikin-insensitive alpha/beta hydrolase receptors, PhKAI2ia. The signaling cascade that follows is distinct, with some similarities to the canonical karrikin signaling pathway that acts through the Skp1-Cullin-F-box (SCF) E3 ubiquitin ligase complex, including the F-box protein MORE AXILLARY GROWTH 2 (MAX2), as well as the ubiquitination and degradation of the transcriptional corepressor, SUPPRESSOR OF MAX2 1 (SMAX1). Interestingly, petunia has two MAX2s that both interact with PhKAI2ia; however, while it also contains two SMAX1s, only SMAX1a degradation is induced by the volatile signal. This raises the question of the differential physiological roles of the two SMAX1s in planta. In silico protein analyses predicted several noteworthy differences in primary sequence and protein structure between SMAX1a and SMAX1b, primarily in the domains essential for KAI2-mediated degradation. We hypothesize that these structural differences between the two proteins are key determinants in their role and determine specificity of downstream KAI2-mediated signaling response(s). This study aims to identify the biological impact of these structural differences and elucidate the SMAX1-dependent signal transduction steps in the PhKAI2-mediated signaling pathway(s).

Keywords: Petunia hybrida; Volatile Organic Compounds; PhKAI2ia; PhSMAX1; PhMAX2

Mentor(s):

Natalia Doudareva (Agriculture); Matthew Edward Bergman (Agriculture)

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

Poster Presentation Abstract Number: 1242
Presentation Time: Session 2: 10:30am-11:30am

PURE-PD

Differential Roles of ACS Enzyme Isoforms in Ethylene-Mediated Abiotic Stress Responses in Arabidopsis thaliana

Life Sciences

Author(s):

Molly Kubal†

Abstract:

Plant hormones control and regulate many aspects of plant growth, development, and response to stress. Ethylene is a gaseous plant hormone that acts as a major regulator in processes such as ripening, senescence, germination, and root growth. 1-aminocyclopropane-1-carboxylate synthase (ACS) is a key rate-limiting enzyme in the biosynthesis of ethylene, regulating its production based on different stimuli. There are three types of ACS enzymes in Arabidopsis thaliana based on their phosphorylation sites. Type I ACS enzymes have calcium-dependent protein kinase (CDPK) and mitogen-activated protein kinase (MPK) phosphorylation sites. Type II utilizes only one phosphorylation site for CDPK with an E3 ligase-binding motif called target of ethylene-overproducing 1. Type III has no phosphorylation sites. Investigation of abiotic stress responses is crucial to improving agricultural productivity and sustainability, as it aids in developing crops that can withstand challenges imposed by environmental and/or anthropogenic stressors. To discover the functional link between ethylene biosynthesis and abiotic stress responses, we utilized knockout mutants of each type of ACS in Arabidopsis. We evaluated their responses to abiotic stresses, specifically drought, heavy metal, and salt stress. These stressors were tested individually and in combination to assess their compounded effects on chlorophyll content, survival rate, germination rate, and ethylene content. Results indicate altered response to these stressors in germination and survival rate among mutants compared to the wild type. These findings suggest that different ACS genes play distinct roles in responding to these stressors and are thus critical for the adaptation of plants to stress.

Keywords: Ethylene Biosynthesis; Stress Response; Arabidopsis Thaliana; ACS Mutants

Mentor(s):

Gyeong Mee Yoon (Agriculture); Hye Lin Park (Agriculture); Yuan-Chi Chien (Science)

Other Acknowledgement(s):

Chao Cai

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

Poster Presentation Abstract Number: 1243
Presentation Time: Session 2: 10:30am-11:30am

PURE-PD

Three novel transcription factors in RAV2, C2H2, and HSF identified to play a key response on tomato during chilling stress

Life Sciences

Author(s):

Samantha Lares†

Abstract:

Cold stress is a major contributor to production loss in tropical origin crop species like tomato (solanum lycopersicum). Much is known about the cold response of temperate origin plants such as Arabidopsis thaliana. However, less is known about the regulation of the cold response in tropical origin crop species, such as tomatoes, which are sensitive to above zero but near freezing temperatures. The tomato cold stress response results in the gene expression which is mediated by the master transcription factors. To further investigate the transcription factors regulating the tomato cold stress response, three knockout lines with mutations in the RAV2, C2H2, and HSF transcription factor families were grown to investigate the transcriptional response under chilling stress (4°C). These transcription factor families were chosen using 1000+ publicly available RNAseq data to identify novel transcription factors that were the most influential in potentially regulating gene expression of known cold stress related genes. When exposed to chilling stress, the tomato undergoes damage to membrane integrity, production of reactive oxidative stress and photosynthesis deficiency. We have investigated these cold stress phenotypes in three different mutant lines using plant wilting assay, electrolyte leakage, DAB staining, and measuring chlorophyll content. Analysis of these phenotypes will provide an understanding of the role our novel transcription factors play in the tomato cold stress response. We anticipate that mutation of transcription factors will alter the overall tomato cold tolerance.

Keywords: Cold Stress; Gene Regulation; Tomato

Mentor(s):

Frederick Isaac Mildenhall (Agriculture); Xiaojin Wang (Agriculture); Kranthi Varala (Agriculture)

Other Acknowledgement(s):

Nathan A Deppe; Chao Cai

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

Poster Presentation Abstract Number: 1244
Presentation Time: Session 2: 10:30am-11:30am

PURE-PD

Responses of Sorghum Differentials to Colletotrichum Sublineola strain Cs29

Life Sciences

Author(s):

Jeremy Ledesma Vicioso†; Abigail Grace Smith* (Science)

Abstract:

Anthracnose disease, caused by Colletotrichum sublineola, results in considerable yield loss of sorghum globally, especially in regions where wet and humid conditions prevail. Genetic studies of natural variants of sorghum have defined many anthracnose resistance loci. Sorghum differential lines have been used as sources of resistance to strains of the fungus and also to define new emerging strains of the pathogen. Here, we evaluated the response of eighteen sorghum differential lines to inoculation by Colletotrichum sublineola strain Cs29. Four-week-old seedlings of the sorghum differential lines were inoculated with 106 spores/mL of Cs 29. Results suggest that some sorghum lines such as Brandes and Theis are resistant to Colletotrichum Cs 29 whereas TAM428 is susceptible to the pathogen. Thus, current results highlight the potential to identify new resistance genes in these sorghum lines and to introgress resistance traits into susceptible cultivars that otherwise have other desirable traits.

Keywords: Anthracnose; C. sublineola; Sorghum; Differential Lines

Mentor(s):

Tesfaye D Mengiste (Agriculture); Pascal Chukwuebuk Okoye (Science)

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Poster Presentation Abstract Number: 1245
Presentation Time: Session 2: 10:30am-11:30am

PURE-PD

Evaluation of the role of the Lateral Boundary Domain Transcription Factor GmLBD5 in Soybean Response to Sulfur Deficiency

Life Sciences

Author(s):

Adrian Muñoz†

Abstract:

Sulfur deficiency is an emerging problem in soybean (Glycine max) due to less atmospheric Sulfur deposition caused by stricter environmental regulations. Sulfur is an essential macronutrient for soybeans in part because it is required for symbiotic nodulation with nitrogen fixing Rhizobia bacteria. GmLBD5 is a class II Lateral Organ Boundary Domain (LBD) transcription factor, many members of which participate in abiotic stress responses. Preliminary results show that LBD5 is responsive to abiotic stresses and is highly expressed in nodules. To evaluate GmLBD5's role in Sulfur deficiency, we grew soybeans in a hydroponic system under both normal and reduced Sulfur conditions. The expression of GmLBD5 and its duplicate paralog, GmLBD45, was measured in roots and nodule tissues under both Sulfur treatment levels. GmLBD5 overexpression and CRISPR/Cas9 knockout constructs targeting GmLBD5 and GmLBD45 were transformed from the soybean cultivar Williams 82. This study will deepen our understanding on how the GmLBD gene family responds to abiotic stresses, paving the way to future functional studies.

Keywords: Soybeans; Sulfur Deficiency; LBD genes; Abiotic Stress; Symbiotic Nodulation

Mentor(s):

Jianxin Ma (Agriculture); Chancelor Bart Clark (Agriculture); Leonie Marie Trabert (Agriculture)

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

Poster Presentation Abstract Number: 1246
Presentation Time: Session 2: 10:30am-11:30am

PURE-PD

Enhancing Plant Transformation through Agrobacterium tumefaciens

Life Sciences

Author(s):

Diallo Thomas†; Jing Huang*; Ana Maria Orjuela Rodriguez*

Abstract:

Agrobacterium tumefaciens is a bacterial pathogen that is extensively employed in plant transformation to manipulate genetic expression in plants. Because of its capacity to naturally infect plant wound sites, causing crown gall disease by delivering transferred (T)-DNA from bacterial cells into host plant cells. A. tumefaciens has gained notoriety for being an important and effective tool in the area of plant transformation, allowing scientists to change genetic characteristics and generate more desired gene products. However, A. tumefaciens is not perfect therefore faces some limitations. One major limitation is A. tumefaciens's low transformation efficiency. As a result, it can be time consuming and financially draining for many researchers and labs, that instead of having to transform a few explants to receive successfully transformed plants must instead transform many explants only to still get a few successfully transformed plants. Another challenge is genotype-dependent regeneration, which limits existing application procedures to a small number of model species or crop types. Some plant species are also resistant to A. tumefaciens infection and T-DNA integration, a condition known as recalcitrance, which presents significant challenges for basic research and agricultural development efforts. The two major factors that influence recalcitrance are the type of plant tissue and strain of A. tumefaciens used for infection. The primary goal of this project is to improve and optimize tissue culture conditions in select plant species in Dr. Zhang's lab. To accomplish this, many skills were required, including the preparation of various basal medias, colony PCR, RNA extraction, and flow hood operation.

Keywords: [no keywords provided]

Mentor(s):

Cankui Zhang (Agriculture); Hannah Elizabeth Levengood (Agriculture)

Other Acknowledgement(s):

Samantha Barker; Juliana Miranda Rodriguez

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

Poster Presentation Abstract Number: 1247
Presentation Time: Session 2: 10:30am-11:30am

PURE-PD

Investigating Protein Interactions in Agrobacterium-Mediated T-DNA Integration

Life Sciences

Author(s):

Demi White†

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Stanton B Gelvin (Science)

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Poster Presentation Abstract Number: 1248
Presentation Time: Session 2: 10:30am-11:30am

PURE-PD

Investigating the contribution of proteotoxicity to juglone's mechanism of action

Life Sciences

Author(s):

Esperanza Zambrano†

Abstract:

Juglone is the phytotoxic allelochemical released into the soil by the black walnut tree (Juglans nigra). After being taken up by nearby susceptible plants, juglone causes oxidative stress through redox cycling. It remains unknown whether juglone's propensity to react with nucleophiles, including thiol groups in cysteine residues, also contributes to juglone's allelopathic mechanism of action.

Previous work in the Widhalm lab demonstrated that juglone binds to thiol groups of cysteine residues in glutathione and the enzyme urease. Moreover, Arabidopsis plants increase expression of NAC53 and NAC78 upon exposure to juglone. These transcription factors are major regulators responsible for activating the proteosome, the enzyme complex that breaks down misfolded proteins. We are using a combination of nac53/nac78 knockout mutants, which are unable to activate their proteosome, and in vitro enzyme assays from Arabidopsis root protein extracts, to test our hypothesis that juglone broadly inhibits cellular enzyme activities and that the proteasome stress regulon is necessary to respond to juglone stress. We are also investigating other structurally similar allelochemicals for their ability to induce proteotoxicity by monitoring the expression of NAC transcription factors using qPCR. These experiments will expand our knowledge on the biochemical mechanism of action of juglone and other allelochemicals, which facilitate many plant-biotic interactions.

Keywords: Juglone; Proteotoxicity; Allelopathy; Proteasome; 1,4-naphthoquinone

Mentor(s):

Joshua R Widhalm (Agriculture); George W Meyer (Agriculture)

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Poster Presentation Abstract Number: 1249
Presentation Time: Session 2: 10:30am-11:30am

SCARF

Enzymatic treatment of hemp for highly functional plant-based meat ingredient in commercial manufacturing.

Life Sciences

Author(s):

Minghao He† (Agriculture)

Abstract:

Hemp cake, a byproduct from hemp oil extraction, is rich in protein and dietary fiber but currently holds low commercial value. Preliminary data also shows that hemp cake compared to soybeans, is higher in fiber, lower in anti-nutrients and allergenicity. This project aims to develop high-quality hemp-based ingredients for plant-based meat products with great nutritional benefits and functionality. Cold extrusion and enzymatic technologies are applied to solubilize the insoluble dietary fiber and reduce phytic acid content. Hemp cake produced as a byproduct of hemp oil production was obtained from IND Hemp. Cellulase, xylanase, and pectinase were used to solubilize the insoluble dietary fiber found in hemp grain. Samples hydrated and then extruded on a Krupp Werner and Pfleiderer ZSK-25 co-rotating twin screw extruder. Plant based meat balls were produced to evaluate end-product quality by texture analysis. The enzyme treatments did not greatly impact the total protein content of the hemp cake. The extrusion of the hemp material was impacted by the enzyme treatment. It was determined that the extrusion was improved when the hemp cake was treated with pectinase. The extruded hemp products had a dark color and a soft texture. Further work will be conducted to characterize changes in dietary fiber content, amino acid profiles, and protein digestibility in the enzyme treated and extruded samples. This meat analog product is not only nutritionally sound, but also adds value to an existing byproduct, promoting sustainability in food production and supporting the hemp industry.

Keywords: [no keywords provided]

Mentor(s):

Senay Simsek (Agriculture)

Other Acknowledgement(s):

Kristin Lynn Whitney; Elise Christine Whitley

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

Poster Presentation Abstract Number: 1250
Presentation Time: Session 2: 10:30am-11:30am

SROP

Screening Human Microbial Communities for Genotoxic Hydrogen Sulfide Production

Life Sciences

Author(s):

Sarah Hong†

Abstract:

Hydrogen sulfide (H2S) is a genotoxin produced by sulfidogenic bacteria, and triggers hyperproliferative and proinflammatory pathways. This bacterial derived gas may be a mechanism of colorectal cancer (CRC), which is the second leading cause of cancer death world-wide. Furthermore, an abundance of sulfidogenic bacteria in the colonic mucosa are associated with CRC incidence rates in Black Americans. The intake of dietary fat and cysteine are positively associated with genes for sulfur metabolism. Dietary cysteine is prevalent in Black Americans as they consume more animal fat and red meat. Therefore, it is crucial to identify the link between H2S composition and risk of CRC by discovering if dietary cysteine intake is utilized by cysteine-metabolizing bacteria for the promotion of colonic inflammation and tumor formation. Thus, fecal H2S concentrations are examined by utilizing a colorimetric assay that turns black in the presence of H2S. Colonic microbes were separated from one gram of stool and inoculated into Sulfur, Indole, Motility (SIM) Medium. The formation of a black precipitate was detected with measurements of the optical density (OD) every hour thereby determining H2S production and growth potential. The fecal sample turned black. Additionally, the increase of OD is likely due to the black color formation. Overall, the assay has been successfully validated by using both human stool and a bacterium that is known to create H2S. These outcomes lay the groundwork for future studies to establish causality. This may lead to pharmaceutical and dietary interventions aimed at reducing H2S producing bacteria to prevent CRC.

Keywords: Hydrogen Sulfide; Colorectal Cancer; Sulfidogenic Bacteria, Sulfide/Sulfite; Cysteine; Colonic Microbiome

Mentor(s):

Patricia Marie Wolf (HHS); Jellie Moore Snyder (Agriculture)

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

Poster Presentation Abstract Number: 1251
Presentation Time: Session 2: 10:30am-11:30am

Structural and Computational Biology and Biophysics REU

Structural characterization of a novel stapled peptide inhibitor bound to the BAM complex

Life Sciences

Author(s):

Jesus Noriega†

Abstract:

The world is facing a global health crisis as antimicrobial resistance has decreased the effectiveness of current antibiotics. Both gram-negative and gram-positive bacteria have defense mechanisms against most antibiotics. However, the outer membrane (OM) of gram-negative prevents antibacterial compounds from reaching their intracellular targets and hinders the discovery of new antibiotics. The OM is composed of outer membrane proteins (OMPs) which serve as unique virulence factors, making them promising targets for new therapeutics. One such target is the beta-barrel assembly machinery (BAM) complex, which itself is responsible for OMP biogenesis. In E. coli, the BAM complex is composed of five components, BamA-E. BamA is the central and essential component of the complex and is highly conserved among gram-negative bacteria, making it a promising target for the discovery of new antibiotics. Recently, a new inhibitor called darobactin A was found to bind to the barrel domain of BamA and block substrate binding. In this project, we are characterizing an in silico designed stapled peptide called X2W7, which has also been shown to inhibit BAM-mediated OMP biogenesis in MIC assays. The goal of this study is to determine the cryo-EM structure of E. coli BAM in complex with X2W7, which will enhance our understanding of the peptide's binding properties and potential as a drug target. The long-term goal is to determine the effectiveness of X2W7 against bacteria listed by the WHO as critical and urgently needing new antibiotics due to multidrug resistance.

Keywords: [no keywords provided]

Mentor(s):

Nicholas Noinaj (Science); Nourin Ferdausi (Science)

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Poster Presentation Abstract Number: 1252
Presentation Time: Session 2: 10:30am-11:30am

Structural and Computational Biology and Biophysics REU

Mapping Local Resolution to Coordinates

Mathematical/Computation Sciences

Author(s):

Angel Ortiz†

Abstract:

Throughout the summer, I focused on developing a Python script to enhance structural biology analysis by mapping local resolution from cryo-EM local resolution maps to modeled coordinates. The project involved processing Protein Data Bank (PDB) and Electron Microscopy Map (MRC) files to generate a new PDB file that includes local resolution as the value in the B-factor column.

The developed script addresses the need for detailed local resolution information, which is crucial for understanding the variability in resolution within a model built from electron microscopy density maps. By integrating this data directly into PDB files, researchers can more accurately interpret structural data and improve the quality of model building.

Our approach involves parsing the input PDB and MRC files, calculating the local resolution at each coordinate, and appending this information to output a new PDB file. This new file format allows seamless integration with existing visualization and analysis tools, facilitating more precise and informative structural interpretations.

Preliminary tests demonstrate that our script efficiently processes large datasets and accurately reflects local resolution variations. This tool promises to be a valuable asset for the structural biology community. We hope to make it available to other labs soon, both as a script as well as a web-service.

Keywords: [no keywords provided]

Mentor(s):

Ramaswamy Subramanian (Centers & Institutes)

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

Poster Presentation Abstract Number: 1253
Presentation Time: Session 2: 10:30am-11:30am

Structural and Computational Biology and Biophysics REU

Evaluating software for G-quadruplex prediction

Life Sciences

Author(s):

Nicholas Paredes†

Abstract:

G-quadruplexes (G4s) are DNA secondary structures formed in guanine-rich genomic regions. G4s are enriched in human telomeres and oncogene promoters, where they play important roles in genomic stability and transcription. G4s are therefore attractive targets for anticancer drugs. To find new genomic G4s, software has been developed to predict if DNA sequences can form G4s, which can then be experimentally assessed. However, it is unclear which software is best, regarding performance and usability. Herein, I compared three different software for their predictive capabilities: pqsfinder, G4Hunter, and G4mismatch. I tested software with a publicly available dataset of 392 experimentally validated sequences, including 298 G4-forming sequences (positives) and 94 non-G4-forming sequences (negatives). Using each software's default settings, I determined their accuracy, precision, recall, and false discovery rate (FDR). G4Hunter has the highest overall accuracy and recall but the lowest precision. pqsfinder has the highest precision but the lowest accuracy and recall. G4mismatch has intermediate accuracy, precision, and recall. All FDRs are <5%. Predictive scores are significantly greater ($P<0.001$) for G4-forming sequences than non-G4-forming sequences for all software. All false positives have above-average guanine content, indicating that guanine overabundance in non-G4-forming sequences can lead to false positive predictions. The percentages of false negatives containing either double-guanine tracts or long nucleotide loops are >80% across all software, meaning that these features may lead to false negative predictions. G4Hunter and G4mismatch have better usability with large datasets than pqsfinder. Based on its accuracy and recall, as well as its usability, G4Hunter outperforms the other software.

Keywords: G-quadruplex; Bioinformatics; Structural Prediction

Mentor(s):

Danzhou Yang (Pharmacy)

Other Acknowledgement(s):

Yichen Han; Sarah Dagher; Jonathan Dickerhoff

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

Poster Presentation Abstract Number: 1254
Presentation Time: Session 2: 10:30am-11:30am

Structural and Computational Biology and Biophysics REU

In vitro Structural Characterization of the Secreted Brucella protein VceC (VirB coregulated effector C) reveals Diverse Multimeric States

Life Sciences

Author(s):

Shaye Ross†

Abstract:

The metazoan unfolded protein response (UPR) is an integrated signaling network initiated within the endoplasmic reticulum (ER) that regulates proteostasis in response to misfolded proteins. Previously, the Mattoo lab established the sole human FIC (filamentation induced by cyclic AMP) protein HYPE (Huntingtin-yeast Partner E) as a key regulator of UPR. HYPE modifies the HSP70 chaperone BiP/GRP78 via reversible adenylylation/AMPylation (adds AMP moiety), which affects BiP’s ATPase activity and subsequent ability to fold misfolded proteins.

Several insults, including infection by the bacterial pathogen Brucella abortus, are known to induce the mammalian UPR. B. abortus secretes an effector protein, VceC (VirB Co-regulated Effector C), via its Type IV secretion system that induces UPR, a process integral to Brucella’s ability to colonize the mammalian ER lumen. VceC is a membrane-tethered protein facing the ER lumen and has been suggested to interact with BiP based on pulldown experiments using cellular lysates. However, the exact mechanism and the role of UPR activation during Brucella infection is not understood.

To address our gap in knowledge, we have used different biochemical and biophysical techniques to study VceC's structure, function, and potential interactions with BiP and HYPE. Using bacterially expressed and affinity purified VceC, we find that its expression in E. coli induces toxicity. Further, size exclusion chromatography and mass photometry indicate that VceC exists in multimeric states, none of which bind directly to BiP. Instead, we find a strong interaction with HYPE. Collectively, our data challenge the idea of a direct VceC-BiP interaction and provide new insights into VceC’s toxicity and stoichiometry, which may influence its role in manipulating ER stress.

Keywords: VceC; HYPE; Unfolded Protein Response; Endoplasmic Reticulum; Brucella Abortus

Mentor(s):

Seema Mattoo (Science); Ben G Watson (Science)

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

Poster Presentation Abstract Number: 1255
Presentation Time: Session 2: 10:30am-11:30am

SURF

Investigation of the Formation of Fracture Intersection Geometry

Physical Sciences

Author(s):

Ozan Altuntas† (Engineering)

Abstract:

Many subsurface engineering applications such as geothermal energy production rely on the connectivity of fracture networks that depends on how fractures intersect. Two outstanding questions are how two fractures intersect and what determines the void geometry of the intersection that ultimately controls connectivity. Here, we study the induced fracture propagation path in analogue rock samples that contain a single pre-existing fracture and the subsequent intersection geometry that is formed. X-ray computed tomography is used to non-destructively observe and characterize fracture intersection formation and geometry (i.e. void space, contact area). Three-point bending (3PB) tests were performed in a Deben CT5000 in-situ uniaxial stress rig in a 3D X-Ray Microscope (Zeiss Xradia 510 Versa) to enable 2D X-ray imaging of 3-D printed gypsum (3D Systems, ProJet CJP 360, layer thickness 100 µm) and alumina (Formlabs, Form 3, layer thickness 50 µm) samples during failure. The geometry of the samples was designed to determine if an intersection would preferentially occur in void regions or contact areas of the pre-existing fracture. 3D X-ray scans were also performed prior to and after the 3PB tests to provide 3D reconstructions of the intersection region. The effect of pre-existing fractures versus an array of cracks, and mixed mode loading on intersection geometry were also examined. The results of this study will aid the development of numerical methods to predict fracture intersections geometry based on stress at the crack tip of fractures, the structure of pre-existing fractures and intersection angle.

Keywords: Geophysics; Additive Manufacturing; X-Ray Computed Tomography; Fracture Intersections; 3-Point Bending Test

Mentor(s):

Laura J Pyrak-Nolte (Science); Alexandra Blair Clark (Science)

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

Poster Presentation Abstract Number: 1256
Presentation Time: Session 2: 10:30am-11:30am

SURF

Evaluation of Flammability Mitigation in Lithium-Ion Batteries Using Phosphorous-Based Electrolyte Additives

Physical Sciences

Author(s):

Ishaan Breinig† (Engineering)

Abstract:

[Abstract Redacted]

Keywords: Lithium-Ion Battery; Thermal Runaway; Electrolyte Additive; Flammability; Self-Extinguishing Time & Flash Point

Mentor(s):

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Poster Presentation Abstract Number: 1257
Presentation Time: Session 2: 10:30am-11:30am

SURF

Synthesis and Study of Magnetic Properties of Ytterbium Based Delafossites and Performing Rietveld Refinement

Physical Sciences

Author(s):

Piyush Dnyaneshwar Chhallare† (Science)

Abstract:

The exploration of ytterbium-based delafossites, a group of compounds that exhibit a S=1/2 spin state at low temperatures, is driven by their potential as Quantum Spin Liquid (QSL) candidates. These compounds do not have long-range magnetic ordering, making them intriguing subjects for study of quantum spin liquid. Despite their potential, the confirmation of these compounds as QSL candidates remains a challenge. This is due to the complexity of their synthesis and the difficulty in characterizing their properties. To tackle this problem, the compounds are synthesized in two forms: poly-crystalline (powder) and single crystal. Magnetic property measurements are conducted at various low temperatures to study their behavior. Additionally, X-Ray diffraction is performed on these compounds, and the data collected from the experiment is refined using the Rietveld method. This refinement enhances the understanding of the phase purity of the polycrystalline compound. The data collected provides valuable insights into the properties of these compounds. The study of these ytterbium-based delafossites as QSL candidates opens up possibilities for theoretical prediction of other QSL candidates and their properties. This work contributes to the broader understanding of quantum physics and the exploration of quantum spin liquids.

Keywords: Delafossites; QSL; X-Ray Diffraction; Quantum Physics

Mentor(s):

Arnab Banerjee (Science); Bishnu Prasad Belbase (Science)

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

Poster Presentation Abstract Number: 1258
Presentation Time: Session 2: 10:30am-11:30am

SURF

The Effects of Cyclic Moment Loading on Concrete Foundations with Post-Installed Anchor Groups

Physical Sciences

Author(s):

Jacob Daniel† (Engineering|JMHC)

Abstract:

Concrete anchors, which allow structural and nonstructural elements to be attached to concrete, are vital in modern architectural design and are found in many common structures such as light pole fixtures, column-to-foundation connections, and facade installations. Due to these fasteners being developed relatively recently compared to more established construction methods, their behavior in certain situations still needs to be fully understood. This research aims to understand how concrete anchors and the foundation they are attached to behave when experiencing cyclic uniaxial moment loading. Various experiments were conducted to determine the performance of the anchors including load-displacement behavior and failure mode/crack pattern. The varied parameters include the distance from the edge of the concrete slab, the starting displacement direction, and anchor embedment depth. In addition, a corresponding static loading test was performed to allow for a comparison of static versus cyclic loading. Preliminary analysis shows the load capacity can decrease by up to 18% and the displacement at the peak load can decrease by up to 45% due to cyclic loading. These results will allow architects and engineers to better determine the effects that seismic loads can have on a structure. Further work involves conducting extensive numerical analysis and small-scale testing to characterize the influence of different parameters on the moment capacity such as anchor diameter, depth, and spacing.

Keywords: Concrete Anchorage; Cyclic Moment Loading; Seismic Loading

Mentor(s):

Gaurav Somnath Chobe (Engineering)

Other Acknowledgement(s):

Akanshu Sharma

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

Poster Presentation Abstract Number: 1259
Presentation Time: Session 2: 10:30am-11:30am

SURF

Micro- and Nano-Precision Testing On Low Temperature Solders

Innovative Technology / Entrepreneurship / Design

Author(s):

Rishipreet Singh Dhir† (Engineering)

Abstract:

One of the leading problems in microelectronics is the assembly of components and their reliability with solder joints. Solder is frequently used to join components electrically and mechanically in electronic packaging. However, frequent mechanical cracking at the solder joints occurs, leading to mechanical failure. This research is crucial as it improves microelectronics, enabling smaller, lighter components for efficient products like cell phones and medical devices through modern material manufacturing. This research aims to understand the use of viscoplastic materials for better failure mode and its reliability in electronic packaging. Viscoplastic materials exhibit time-dependent strain which help in examining the shear stresses during various fatigue, creep and monotonic testing conditions. The research involves characterizing solders through fatigue testing and constitutive modeling. Fatigue testing involves applying a load profile resembling real-world conditions to assess durability, number of cycles to reach failure, low-melting point eutectic solder alloys in various testing conditions. Alternatively, constitutive modeling predicts stress-strain responses under various load conditions, typically through monotonic and creep tests. The research analyzes the shear strain over time and creates a damage accumulation model that considers material responses based on current and prior loading. Analysis of these results helps us understand what composition of materials work best for microelectronics, microstructural complexity, and complex rate-dependent mechanical behavior. Further research is required in creating a better temperature-controlled environment, tooling fixtures for less error propagation and simultaneous testing conditions for micro and nano precision testers to allow ease of repeatability and larger dataset for analysis of solder sample.

Keywords: Viscoplastic; Fatigue Testing; Microelectronics; Electronic Packaging; Solder Joints

Mentor(s):

Sean Yenyu Lai (Engineering); David Neal Halbrooks (Purdue University)

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

Poster Presentation Abstract Number: 1260
Presentation Time: Session 2: 10:30am-11:30am

SURF

Nanoscale 3D Printing using Two-Photon Lithography for Biomedical and Electronic Applications

Physical Sciences

Author(s):

Jack Rearden Ferlazzo† (Engineering|JMHC)

Abstract:

[Abstract Redacted]

Keywords: Nanoprinting; Two-Photon Lithography; Multi-Photon Lithography; Submicron Features; Projection Printing

Mentor(s):

Anwarul Islam Akash (Engineering); Xianfan Xu (Engineering); Jason Johnson (Engineering); Ishat Raihan Jamil (Engineering)

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

Poster Presentation Abstract Number: 1261
Presentation Time: Session 2: 10:30am-11:30am

SURF

Testing and Validation of High-Efficiency Hydraulic System for Off-Road Vehicles

Innovative Technology / Entrepreneurship / Design

Author(s):

Nicolas Giesemann† (Engineering)

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Andrea Vacca (Engineering); Timir Rajendra Patel (Engineering)

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

Poster Presentation Abstract Number: 1262
Presentation Time: Session 2: 10:30am-11:30am

SURF

Investigating fibroblast response to porous hydrogel implantation in a mouse model of volumetric muscle loss.

Life Sciences

Author(s):

Kyle Jeffery Heaton† (Engineering|JMHC)

Abstract:

Volumetric muscle loss (VML) injuries are highly prevalent and often result in fibrotic scarring that reduces muscle function and compromises quality of life. Although many biomaterial therapies have been developed to treat VML, an understanding of how biomaterial features affect endogenous fibroblast activation and matrix deposition remains unexplored. One challenge lies in identifying fibroblasts in preserved tissue sections. It has been reported that alpha-smooth muscle actin (?-SMA), a well-known marker of activated fibroblasts in other tissues, does not accurately stain muscle-resident fibroblasts. To address this, we qualitatively and quantitatively compared the presence of fibroblasts stained with either alpha smooth muscle actin (?-SMA) or platelet-derived growth factor receptor alpha (PDGFRA) in bulk or porous hydrogels implanted into a mouse tibialis anterior VML defect. PDGFRA is a well-known marker for muscle-resident fibro/adipogenic progenitor cells (FAPs), a cell type believed to play a role in muscle fibrosis after injury. Muscle cryosections were processed using an optimized immunohistochemistry protocol. Additionally, the samples were visualized using fluorescence microscopy and the image processing tool ImageJ. Our data revealed fibroblast integration into the granular hydrogel injury models; as well as, a difference in staining abundance between ?-SMA and PDGFRA revealing a difference in identified staining elements. Our findings demonstrate the importance of antibody selection to stain for fibroblasts during muscle repair. Future work will correlate fibroblast presence with collagen staining to determine patterns of fibrosis around or within implanted biomaterials.

Keywords: Volumetric Muscle Loss; Biomaterials; Immunohistochemistry; Fibrosis; Antibodies

Mentor(s):

Taimoor Hasan Qazi (Engineering)

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

Poster Presentation Abstract Number: 1263
Presentation Time: Session 2: 10:30am-11:30am

SURF

Smart PV and Battery Control at the Purdue DC Nanogrid House

Innovative Technology / Entrepreneurship / Design

Author(s):

Liam Q Johnson† (Engineering); Lokesh Sriram* (Engineering); Benjamin Garrett Drillings*; Levi Darian Reyes Premer* (Graduate)

Abstract:

The modern AC electrical macrogrid struggles with a variety of challenges, namely increasing energy demands, overreliance on nonrenewables, and power losses due to long-distance transmission and endpoint AC to DC rectification. This can make the grid unstable and unsustainable. To combat these issues, this research aims to design and test a DC “nanogrid” semi-isolated from the macrogrid which operates on renewables and prevents rectification losses when possible. To accomplish this, the design of the DC House nanogrid will be updated and communication between the house’s solar PV system, battery, and other intermediate devices will be established. A DC-DC converter will be installed to control battery charging/discharging, and a programmable logic controller (PLC) will be used to implement smart controls along with programming software. Implementing smart controls with the PV and battery will increase the energy efficiency of the house significantly, providing a cost-effective source of renewable energy which bolsters the DC nanogrid, making the house less grid-dependent in times of failure and over usage. This research shows that DC nanogrids with renewable energy sources can be retrofitted into residential homes, such as the 1920’s era DC Nanogrid house, making existing homes more sustainable and able to operate independently from the macrogrid for sustained periods of time. Further research will demonstrate the scalability of such nanogrid systems to a wide variety of homes in North America when designs are made more cost-effective and feasible.

Keywords: Nanogrid; Microgrid; Direct Current; Residential; Solar

Mentor(s):

Elias Nikolaos Pergantis (Engineering); Kevin James Kircher (Engineering)

Other Acknowledgement(s):

Aaron Harron Patrick Farha

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

Poster Presentation Abstract Number: 1264
Presentation Time: Session 2: 10:30am-11:30am

SURF

Machine Learning Support for Semiconductor Nanodevice Design

Innovative Technology / Entrepreneurship / Design

Author(s):

Xu Lu† (Polytechnic); Spasko Aleksov* (Engineering); Benjamin Charles Miller* (Engineering)

Abstract:

Device simulations play a major role in the 21st Century electronics industry. The continuous miniaturization in the Moore’s law era has driven semiconductor R&D engineers towards nanodevices with atomic-scale dimensions, necessitating quantum mechanical simulation tools for reliable predictive modeling. This research focuses on simulations being computationally expensive for larger materials, utilizing the mode space approach for basis reduction. To alleviate the limitation of the high cost of nanodevice simulation in quantum mechanical and atomic resolution, this research aims to de velop a machine learning algorithm based on device-specific basis representations that can apply low rank approximations to reduce the simulation costs. In the initial phase, we generate basis representations from band structure calculations using Purdue’s quantum code library, NEMO5, on semiconductor nanowire structures. This data is initially assessed by the human eye for quality. Once a sufficient number of data sets is available, a machine learning model will be trained to reproduce basis representations first with the quantum code and later from the device structure directly. Simulation results indicate that it is feasible to predict accurate data for developing nanoscale transistors. After the ML model is developed and preliminary tested, various optimization techniques are applied to ensure the strength of the machine learning algorithm. Stress tests will be performed to evaluate the validity and to inform any required modifications based on outliers. This research aims to create a sufficiently large database of device- specific basis representations to train an AI to run the quantum code library tools fully automatically and predict basis representations without any tools involved. Further improvements will expand the applicability of our ML algorithms to a broader range of nanoscale devices.

Keywords: Machine Learning; NEGF; NEMO5; Mode Space; Semiconductors

Mentor(s):

Logan Jacob Melican (Engineering)

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

Poster Presentation Abstract Number: 1265
Presentation Time: Session 2: 10:30am-11:30am

SURF

Auto Retrieval of Specific Cows from Unlabeled Videos

Mathematical/Computation Sciences

Author(s):

Jiawen Lyu† (Science)

Abstract:

Video analytics has the potential to analyze animal behavior and identify individual cows. Retrieving all relevant video clips for each cow from unlabeled videos using cow recognition enables us to monitor individual cows. This research aims to develop a system that can effectively find all video clips for each cow from videos recorded in commercial settings. Original side-view and top-view videos, collected from January to April 2024, are taken from two cameras at a dairy farm. A deep-learning model is applied to the top-view videos to create a catalog (cattlog) storing each cow's coat pattern represented by bit vectors. The system compares each cow's coat pattern in the unlabeled top-view videos with each coat pattern in the cattlog to identify each cow. The system records the moments when a cow enters and leaves the camera view as the start and end times, respectively. Using this information, the system segments the unlabeled videos to generate all relevant video clips for each cow. We test the system for the accuracy of identification predictions and the proportion of specific cows of interest that are successfully found. The proposed system enables better monitoring of specific cows, facilitating analysis of health conditions and behaviors.

Keywords: [no keywords provided]

Mentor(s):

Amy R Reibman (Engineering); Manu Ramesh (Engineering)

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

Poster Presentation Abstract Number: 1266
Presentation Time: Session 2: 10:30am-11:30am

SURF

Improving malware detection tools

Mathematical/Computation Sciences

Author(s):

Karla Erendira Obermeier Velazquez†

Abstract:

The attack on XZ Utils highlighted the critical importance of security in the software supply chain.It underscored the need for implementing stricter security controls, such as more rigorous code reviews, multi-factor authentication for repository access, and the use of automated malware detection tools to prevent the introduction of malware into open-source packages.The lack of empirical studies evaluating tools for detecting malware in the original source code and Linux package binaries is an outstanding problem and needs to be tackled.The study will involve evaluating various malware detection tools, such as Bandit4mal, Guarddog, and ClamAV, both in source code and binaries. The research aims to fill this gap by assessing the performance of these tools in identifying malware. This research will provide valuable insights for improving product security decisions and will significantly contribute to the field of cybersecurity, offering new perspectives on how to detect and prevent the inclusion of malware in open-source packages before their incorporation into Linux distributions.

Keywords: Malware; Open-Source; Software Supply Chain; Security

Mentor(s):

Santiago Torres Arias (Engineering)

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

Poster Presentation Abstract Number: 1267
Presentation Time: Session 2: 10:30am-11:30am

SURF

AI-powered data analysis and automation for smart manufacturing

Innovative Technology / Entrepreneurship / Design

Author(s):

Vidit Hemal Patel† (Science|JMHC)

Abstract:

In recent years, advancements in Internet of Things (IoT) and Artificial Intelligence (AI) have significantly boosted interest in smart manufacturing. This has led to increased use of Computer Numerical Control (CNC) machines, which can be automatically controlled by a computer. However, automated monitoring of these machines remains a significant challenge. To address this issue, we propose a real-time monitoring system that analyzes the sound signals emitted by the machines using a Convolutional Neural Network (CNN). To test this hypothesis, we installed a sound sensor at the base of a 16-cylinder shaft grinding machine, capturing sound signals over a 90-minute period during which the machine completed seven different grinding cycles. Mel-spectrograms were generated for each cycle and analyzed. We labeled different segments of the spectrograms into distinct classes, such as Grinding, Running, Idle and Rapid-movement, creating a labeled dataset for training the CNN. We then trained three models: one classifying Grinding, Running, and Rapid-movement; another distinguishing between Grinding and Running; and a third classifying Grinding, Running, and Idle states. Due to the limited amount of data available for Rapid-movement class, the first model lacked accuracy, but the other two models accurately predicted the activities they were trained to recognize. These results demonstrate that sound analysis using a CNN has significant potential for automation in machine monitoring. Potential applications of this research include enhanced machine maintenance, early fault detection, and improved operational efficiency. However, to fully realize this potential, further data collection is necessary to train the CNN model to classify a broader range of activities accurately, and more extensive testing of the model is required.

Keywords: Convolutional Neural Network; Data Analysis

Mentor(s):

Martin Byung-Guk Jun (Engineering)

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

Poster Presentation Abstract Number: 1268
Presentation Time: Session 2: 10:30am-11:30am

SURF

Simulation of Membrane Deflection Response to Temporally Impulsed Optical Pressure

Physical Sciences

Author(s):

Carolyn Sun†

Abstract:

The field of optomechanics is the study of the mechanical properties of light. Diverse optomechanical applications range from efficient switching in optical communication systems to precision control techniques and novel methods for probing single-protein dynamics with optical tweezers. The development of useful optomechanical devices requires accurate models of the underlying physics, where the mechanical response of a system to optical forces is fully described. However, there have been historical discrepancies regarding the theoretical considerations of the mechanical properties of light. Results from cornerstone optomechanical experiments conducted by Ashkin and Dziedzic, as well as by Jones and Leslie, provided a macroscopic understanding of incident radiation pressure. These findings contributed to a partial consensus that the Einstein-Laub electromagnetic force density formulation accurately predicts key, albeit limited, experimental observations. This lack of experimental data motivates the development of panoptic simulation tools for validation and experimental design purposes. Prior approaches primarily focused on the deflection of a thin membrane under only a constant, single frequency pressure source. This project presents an alternative model that simulates membrane responses to a pulsed pressure source with specified spatial and temporal profiles. We model the membrane mechanical response with a two-dimensional partial differential equation. Decomposition of the spatial profiles of the pressure and membrane response into orthogonal spatial modes allows treatment of the motion as a sum of uncoupled damped harmonic oscillators; the temporal profile is treated as a series of infinitesimal impulses. This dynamic forward model for membrane motion in response to electromagnetic stimuli will assist in future optomechanical experiment design and interpretation of data.

Keywords: Optomechanics; Membrane Vibration; Optical Pressure; Pulsed Laser; Forward Dynamic Simulation

Mentor(s):

Kevin J Webb (Engineering); Adam Winston Behnke (Engineering); Thomas J Pollei (Engineering)

Poster Presentation Abstract Number: 1269
Presentation Time: Session 2: 10:30am-11:30am

SURF

Evaluating the Use of LiDAR Traffic Data for Assessing Infrastructure

Mathematical/Computation Sciences

Author(s):

Andrew Joseph Thompson† (Science); Vihaan Vajpayee* (Science)

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Enrique Daniel Saldivar Carranza (Engineering); Darcy M Bullock (Engineering)

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

Poster Presentation Abstract Number: 1270
Presentation Time: Session 2: 10:30am-11:30am

SURF

Interfacial Phase Behavior and Growth of Hexagonal Phase in Concentrated Lamellar Sodium Laureth Sulfate Solution and Cetostearyl Alcohol Crystal

Physical Sciences

Author(s):

Evan R Williams† (Engineering)

Abstract:

Cetostearyl fatty alcohol is a common additive to consumer products due to its emulsifying abilities improving rheological properties and allowing for a wide range of solubility, however, little research has been done investigating the interactions of cetostearyl alcohol and concentrated aqueous surfactants. The interfacial phase interaction between heterogeneously mixed crystals of cetostearyl fatty alcohol and concentrated aqueous lamellar surfactant solutions was analyzed. A hexagonal liquid crystal phase was observed when a single cetostearyl fatty alcohol crystal was heated to 85°C when surrounded by 72 weight percent lamellar sodium lauryl ether sulfate aqueous solution. Cross polarized light microscopy, dynamic scanning calorimetry, and small angle x-ray scattering were used to analyze the phases present and the growth rate of the hexagonal phase. The effects of bilayer alignment through preshear and annealing before heating and gap size on the hexagonal growth rate were investigated. It was found that under normal conditions with a gap size of 400 µm the hexagonal phase had a linear growth rate of 2.7 µm/min.

Keywords: Surfactant; Interface; Phase

Mentor(s):

Matthew Kaboolian (Engineering); Kendra A Erk (Engineering)

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

Poster Presentation Abstract Number: 1271
Presentation Time: Session 2: 10:30am-11:30am

Bed Adhesion Testing of Industrial Scale 3D Printed Materials

Physical Sciences

Author(s):

Alexander Douglas Carlson† (Engineering|JMHC)

Abstract:

[Abstract Redacted]

Keywords: 3D Printing

Mentor(s):

Eduardo Barocio Vaca (Engineering)

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

Poster Presentation Abstract Number: 1272
Presentation Time: Session 2: 10:30am-11:30am

The investigation and optimization of MIP-based PFAS sensing across sample matrices

Physical Sciences

Author(s):

Keeley Vonne Farmer† (Science)

Abstract:

Per- and polyfluoroalkyl substances (PFAS) are a long-lasting, widely used chemical class known for its environmental harm and potentially adverse health effects. Addressing these environmental and health concerns necessitates the development of a sensitive, reliable, and rapid method of PFAS detection. Electrochemical sensing via molecularly imprinted polymer (MIP) modified electrodes presents a promising approach to PFAS detection. MIP-based sensors detect PFAS by measuring the current proportional to the concentration of target PFAS molecules as they associate with template-extracted cavities in the polymer. However, these sensors, like many others, are plagued with interferent effects, making their relevant use in environmental samples challenging. Here, we show an approach that potentially accounts for the complex matrices of environmental samples through a ratiometric comparison by using a known sample that mimics the complex sample matrix minus the analyte of interest. The present study investigates the dependability of the MIP-based sensing of two types of PFAS, perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA), across fluorinated and non-fluorinated counterparts, pH-buffered and non-pH-buffered, and tap water and Milli-Q water sample matrices.

Keywords: Sensor; PFAS; Environmental; Interferent; MIP

Mentor(s):

Jeffrey Edward Dick (Science); Dane Christophe Wagner (Science); Mobina Masdari (Science)

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

Poster Presentation Abstract Number: 1273
Presentation Time: Session 2: 10:30am-11:30am

Silver leakage in commercially available and bipolar reference electrodes (BPREs): a TNBC toxicity study

Life Sciences

Author(s):

Sadie A Poirier† (Science|JMHC); Yashvi Choudhary‡ (Science); Megan Leigh Hill* (Graduate); Keeley Vonne Farmer* (Science)

Abstract:

The silver chloride (AgCl) reference electrode is widely employed in electrochemical and biological investigations due to its well-defined potential, cost-effectiveness, and lower toxicity when compared to mercury-containing electrodes such as the saturated calomel electrode. The commercially available AgCl reference electrode features silver wire in Cl- solution, with a porous frit at the base allowing ion exchange between sample solution into the reference electrode. However, this frit presents two substantial challenges: it limits the potential for miniaturization to the nanoscale, and it allows the leakage of silver and chloride ions into the sample solution.

Previous attempts have been made to address these issues while retaining the benefits of the AgCl reference electrode, such as the bipolar reference electrode (BPRE). The BPRE replaces the frit with a sealed conductive wire, minimising leakage and allowing for miniaturization. Although theoretically leakless, these BPREs have been shown to leak small quantities of silver ions into sample solution. This is an especially pressing issue at the nanoscale, particularly since silver is toxic to biological systems and can significantly impact studies involving cells or other biological materials.

In this study, we examined the impacts of continuous exposure of triple-negative breast cancer cells (TNBC) to commercially available reference electrodes and BPREs from 0 to 6 hours. Flow cytometry was used to assess cell viability after this incubation period.

Keywords: Electrochemistry; Cellular Biology; Toxicology

Mentor(s):

Vanshika Gupta (Science); Samuel Patrick Nortz (Science); Dane Christophe Wagner (Science)

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

Poster Presentation Abstract Number: 1274
Presentation Time: Session 2: 10:30am-11:30am

Investigating Leotiomycetes from Indiana Aquatic Ecosystems

Life Sciences

Author(s):

Bryan Reyes† (Science); Lane Bell‡ (Agriculture)

Abstract:

Leotiomycetes are a class of ecologically important fungi belonging to the phylum Ascomycota. They play a large role in plant mycorrhizal relationships, and, within aquatic ecosystems, they are important decomposers of organic litter. Although there are more than 75 recognized species in aquatic environments, the taxonomy of aquatic Leotiomycetes remains unresolved. Most aquatic Leotiomycetes species produce tetraradiate, helical, or highly-branched spores. Therefore, this study focuses on collecting spores from foam, organic litter, soil, and water samples from five aquatic sites - a large lake, a large river, a marsh, a pond, and a small stream - across the state of Indiana to isolate and culture Leotiomycetes from their spores. Samples were transported on ice and the organic litter was submerged in moist chambers to induce sporulation. Spores visualized under the microscope were transferred onto 2% malt extract agar and incubated in the dark at 18-20?. Approximately 40 pure isolates were obtained and their identity will be ascertained by sequencing similarity of the Internal Transcribed Spacer region (the fungal barcode locus) using blastn analysis against the NCBI GenBank database. In addition, 10 environmental samples were submitted for environmental sequencing (NGS) to assess the potential unculturable Leotiomycetes species. This research will provide additional sequences for aquatic Leotiomycetes species that can contribute to the resolution of relationships within the genera and class.

Keywords: Fungi; Spores; Taxonomy

Mentor(s):

Daniel B Raudabaugh (Agriculture); Jeffery Kirk Stallman (Agriculture); Mary Aime (Agriculture)

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

Poster Presentation Abstract Number: 1275
Presentation Time: Session 2: 10:30am-11:30am

Implementation of a Heat Recovery Chiller In A Solar Thermal Loop

Innovative Technology / Entrepreneurship / Design

Author(s):

Janessa M Rieser† (Polytechnic); Chaoyi Hu† (Polytechnic)

Abstract:

In an effort to decarbonize buildings, researchers are looking for new ways to reuse heat that would otherwise be rejected from air conditioning systems. This project focuses on the design and implementation of a heat recovery chiller for existing HVAC infrastructure in Purdue's Applied Energy Lab (AEL). In addition to cooling, the chiller provides supplemental heating to an existing solar thermal loop, greatly improving the overall Coefficient of Performance (COP) of the chiller. The research aspect of this project is developing and testing control strategies to ensure functionality during all types of weather-related heating and cooling scenarios. The heat recovery chiller provides heating or cooling on demand, but it has several modes of operation based on environmental variables. This project is an example of how thermally integrated HVAC equipment can help reduce fossil fuels used to operate modern commercial buildings. We would like to acknowledge the MET 421 students who worked on this project before us.

Keywords: HVAC; Heating; Cooling; Decarbonization

Mentor(s):

William Hutzel (Polytechnic); Ivan Arturo Nunez ferro (Polytechnic)

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

Poster Presentation Abstract Number: 1276
Presentation Time: Session 2: 10:30am-11:30am

Changes in soil properties in steep small watersheds

Physical Sciences

Author(s):

Shawn Saturday†

Abstract:

Steep cropland areas are prone to soil erosion if conservation practices are not implemented. In addition to sediment and nutrient losses, soil properties might change during soil erosion, including soil moisture content, pH, and electrical conductivity (EC), which are important soil properties in soil fertility. This study investigates the changes in the above soil properties in two steep watersheds in corn-soybean rotations in central Indiana. Two small watersheds, ~ 1 ha each, from Meigs farm (Purdue University), were located, and soil samples were collected ~ 50 m in a transect from the top to bottom of the hill. Soil samples were collected from the top to the bottom of the hill of each watershed at 0-5 cm depth. Soil pH and EC were measured after samples were 2-mm sieved and air dried. Soil moisture content was measured in situ in the top 5 cms using a time domain reflectometry (TDR) instrument. Preliminary data show that at the top 0-5 cm soil depth, pH, EC as well as the soil moisture are higher at the bottom of the hill. The results suggest that the soil properties measured in this study depend on the location of the soil. Thus, best management practices are needed to address these issues in steep cropland areas.

Keywords: [no keywords provided]

Mentor(s):

Javier M Gonzalez (Agriculture)

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

Poster Presentation Abstract Number: 1400
Presentation Time: Session 3: 12:00pm-1:00pm

CISTAR

Coke Formation on Catalysts

Physical Sciences

Author(s):

Errol B Alden†

Abstract:

Catalytic alkane dehydrogenation is key to the natural gas industry as it allows for natural gases to be converted to alkenes such as ethylene which is used as feedstock in production of many chemicals. Catalysts deactivate overtime because of the formation of coke on catalysts blocking active sites. Coke is formed as hydrogens are removed from an alkane and the alkane remains adsorbed to the catalyst surface instead of desorbing. However, while there is a general understanding of how coke forms, the direct aspects are unknown. Acetylene was used as the reactant as it is a single step away from coke and it can be done at a lower temperature effectively allowing the reaction to be done slower to acquire more early-stage information. Gas chromatography mass spectrometry (GCMS), and transition electron microscopy (TEM) tested the spent catalysts to determine coke precursors and surface of the spent catalyst. This study will compare the results from a Pt, PtIn, PtIn2, and Pt3In, synthesized using incipient wetness impregnation (IWI), to learn about the formation of coke. There is research about how catalyst composition impacts coke formation but not about coke formation. The data shows that as the ratio of platinum to indium increases the activity of the catalyst increases, and as activity increases the amount of coke precursors increases.

Keywords: Coking; Alkane Dehydrogenation; Catalysis; Bimetallic Nanoparticle

Mentor(s):

Joanna Marie Rosenberger (Science); Christina W Li (Science)

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

Poster Presentation Abstract Number: 1401
Presentation Time: Session 3: 12:00pm-1:00pm

CISTAR

Methane Dehydroaromatization of Synthesized Zeolite Templated Carbon to Access Thermal and Structural Stability

Physical Sciences

Author(s):

Kirshaun McGhee†

Abstract:

Non-oxidative methane to ethylene conversion occurs at high temperatures, using catalysts such as zeolite templated carbons (ZTC). Though ZTC is a good catalyst for non-oxidative methane to ethylene conversion, this reaction must occur at high temperatures, and ZTC is notable for decomposition at high temperatures. Our research aims to conduct a methane dehydroaromatization (MDA) experiment using synthesized ZTC and commercial zeolites faujasite (FAU), chabazite (CHA), and Beta (BEA) with molybdenum (Mo) under differing gas environments and temperature conditions. The initial step of this process is Molybdenum zeolite synthesis for each zeolite framework tested. Synthesis includes use of a mortar and pestle, pellet press, and heating the mixture overnight in a furnace to create a Mo-zeolite template for each commercial zeolite. After synthesis, each synthesized zeolite template will undergo a methane dehydroaromatization reaction. As a result, ZTC materials will be extracted from the synthesized materials and characterized. Each ZTC material will undergo characterization using gas physisorption and x-ray diffraction. Based on our results we can conclude which ZTC material is the most stable and what conditions are deemed most favorable for thermal stabilization of the ZTC materials. Future research will focus on testing zeolites with differing frameworks and recycling coke materials into useful materials.

Keywords: ZTC; Molybdenum; Zeolites; MDA

Mentor(s):

Rajamani P Gounder (Engineering)

Other Acknowledgement(s):

Justin Emanuel Rosa-Rojas; Angel Noel Santiago Colon

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

Poster Presentation Abstract Number: 1402
Presentation Time: Session 3: 12:00pm-1:00pm

CISTAR

Optimizing Non-Sharp Distillation Column Sequence using Surrogate Physics-Informed Neural Network

Mathematical/Computation Sciences

Author(s):

Zachary Rasmussen†

Abstract:

Distillation column sequences are an important component in industrial plants, however, their energy usage can account for up to 60-70% of the plants' annual capital. Therefore, synthesizing an optimal distillation sequence provides grounds for reducing energy consumption and increasing profit. Synthesizing distillation sequences through a superstructure approach proves to be difficult due to the nonlinear behavior of the columns, so a simplifying surrogate model is required for the problem to be solvable. This research investigates the use of a novel physics-informed neural network that can guarantee linear physical constraints, KKT-hPINN, to capture the behavior of the distillation columns and simplify the problem. The KKT-hPINN model was created by obtaining training and test data through a commercial process simulator, and the model was trained with linear mass flow constraints embedded into the architecture. A distillation sequence optimization problem with non-sharp splits is then solved once with the KKT-hPINN model embedded in the optimization formulation, and again with a standard feed forward neural network. The accuracy of each model is then evaluated using root mean square error to determine the efficacy of using the KKT-hPINN architecture over a neural network. This research presents an alternative to standard surrogate models for applications where it is essential for linear constraints such as mass balances to be conserved.

Keywords: [no keywords provided]

Mentor(s):

Can Li (Engineering); Hao Chen (Engineering)

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

Poster Presentation Abstract Number: 1403
Presentation Time: Session 3: 12:00pm-1:00pm

CISTAR

Propylene hydrogenation by main group metal Ga+3 on SiO2 and Al2O3 supported catalysts

Physical Sciences

Author(s):

Joyce M Rivera Sanchez†

Abstract:

The United States is searching for better ways to satisfy the high energy demand. As most know, the majority of our energy is fossil fuel-based, produced in other countries from oils found underground. This is neither economically nor environmentally efficient. To solve this issue the United States, attempt to evolve from fossil fuels to natural gas consists of using their resources, which are hydrocarbons extracted from shale rocks found in their lands. Industries transform short-chain hydrocarbons into bigger chains to produce gasoline and diesel using catalysts such as zeolites, which can be expensive and deactivate easily under certain reaction conditions. New catalysts that can transform these hydrocarbons while being highly active and economically efficient are being studied. The synthesis of Ga/SiO2 and Ga/Al2O3 catalysts has been proposed. These catalysts will be used for a series of propylene hydrogenation reactions done with gas chromatography to obtain a conversion percentage. This will be related to the time on stream to learn the thermostability of the catalysts and, therefore, understand their catalytic properties. These results will prove that these catalysts are active and selective, giving new strength to the petrochemical industry of the United States using local resources. Eventually, more studies can be conducted to understand the catalytic structure of gallium catalysts and its correlation with catalytic performance such as selectivity and rates.

Keywords: Propylene Hydrogenation; Heterogeneous Catalysis; SiO2 Support; Al2O3 Support; Gallium Single Site Catalysts

Mentor(s):

Wei-Ling Huang (Engineering); Jeffrey T Miller (Engineering)

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

Poster Presentation Abstract Number: 1404
Presentation Time: Session 3: 12:00pm-1:00pm

DUIRI

Environmental Contamination and Birth Defects in Iraq

Life Sciences

Author(s):

Bethany Faber† (HHS)

Abstract:

Following the Gulf War in Iraq, the potential for increased birth defects related to war-related exposure became a public health concern. To investigate this, an interdisciplinary collaboration conducted anthropological interviews of parents in Fallujah, Iraq, between December 2022 and February 2023. In this analysis, participant's self-reported experiences of exposure to military conflict events were identified. Previous literature was reviewed to examine potential environmental contaminants related to each documented self-reported military conflict. There were 16 types of military conflict events reported, including hot houses, burn pits, smoke, dust, and air strike exposure. Predominantly recorded were hot houses, reported by 32% of participants (286 total exposures: 134 mother exposures and 152 father exposures). For the literature review, data on specific military action events and measured environmental contaminants were extracted from the papers. A total of 13 papers were identified that met inclusion criteria: from an acclaimed source, evident analysis of toxicants from an identified exposure (corresponding to participants' reported exposures), with reliable and reported conclusions constructed by data (with minimal bias). A total of 3 (23%) of the papers identified uranium contamination; 2 papers (15%) reported titanium contamination; 2 of the papers (15%) identified recorded fine particulate matter contamination. Many of these articles recorded multiple toxicants related to individual military conflict events. These results will provide insight into potential environmental contaminants that participants in Fallujah may have been exposed to during the military conflict, and provide a basis for further analyses.

Keywords: [no keywords provided]

Mentor(s):

Ellen M Wells (HHS); Aaron James Specht (HHS)

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

Poster Presentation Abstract Number: 1405
Presentation Time: Session 3: 12:00pm-1:00pm

SCALE

Degradation of Thermal Interface Materials From Thermal Cycling Experiments

Innovative Technology / Entrepreneurship / Design

Author(s):

Johan Martinez†

Abstract:

Electronic packages are present in our everyday devices and there is a constant need to make the devices smaller every year. These devices dissipate heat over time and the demand for miniaturization needs robust and effective thermal management. A typical electronic package consists of different materials and interfaces that act as bottlenecks for heat dissipation. Thermal interface materials (TIMs) are highly thermally conductive substances used across the interfaces to decrease thermal resistance by replacing the small air pockets. One commonly used form of these materials is thermal grease, which is easy to handle, cheaper than other forms of TIMs, and has good thermal conductivity. However, thermal grease suffers from pump-out degradation, which occurs when two materials with different coefficients of expansion push and pull the thermal grease outwards and outside of the interface. This can be seen by the presence of voids and overall deterioration of the material's performance, thereby reducing the reliability. Hence, it is increasingly important to understand how this happens and how to prevent it. Our research aims to analyze how the non-flatness of mating surfaces sharing interface plays a role. We will perform temperature cycling experiments on grease TIMs and use different forms of curved lenses and aluminum heaters to mimic the temperature fluctuations of electronic devices. The investigations aim to provide a better understanding of how surface shape affect the degradation of TIMs and share insights about their reliability.

Keywords: Grease; Thermal Interface Material; Pump-Out; Voids

Mentor(s):

Ritwik Vijaykumar Kulkarni (Engineering)

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

Poster Presentation Abstract Number: 1406
Presentation Time: Session 3: 12:00pm-1:00pm

SCALE

Transitions Between Electron Emission Mechanisms in Semiconductors

Physical Sciences

Author(s):

Dania M Zein†

Abstract:

Ionizing radiation creates a charge imbalance in a semiconductor that alters the current flow, resulting in changes to the electron emission behavior that may alter diode operating effectiveness. We apply a theoretical technique referred to as “nexus theory” to assess the transition between the maximum steady-state current in a diode, defined as the space-charge limited current (SCLC), and the canonical source current given by the Fowler Nordheim (FN) equation for field emission. In a semiconductor, the SCLC is given by the Mott-Gurney (MG) law for a trap-free device and the Mark-Helfrich (MH) law for a device with traps. In this project, we derive nexuses between these mechanisms under different device and operating conditions to demonstrate the conditions required for the transition between these mechanisms. We apply the resulting theoretical current-voltage (I/V) to measurements for Schottky diodes to assess this behavior before and after exposure to ionizing radiation to demonstrate the transitions between these mechanisms and the conditions for device breakdown. Comparing the results from theory and experiment will provide information for future studies concerning device reliability and operation.

Keywords: Electron Emission; Semiconductors

Mentor(s):

Allen L Garner (Engineering); Lorin Irene Breen (HHS); Cameron James Buerke (Engineering); Samera Hossain (Engineering); Alexander Gregory Sinelli (Engineering); Reagan LiPing McCafferty (Purdue University)

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

Poster Presentation Abstract Number: 1407
Presentation Time: Session 3: 12:00pm-1:00pm

SCARF

Unraveling the roles of DEAD-box helicases in eukaryotic gene regulation

Life Sciences

Author(s):

Jamie Kim Bryan† (Agriculture)

Abstract:

RNA helicases play vital roles in regulating gene expression and transcription processes. Our present study explores the roles of the DEAD-box helicase, Dbp2, in budding yeast Saccharomyces cerevisiae and its human ortholog, DDX5. While Dbp2 is known to be involved in RNA processing, its specific functions in transcription termination require further investigation. Through high-throughput transient transcriptome sequencing (TT-seq), it was found that Dbp2 plays a crucial role in transcription termination. In this study, through a series of termination reporter assays, we validate our findings that Dbp2 plays a pivotal role in transcription termination, with DBP2 knockouts resulting in read-through defects. Additionally, mammalian DEAD-box helicase DDX5 is associated with the proliferation of small-cell lung cancer (SCLC). Several studies show that DDX5 itself undergoes multiple post-translational modifications, which contribute to its involvement in the development of different types of cancer. In our current study, our lab identified unique phosphorylation sites in DDX5 that can be attributed to its role in SCLC progression. Through site-directed mutagenesis studies (SDM), we will take a closer look into the roles of these critical phosphorylation sites in SCLC proliferation. Our findings will provide insights into the roles of DEAD-box helicases in modulating gene expression. Furthermore, it has the potential to reveal vital clues for the treatment of SCLC.

Keywords: RNA Helicase; DBP2; DDX5; Transcription; Small-Cell Lung Cancer

Mentor(s):

Elizabeth J Tran (Agriculture); Subhadeep Das (Agriculture); Maria Paula Zea Rojas (Agriculture)

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

Poster Presentation Abstract Number: 1408
Presentation Time: Session 3: 12:00pm-1:00pm

SCARF

Investigating the role of Erg5 in azole susceptibility in Candida glabrata

Life Sciences

Author(s):

Lauren Rose Connors† (Agriculture)

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Scott D Briggs (Agriculture); Justin Bradley Gregor (Agriculture)

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

Poster Presentation Abstract Number: 1409
Presentation Time: Session 3: 12:00pm-1:00pm

SCARF

Effects of Intrauterine Growth Restriction (IUGR) on Pre-Weaning Performance in Swine

Life Sciences

Author(s):

Samantha Teal Fairchild† (Agriculture)

Abstract:

Genetic selection for increased litter size has increased ovulation rates without an equivalent increase in maternal uterine capacity. The crowded uterine environment creates placental insufficiency in a subpopulation of the litter, leading to varying degrees of intrauterine growth restriction (IUGR) and non-allometric growth. The most notable effect of IUGR is alteration in the morphology of the piglet's head, resulting from a “brain-sparing effect”, wherein vital nutrients are redirected to the developing brain at the expense of other organ systems. The goal of this study is to evaluate the variation in piglet phenotypes at birth and understand the relationship between these phenotypes and pre-weaning performance. To accomplish this, we collected detailed phenotypic data on 1061 piglets from 82 sows, split over three farrowing groups. Piglets were weighed prior to suckling colostrum to determine true birth weight, and lateral views of the whole piglet and dorsal views of the head collected for morphometric analysis. Piglets were reweighed after 2 hours to determine initial colostrum intake, and again after 48 hours, with rectal temperatures collected on the same schedule. Piglets were then weighed again on days 7 and 14, and 24 hours prior to weaning (~21 days old). We hypothesize that IUGR piglets, as identified by birth weight or head shape, will have reduced colostrum intake, poor thermoregulation, and reduced average daily gain in the preweaning period relative to the rest of the population. Data collection for group three is ongoing, but preliminary analysis indicates significant within litter variation in all variables.

Keywords: IUGR; Brain Sparing Effect; Swine

Mentor(s):

Jonathan Pasternak (Agriculture); Alyssa Smith (Agriculture)

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Poster Presentation Abstract Number: 1410
Presentation Time: Session 3: 12:00pm-1:00pm

SCARF

One-step Colorimetric Isothermal Detection of Live Foodborne Pathogens

Life Sciences

Author(s):

Anagha Gaitonde† (Engineering)

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Simerdeep Kaur (Engineering); Mohit Verma (Engineering)

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Poster Presentation Abstract Number: 1411
Presentation Time: Session 3: 12:00pm-1:00pm

SCARF

Metabolite extraction and analysis of High Chlorophyll Fluorescence (HCF) in Sorghum mutants

Life Sciences

Author(s):

Gage Ryan Edward Gottman† (Agriculture|JMHC)

Abstract:

Sorghum is one of the most important crops for food, biofuel, and fodder, producing a diverse array of metabolites that are essential for plant survival and beneficial to agriculture and human health. However, the majority of metabolites have not been identified. Thus, gaining insight into secondary metabolism and genetic mutations affecting metabolism is essential for improving sorghum crop resilience and productivity. We conducted metabolite extractions on a sorghum EMS mutant population to identify key metabolic changes and provide insights into the biochemical impacts of mutations. The sorghum mutants were phenotypically analyzed and were studied for high-impact mutations (mutations in the coding region). I focused on a mutant line that had a yellow-green phenotype. Among the high-impact mutations of this mutant line, were SNPs in the High Chlorophyll Fluorescence (HCF) gene. hcf mutants in Arabidopsis are known to produce a yellow-green phenotype. I specifically investigated HCF 107 and HCF 173. These genes are vital for photosystem II assembly and function. They have been studied in other organisms but not sorghum, nor have the metabolic consequences been studied. Mutants in these genes were highlighted to understand their impact on photosynthesis and plant development. The mutant line showing a yellow-green phenotype, along with reduced height, indicates a potential disruption in photosynthesis. Further analysis to determine if the SNPs in HCF are causing the yellow-green phenotype is needed. My project aims to profile and deduce the metabolic consequences of these sorghum mutants to better understand the function of these genes.

Keywords: Sorghum; Metabolite; High Chlorophyll Fluorescence; Photosynthesis; Photosystem II

Mentor(s):

Jacob Mark Olson (Agriculture); Brian Dilkes (Agriculture)

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

Poster Presentation Abstract Number: 1412
Presentation Time: Session 3: 12:00pm-1:00pm

SCARF

Cdc14 Targeted Antifungal Drug Discovery

Life Sciences

Author(s):

Nathan Michael Henderson† (Agriculture)

Abstract:

For the immunocompromised, pathogenic fungi are a serious concern causing over 1 million deaths annually from invasive infections [1]. Candida and Aspergillus species are responsible for over two-thirds of these deaths [1]. Within these fungal genera, the Cdc14 family of phosphatases has been identified as an attractive target for new drug design. Cdc14 is vital for fungal infection, as demonstrated through a mouse model in which loss of Cdc14 function rendered Candida albicans avirulent [2]. In addition, the Cdc14 active site is highly conserved and has a unique substrate specificity, making it a potentially effective and broad-range target. Moreover, it has been shown that Cdc14 orthologs in animals are not vital for growth or development [3]. The overall objective of my project was to pursue identification of small molecule Cdc14 inhibitors from chemical libraries as an initial step in the antifungal drug development process. All Cdc14 enzymes have a highly reactive cysteine catalytic residue in the active cite and therefore we screened for covalent inhibitors from chemical libraries. Aspergillus fumigatus Cdc14 was used as a model pathogen Cdc14 for this screen. And the activity of several pathogen Cdc14 enzymes were characterized to assess conservation of specificity and test if inhibitors of the screen would be broadly active. Then, various pathogen Cdc14 enzymes were expressed and purified to test suitability for X-ray crystallography analysis in complex with identified inhibitors. 16,606 compounds were screened, and 20 inhibitors were identified that exhibited at least 40% inhibition, with the highest displaying 85% inhibition. Subsequent experiments should now focus on further optimization of the broadest-acting inhibitors and animal trials to test their antifungal properties in living organisms.

Keywords: Cdc14; Phosphatase; Drug Discovery; Covalent Inhibitor; Antifungal

Mentor(s):

Mark C Hall (Agriculture); Kevin Gabriel Velazquez-Marrero (Agriculture)

Other Acknowledgement(s):

Lan Chen; Li Wu

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

Poster Presentation Abstract Number: 1413
Presentation Time: Session 3: 12:00pm-1:00pm

SCARF

Investigating AHCY Interacting Partners in Drosophila S2 Cells.

Life Sciences

Author(s):

Madolyn Marie Jarrett† (Agriculture)

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Vikki Marie Weake (Agriculture); Sarah Caroline Stanhope (Agriculture)

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

Poster Presentation Abstract Number: 1414
Presentation Time: Session 3: 12:00pm-1:00pm

SCARF

Phenotypic characterization of Arabidopsis MLO overexpression and mutant lines to determine the role of MLO proteins in plant development

Life Sciences

Author(s):

Molly Elizabeth Kosiba† (Agriculture)

Abstract:

MILDEW RESISTANCE LOCUS-O (MLO) proteins are a plant specific gene family involved in a variety of functions such as powdery mildew susceptibility, reproduction, and root tropism. Within the model species Arabidopsis, there are 15 MLO proteins which were recently discovered to function as calcium channels. Calcium signaling is an important mechanism within plants as it aids in the response to abiotic and biotic stress and helps in the development of tip-growing cells, such as root hairs and pollen tubes. Although there are 15 MLO proteins in Arabidopsis, many have yet to be characterized. In order to better understand the role of MLO proteins in plant development, previously generated MLO overexpressor and knockout lines were phenotyped. The phenotypes observed were primary root and root hair length, rosette area, and flowering time. The results of the phenotyping were compared to the previous findings in Gao et al., 2022 on whether these proteins could function as calcium channels. The subcellular localization of these proteins was then compared to the phenotyping results to understand if subcellular localization affects the protein's ability to function as a calcium channel. In addition, for the overexpressor lines that displayed an interesting phenotype, the plants were GUS stained to determine whether the native promoter is active in the tissues where the phenotype was observed. Through the study of MLO overexpressor or knockout lines and the resulting plant's phenotype, we can better understand how each MLO protein contributes to plant development.

Keywords: Plant Biology; Development; Arabidopsis

Mentor(s):

Sharon A Kessler (Agriculture); Sienna Tsuruko Ogawa (Agriculture)

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

Poster Presentation Abstract Number: 1415
Presentation Time: Session 3: 12:00pm-1:00pm

SCARF

Predicting binding of NADPH/ NADH family of Cofactors to Enzymes Using Machine Learning

Mathematical/Computation Sciences

Author(s):

Joel Jenson Kuriakose† (Engineering|JMHC)

Abstract:

This study investigated data-driven approaches for predicting the function of enzymes using primary amino acid sequences. Our long-term goal is to predict the substrates that bind to enzymes and the reactions catalyzed by enzymes using primary amino acid sequences alone. Here, we classify enzymes based on their ability to bind NADPH/NADH family of cofactors, and it represents an important first step towards our long-term goal. The study began with the curation of a dataset of approximately 360,000 sequences with corresponding reaction descriptions from RHEA/UniProt databases. This dataset comprises diverse enzymatic transformations seen in Nature. Relevant reactions that use NADH/NADPH were then identified by filtering the reactions to identify ones containing these molecules. Data cleaning steps were crucial; this included eliminating duplicates, disregarding sequences containing non-standard amino acids, and removing low-frequency occurrences. Our final dataset comprises 31,329 positive sequences that bind to NADH/NADPH family of cofactors and 31,329 negative sequences that do not bind to these cofactors. A transformer model was then trained to predict the capability of an input amino acid sequence to bind to the NADH/NADPH family of cofactors. On a hidden test set comprising of 6,266 amino acid sequences, the model achieved 82% accuracy on discriminating between sequences that bound to NADPH/NADH and sequences that do not bind these cofactors. This study opens the door for computational substrate and reaction prediction using primary amino acid sequences. Such tools can facilitate identification of biocatalysts to catalyze desired industrial transformations.

Keywords: [no keywords provided]

Mentor(s):

Karthik Sankaranarayanan (Engineering)

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

Poster Presentation Abstract Number: 1416
Presentation Time: Session 3: 12:00pm-1:00pm

SCARF

Fumarase and the DNA Replication Stress Response

Life Sciences

Author(s):

Maxine Katya Kushner† (Agriculture)

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Ann L Kirchmaier (Agriculture); Ronard Kwizera (Agriculture)

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

Poster Presentation Abstract Number: 1417
Presentation Time: Session 3: 12:00pm-1:00pm

SCARF

Characterization of Prevotellaceae in the pig gut

Life Sciences

Author(s):

Erica Ann Long† (Agriculture)

Abstract:

Prevotellaceae is a gram-negative bacterial family composed of the genera Prevotella, Alloprevotella, Hallella, and Paraprevotella that has been found in the pig gut. Although a positive correlation between Prevotellaceae and growth performance in pigs has been reported, our understanding of the biology and function of Prevotellaceae and its impact on pig production remains limited. In the current study, we hypothesized that as a known dietary fiber fermenter, Prevotellaceae will show an increased prevalence within the gut microbiome of pigs that have been fed a high-fiber diet. Fecal samples were taken from grower pigs (body weight around 31 to 32 kg) being fed a control diet or a high-fiber diet (n = 4) that contains dehydrated alfalfa meal and beet pulp. Fecal DNA was extracted for 16S rRNA gene amplicon sequencing on an Illumina MiSeq platform. Prevotellaceae tended to be increased by the high-fiber diet compared with the control group (mean value, 10.05% vs. 5.56%), which was largely attributed to an enrichment of ASV14 (Alloprevotella) and ASV39 (Prevotellaceae NK3B31 group). The genomic capacity of Prevotellaceae species that have been reported in the pig gut was further investigated based on publicly available genome sequences. The species composition of Prevotellaceae varied among individuals. Analyses based on the ten identified Prevotellaceae species from pig feces demonstrated that Prevotellaceae members may fill a unique niche in the gut and contributes to metabolic functionality. Future work to identify and characterize Prevotellaceae at strain-level will be critical to understand its function and biological properties in pigs.

Keywords: Prevotellaceae; Pig; Gut Microbiome; Fiber

Mentor(s):

Tingting Ju (Agriculture)

Other Acknowledgement(s):

Caitlyn Rose Sullivan; Brian T Richert; Weicang Wang

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

Poster Presentation Abstract Number: 1418
Presentation Time: Session 3: 12:00pm-1:00pm

SCARF

To Thirst or to Hunger: The Hydraulic Physiology of Drosera capensis

Life Sciences

Author(s):

Jonathan Michael Lu† (Agriculture)

Abstract:

Drosera capensis is a curious and prolific species of insectivorous sundew that is native to the cape of South Africa. It lives in boggy conditions with soil that is consistently saturated. Sundew plants use highly modified, glandular trichomes to lure, trap, and digest insect prey. Under droughted conditions, the tension in the xylem can reach lethal values. This stress causes embolism to form, which reduces the water conduction of the xylem. The P50 indicates when 50% of the xylem vessels have embolized and is a common metric to compare drought resistance between plant species and across tissues. The frequency and severity of drought events are expected to increase due to climate change. While research in embolism resistance among carnivorous plant species is sparse, this leaves speculation on how these fragile, boggy ecosystems and their green inhabitants will be impacted predicted future conditions. Here we use the optical vulnerability method to explore the desiccation tolerance of roots, leaves, and peduncles of D. capensis. Plants were seed-grown to reproductive maturity then randomly selected. Individuals were bench dehydrated and water potential (?) measurements were taken with a pressure bomb. We found that Drosera exhibits hydraulic segmentation, where the leaves are akin to a hydraulic fuse to safeguard the integrity of the xylem. This discovery shows that peduncles and roots have embolism resistance, which could hint at how these plants evolved to withstand desiccation in a wet environment.

Keywords: Embolism; Carnivorous; Drosera; Drought; Xylem

Mentor(s):

Scott McAdam (Agriculture)

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

Poster Presentation Abstract Number: 1419
Presentation Time: Session 3: 12:00pm-1:00pm

SCARF

Changes in development and metabolism in an inducible lignin-modified Arabidopsis mutant

Life Sciences

Author(s):

Eleanore Margaret Malinowski† (Agriculture)

Abstract:

Lignin is a product of phenylpropanoid metabolism that is crucial for plant structure and development, but it hinders the use of plant materials in biofuel production, the pulp and paper industry, and as feedstocks for animals. These applications could all benefit from engineered lignins that are easier to degrade; however, modifying lignin often negatively impacts plant development. The combination of overexpressing the gene F5H and disrupting the genes CADC and CADD cause dwarfism, sterility, and lateral root deficiency. To study the developmental defects in these plants, we implemented an inducible system which uses the steroid dexamethasone (DEX) to overexpress F5H. We first examined the strength of the inducible construct to phenocopy cadc cadd plants overexpressing F5H by quantifying lateral root deficiencies and dwarfism. To quantify the timing of metabolic changes after induction, we tracked the accumulation of phenylpropanoids syringin and sinapolymalate. Finally, we analyzed the sensitivity of the mutant to varying amounts of DEX by generating a dose response curve to optimize induction conditions. These results reveal an optimal time to conduct RNA sequencing experiments to identify potential genes responsible for dwarfism. Our work provides a new way to study growth defects of plants with modified lignin.

Keywords: Lignin; Phenylpropanoids; Biochemistry; Plant Biology; Arabidopsis

Mentor(s):

Clint C S Chapple (Agriculture); Chase Taylor Hearn (Agriculture)

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

Poster Presentation Abstract Number: 1420
Presentation Time: Session 3: 12:00pm-1:00pm

SCARF

Benchmarking Dimethyl Labeling-based Data-Independent Acquisition Pipelines for Extracellular Vesicle Proteomics and Phosphoproteomics

Life Sciences

Author(s):

Nathaniel Merrick Miller† (Engineering)

Abstract:

Chemical labeling has become a crucial part of many disciplines of biochemistry. Proteomics, for example, uses isotopic labeling to run more than one sample at once in a mass spectrometer, decreasing variation, increasing proteomic depth, and allowing for direct comparison of the intensity of peptides between channels. While DDA (data-dependent acquisition) has been the main method used in LC-MS/MS-based proteomic analysis for the last 15 years, DIA (data-independent acquisition) has become increasingly competitive in terms of unbiased detection and better quantification. Recently, several studies have demonstrated advanced proteomics methods by combining chemical labeling and DIA. Moreover, more bioinformatic tools have been developed to improve DIA data analyses. Therefore, we set out to determine the most effective proteomics pipelines for multiplex isotope labeling-based DIA analysis. We also apply this same technique to the phosphoproteome, a subfield of proteomics that has shown biological and diagnostic relevance. In this study, several proteomics pipelines including different data acquisition methods and bioinformatic tools were performed and carefully evaluated. In both the proteomic and phosphoproteomic analyses, the directDIA analysis offered the best quantification results between multiplexed channels. Still, it was comparable to or lagged behind DDA and library DIA in identification results and reproducibility. Our preliminary results demonstrated that while different DIA methods outperform DDA in certain areas, overall, the current DIA algorithms still need to be improved to obtain better quantitative detection.

Keywords: Proteomics; Isotopic Labeling; Mass Spectrometry; Extracellular Vesicles; Phosphoproteomics

Mentor(s):

Weiguo Andy Tao (Science); Yi Kai Liu (Agriculture)

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

Poster Presentation Abstract Number: 1421
Presentation Time: Session 3: 12:00pm-1:00pm

SCARF

Antioxidant Activity of Phenolic Compounds from Chlorella vulgaris

Life Sciences

Author(s):

Anja Chloe Owens† (Science)

Abstract:

[Abstract Redacted]

Keywords: Phenolic Compounds; Antioxidants; Chlorella vulgaris

Mentor(s):

Andrea M Liceaga (Agriculture)

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

Poster Presentation Abstract Number: 1422
Presentation Time: Session 3: 12:00pm-1:00pm

SCARF

Effect of Long-Term System Disuse on Pipe Wall Biofilms

Life Sciences

Author(s):

Katie Nicole Smith† (Engineering)

Abstract:

Water systems that are shut down seasonally, such as water parks and splash pads, may have very specific water treatment needs upon start-up. It is unclear how microbial biofilms react to long-term stagnation. Pipe wall biofilms have a strong effect on the bacterial cell concentrations in these water systems, and potentially exposure to pathogens surviving in biofilms. This study investigates the differences in bacterial cell concentrations in a system that has been shut down for 6 months to previous experiments in which the system was under consistent daily operation. The system contains three different pipe materials in triplicate: ice maker lines, shower hose, and CPVC pipe. After approximately 6 months of system disuse, wherein some of the system may have dried out, water samples were collected after varying lengths of stagnation. For sample collection, each pipe was flushed for 2 minutes, with the initial 15 mL of water taken for measurement. The chlorine concentration was measured immediately following sample collection using a chlorine pocket colorimeter. Flow cytometry was used to measure total and intact cell concentrations. Similar experiments were performed one year ago, when the system had been in constant use. It was found that the pipe wall biofilm and thus water characteristics changed substantially following the system shutdown. While cell concentrations in first flush samples had a similar order of magnitude, the maximum reached during stagnation was lower than when the system was in constant use. This demonstrates that system shutdowns that allow dry out may help with biofilm management in water parks and splash pads, but disinfection upon start-up is still important. A changing climate and lack of shutdowns for these systems could potentially increase exposure to pathogens surviving in biofilms.

Keywords: Biofilm; Water; Pathogens; Chlorination

Mentor(s):

Caitlin Rose Proctor (Engineering)

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

Poster Presentation Abstract Number: 1423
Presentation Time: Session 3: 12:00pm-1:00pm

SCARF

Nepenthes on a Cellular and Biomolecular Level

Life Sciences

Author(s):

Grace Anne Stanton† (Science)

Abstract:

Many studies have been conducted on the carnivorous plant genus—Nepenthes; however, most of these studies focus on describing the growth stages and morphology of the pitchers. There is a gap in knowledge within this field of study on the tropism of the plant and its effects the placement of the pitchers. There is no known tropism—the movement of an organism in response to external stimuli—for Nepenthes sp. This project was focused on assessing the plant's molecular response to external stimuli; this response could be quantified through following the signal transduction pathway. A calcium ion was chosen as an indicator of pathways activation due to its pervasiveness through many different pathways. Calcium selective microelectrodes were fabricated using glass micropipettes, an electrolyte, calcium selective LIX solution, and silver wire. These microelectrodes were used in conjunction with SIET hardware and ASET-LV4 software to map the fluctuation of calcium ions within various sections of the plant. This map shows which sections of the plant have a reaction to the external stimuli and the intensity of the response. The larger concentration of calcium ions is indicative of a greater signaling response. Mapping signaling pathways through the quantification of calcium ions will shine a light on the tropism of Nepenthes sp.

Keywords: Calcium; Nepenthes; ASET-LV4; SIET; Molecular Signaling

Mentor(s):

D. Marshall Porterfield (Agriculture)

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

Poster Presentation Abstract Number: 1424
Presentation Time: Session 3: 12:00pm-1:00pm

SCARF

Proximity Labeling to Identify Transient Protein Interactions with ATP-dependent Chromatin Remodeler PICKLE

Life Sciences

Author(s):

Elysia Marlena Uggen† (Agriculture|JMHC); Joshua Paul Kaluf‡ (Agriculture); Shelby Sliger‡ (Agriculture|JMHC)

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Joseph P Ogas (Agriculture); Jacob Ryan Fawley (Agriculture); Jiaxin Long (Agriculture)

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

Poster Presentation Abstract Number: 1425
Presentation Time: Session 3: 12:00pm-1:00pm

SCARF

Revolutionizing Cattle Environmental Sustainability using Precision Monitoring

Life Sciences

Author(s):

Rieko Simone Wilford† (Agriculture); Alejandro Daza Gallo*; Jihyo Park* (Engineering)

Abstract:

[Abstract Redacted]

Keywords: Methane Emissions; Sensors; Cattle; Feed-Intake; Prediction Model

Mentor(s):

Hinayah Rojas de Oliveira (Agriculture); Upinder Kaur (Engineering)

Other Acknowledgement(s):

Henrique Alberto Mulim; Yuelin Deng; Yuanmeng Huang

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

Poster Presentation Abstract Number: 1426
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Novel Method for Enhancing Boron Combustion vis Electrochemical Deposition of Lithium

Physical Sciences

Author(s):

Gianna Marie Arnone† (Engineering); Matthew William Vaughn* (Graduate)

Abstract:

Within the aerospace industry, current research aims to maximize energy output using high-energy-density materials (HEDMs) while also minimizing their sensitivities. Boron has been of interest due to it having the second highest gravimetric heating value, meaning optimizing boron combustion would result in a desirable higher energy output. However, boron is less commonly used as a fuel additive due to its propensity to incompletely combust and difficulty igniting. This study employs an electrochemical deposition process using a specialized air-free battery cell to properly coat boron with a thin layer of lithium, eliminating the concern of lithium's pyrophoricity. Lithium is chosen due to previous studies obtaining complete combustion and lower ignition temperatures when coated on boron. Once fabricated the boron was introduced into a protective polymer and then tested for combustion behavior. With the challenges of lithium handling there has been minimal research to characterize its effects on boron ignition and combustion. This study quantifies the enhancement of a thin lithium layer, explores the relative volumetric limitations, and determines Li-B heat of combustion to be 40.47 kJ/g and have a high combustion efficiency of 89.1% compared to pure boron. Using this new method of electrochemical deposition for boron coating, further research on boron combustion can be taken on pyrophoric materials.

Keywords: Modified Fuels; Combustion; Electrochemical Deposition

Mentor(s):

Diane Collard (Engineering)

Other Acknowledgement(s):

Ethan Christopher Binkley; Steven F Son; Dhruval Natubhai Patel

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

Poster Presentation Abstract Number: 1427
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Enhancing the Gallium Thermal Hydraulic Experiment (GaTE) Facility with Remote Automation for Advanced Reactor Simulation

Innovative Technology / Entrepreneurship / Design

Author(s):

Apoorva Bahl† (Engineering); Stella Mae Betts‡ (Engineering)

Abstract:

[Abstract Redacted]

Keywords: Remote Operation; Thermal Stratification; Liquid Metal

Mentor(s):

Hitesh Bindra (Engineering); Broderick Michael Sieh (Engineering)

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

Poster Presentation Abstract Number: 1428
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Enabling Remote Sensing and Remote Operation of the Gallium Thermal Hydraulic Experiment (GaTE) Facility

Physical Sciences

Author(s):

Stella Mae Betts† (Engineering); Apoorva Bahl‡ (Engineering)

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Hitesh Bindra (Engineering); Broderick Michael Sieh (Engineering)

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

Poster Presentation Abstract Number: 1429
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Physics and Analytics of Lithium Batteries

Mathematical/Computation Sciences

Author(s):

Trisha Boodhoo† (Engineering)

Abstract:

The Energy and Transport Sciences Laboratory (ETSL) at Purdue University developed a Python based tool for Li-ion batteries. This project focuses on packaging and securely distributing the application to run seamlessly on multiple operating systems without requiring users to set up Python or dependencies. Relevant modifications include making Linux-dependent code cross-platform and creating separate executables using PyInstaller. This separation was crucial in resolving bugs including application freezing, endless spawn loops, and resource conflicts, which were encountered when packaging scripts using subprocess and multiprocessing libraries. To simplify installation and future updates for Windows, an MSIX-compatible installer was created using Advanced Installer. Additionally, a collaborative design effort led to implementing a low-cost and easily maintainable authentication mechanism using Google Cloud Functions, thus restricting application access to authorized users. Introducing version control with GitHub significantly improved workflow and documentation, preventing frequent application breakdowns during development. Key outcomes include resolving cross-platform file I/O issues, creating executables, and establishing a robust authentication system. Future work involves creating installers for Mac and Linux, and potentially developing a data-sharing functionality similar to Jupyter Hub, considering recent discussions on leveraging cloud capabilities. This project ensures that users can securely and easily use the application.

Keywords: Authentication Mechanism; Pyinstaller; Google Cloud Functions; Python; Cross-Platform

Mentor(s):

Bairav Sabarish Vishnugopi (Engineering); Partha P Mukherjee (Engineering); Arpan Kumar Sharma (Engineering)

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

Poster Presentation Abstract Number: 1430
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Plastic Waste Conversion into Useful Products

Innovative Technology / Entrepreneurship / Design

Author(s):

Ryan L Bottini† (Engineering)

Abstract:

[Abstract Redacted]

Keywords: Low Pressure; Hydrothermal Processing; Acrylonitrile-Butadiene Styrene

Mentor(s):

Cagri Un (Engineering)

Other Acknowledgement(s):

Clayton C Gentilcore; Nien-hwa L Wang

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

Poster Presentation Abstract Number: 1431
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Tracking Controllers For Autonomous Aircraft Taxiing

Mathematical/Computation Sciences

Author(s):

Zarif Cabrera†

Abstract:

[Abstract Redacted]

Keywords: PID Controller; Model Predictive Control

Mentor(s):

Philip Eugene Pare (Engineering)

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Poster Presentation Abstract Number: 1432
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Performance Assessment of a Novel Wall-Embedded Micro Heat Pump for Radiant Heating in Buildings

Innovative Technology / Entrepreneurship / Design

Author(s):

Pablo Cambra Valcarcel†

Abstract:

The growing concerns over environmental degradation and the urgent need to combat global warming have heightened the exploration of sustainable and efficient energy solutions. With space heating and cooling accounting for 45% of electricity consumption in U.S. residential and commercial buildings, new cost-effective heat pump technologies are needed to improve energy efficiency and reduce energy demand. In this context, distributed wall-embedded micro heat pumps (WEMHP) are an emerging alternative to traditional hydronic radiant systems such as radiant floor heating or radiant ceiling cooling, potentially offering numerous benefits both from an energy efficiency and comfort standpoint. Thus far, limited numerical and experimental research efforts have been carried out.

To evaluate the potential benefits of the WEMHP with respect conventional heat pump systems, characteristics such as comfort, energy savings, manufacturing and installation processes must be considered.

A WEMHP has been designed, assembled, and tested in a laboratory environment to demonstrate its potential. The developed prototype consisted of variable-speed miniature compressor and aluminum compact roll-bond heat exchangers acting as evaporator and condenser, respectively. Designed for a 200 W heating load, the WEMHP delivers heat through its 20in x 40in interior surface panel. The system performance has been evaluated inside a pair of psychrometric chambers under varying operating conditions. The experimental results were used to validate a detailed system model, which will aid in future design optimizations. The system's heating performance is evaluated holistically, and future improvements are discussed.

Keywords: Heat Pump; Radiant Heating; Energy Efficiency; Experimental Validation

Mentor(s):

Davide Ziviani (Engineering); Feng Wu (Engineering); Panagiota Karava (Engineering)

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

Poster Presentation Abstract Number: 1433
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Search for leakage-free and entangling quantum gates in the Fibonacci and D(S_3) anyon systems

Mathematical/Computation Sciences

Author(s):

Rafael Casas Lozano†

Abstract:

The pursuit of constructing a fault-tolerant quantum computer is becoming increasingly feasible due to advancements in topological quantum computing. This approach employs quasi-particles in two dimensions, known as anyons, which exist in topological phases of matter. The braiding of anyons induces unitary transformations that function as quantum logic gates, achieving hardware-level fault tolerance. Unlike the standard circuit model, the multi-anyon spaces in topological quantum computing seldom have an exact tensor product structure. Hence, a crucial problem is determining if there exist braiding gates that are leakage-free and entangling. We focus on two important anyon systems, the Fibonacci anyon and the anyons of the double group of the permutation group \(S_3 \) (denoted as \(D(S_3) \)). It is conjectured that leakage-free entangling gates do not exist in the Fibonacci anyon system, while such gates do exist in the \(D(S_3) \) system. This study aims to determine whether it is possible to find or approximate leakage-free entangling quantum gates in anyonic systems. The initial phase involves calculating the basic braidings \(\sigma_1 \) through \(\sigma_5 \) for a 6-anyon Fibonacci system and representing them with F-matrices and R-symbols. Subsequently, various combinations will be tested to identify leakage-free entangling gates, a process repeated for the \(D(S_3) \) anyon system. The study will either confirm the existence of leakage-free entangling gates in these anyon systems or provide numerical and theoretical evidence for their non-existence. These results will enhance our understanding of the entangling capabilities of anyonic systems and suggest new research directions with potential practical implications for the development of robust quantum computing technologies.

Keywords: [no keywords provided]

Mentor(s):

Xingshan Cui (Science)

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

Poster Presentation Abstract Number: 1434
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Hydrolytically Degradable Hyaluronic Acid Hydrogels for Biomedical Applications

Physical Sciences

Author(s):

Zhiyuan Chen† (Engineering)

Abstract:

Biodegradability is an important parameter in biomaterials design, with implications for drug delivery and tissue engineering. While various degradable polymers have been developed, precisely tuning the rate of degradation to range from days to months has been challenging. Here, we develop hyaluronic acid (HA)-based polymeric hydrogels that are chemically modified to confer hydrolytic degradability. Specifically, we hypothesized that varied amounts of dialdehyde groups on the HA backbone, in combination with covalent crosslinking via norbornene groups with enhanced susceptibility to hydrolysis, would achieve tunable degradation profiles. We used esterification and oxidation reactions to chemically modify HA to introduce norbornene (via carbic anhydride) and dialdehyde (via sodium periodate) groups, respectively. Nuclear magnetic resonance was used to verify chemical modifications. Gelation properties were determined using oscillatory shear rheology with dynamic light exposure and mechanical properties were characterized using uniaxial compression testing. The polymers were used to make microgels using a flow-focusing microfluidic device. Microgel mass swelling ratio, morphology, and degradation via release of a fluorescent label were characterized over time. Hydrogels crosslinked instantaneously on light exposure, and mechanical properties could be tuned by varying crosslinker density. We found carbic anhydride-modified hydrogels degraded after 10 days of immersion in aqueous media, whereas control hydrogels showed negligible degradation. The presence of dialdehyde groups (2.5% theoretical degree of modification) had limited effects on degradability but showed significantly greater swelling behavior. These promising findings warrant further investigation of how different degrees of oxidation, in combination with different crosslinking densities and polymer concentrations, influence hydrogel degradability.

Keywords: Biodegradable; Hydrogel; Tissue Engineering; Biomaterials; Controlled Release

Mentor(s):

Taimoor Hasan Qazi (Engineering)

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Poster Presentation Abstract Number: 1435
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Revealing the Role of Reactive Oxygen Species in Actin Cytoskeleton Remodeling During Plant Immunity

Life Sciences

Author(s):

Rem Quintin Villanueva David†

Abstract:

Understanding plant immunity is necessary for agriculture as it addresses food security and disease control, especially as pathogens continually evolve. Studies have demonstrated that the actin cytoskeleton is heavily involved in the plant immune response. It has been a focus to investigate the key players and the mechanism that regulates the changes of the actin cytoskeleton. During pattern-triggered immunity in plants, which involves the perception of danger signals, ROS is one of the early messengers that modulates actin dynamics. Current research speculates that ROS directs actin cytoskeleton remodeling through actin-binding proteins, such as capping protein. We intend to investigate how ROS influences actin architecture and dynamics by quantitative live-cell imaging approaches. To do this, Arabidopsis thaliana hypocotyls and cotyledons were treated with a dose series of exogenous hydrogen peroxide and imaged by variable-angle epifluorescence or spinning disk confocal microscopy. The cortical actin filament density and the extent of bundling in treated cells were quantified using Fiji/ImageJ software. The effective concentration range of hydrogen peroxide in eliciting actin modeling was determined based on quantitative comparison of actin density among treatments. Our results indicate that low concentrations of hydrogen peroxide were not sufficient in causing a response, while a high concentration increased the actin density. Future work includes developing an automated method to quantify and observe actin dynamics under hydrogen peroxide treatments. This would provide more insight into how ROS may interact with other actin-binding proteins and influence the single filament properties of the actin cytoskeleton.

Keywords: Actin Cytoskeleton; Plant Immunity; Reactive Oxygen Species

Mentor(s):

Christopher J Staiger (Agriculture); Weiwei Zhang (Agriculture)

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

Poster Presentation Abstract Number: 1436
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Formulation Engineering to Improve Drug Dissolution Kinetics in GI Tract

Life Sciences

Author(s):

Luke DeLion† (Engineering)

Abstract:

Effective delivery of hydrophobic drugs is challenging due to poor solubility and bioavailability. Vodobatinib (VBN) is a strongly lipophilic, weakly basic drug with low oral bioavailability in its crystalline form. This project aims to adapt an 'amorphous drug polymer salt' formulation strategy for VBN that increases the rate of drug dissolution in vitro. The technique involves dissolving and mixing basic drugs with acidic polymers in an aqueous system to form drug-polymer salts. In this work, we compared poly(styrene sulfonic acid) and poly(acrylic acid) as candidate polymers. Tetrahydrofuran, acetonitrile, and dimethyl sulfoxide were used as solvents to form the aqueous environment, and ethanol and water were incorporated as protic ionic liquids to facilitate acid-base reactions for improved protonation and to ensure high salt formation. We additionally studied the effects of temperature, mixing time, and solvent amount on drug-polymer salt formation. After formulation, vacuum desiccation and heating were used to remove residual solvent, which was quantified using nuclear magnetic resonance (NMR). The degree of salt formation will be evaluated on the dry solid products using X-ray photoelectron spectroscopy. The salt product is predicted to yield higher drug release and improved solubility compared to crystalline VBN in simulated intestinal fluids (in progress). The potential success of this technique offers pharmaceutical manufacturers an alternative method to improve efficacy of small-molecule drugs.

Keywords: Vodobatinib; Bioavailability; Amorphous Solid Dispersions; Hydrophobicity; Dissolution Kinetics

Mentor(s):

Sophia R Dasaro (Engineering); Kurt Ristroph (Engineering)

Other Acknowledgement(s):

Mojhdeh Baghbanbashi

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

Poster Presentation Abstract Number: 1437
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Exploring the extent of similarities in software failures across industries using LLM's

Mathematical/Computation Sciences

Author(s):

Martin Detloff†

Abstract:

Background/Motivation:

The rapid evolution of software development necessitates enhanced safety measures. Extracting information about software failures from companies with opaque privacy policies is challenging.

Problem Statement:

This research utilizes the Failure Analysis Investigation with LLMs (FAIL) model to extract industry-specific information. Although the FAIL model's database is rich in information, it could benefit from further categorization and industry-specific insights to further assist software engineers.

Methods:

In previous work news articles were collected from reputable sources and categorized by incidents inside a database. Prompt engineering and Large Language Models (LLMs) were then applied to extract relevant information regarding the software failure. This research extends these methods by categorizing articles into specific domains and types of software failures. The results are visually represented through graphs.

Results:

The analysis shows that throughout the database some software failures occur significantly more often in specific industries. This categorization provides a valuable resource for software engineers and companies to identify and address common failures.

Conclusion:

This research highlights the synergy between software engineering and neural networks to automate and enhance the analysis of software failures. By transforming data from the database into an industry specific model, we provide a valuable resource that can be used to identify common vulnerabilities, predict potential risks, and implement proactive measures for preventing software failures. Leveraging the power of the current FAIL database and methods such as data visualization, we aim to provide an avenue for safer and more secure software in the future.

Keywords: Prompt Engineering; Software Failures

Mentor(s):

James C Davis (Engineering)

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

Poster Presentation Abstract Number: 1438
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Selective Leaching of Rare Earth Element Compounds using Organic Acid

Innovative Technology / Entrepreneurship / Design

Author(s):

Victor Alexander Dossin† (Engineering)

Abstract:

Rare earth elements (REEs) are a group of seventeen elements that are critical to making permanent magnets for green energy products such as wind turbines and EVs. They are primarily produced abroad, and it is crucial for the US to have a reliable source to protect our innovation. It is not feasible for the US to mine REEs at large-scale so the alternative is to develop a circular economy process that can take end-of-life magnets and extract pure REEs from them. REEs are physically and chemically similar to each other and thus a challenge to separate. We have developed an effective recycling process but one part of it, acid leaching, has not been well optimized and not much research has been done using eco-friendly organic acids. Acid leaching involves agitating a solid mixture of REEs in acid to dissolve them into a liquid mixture. We plan to conduct a sensitivity analysis to investigate the operating parameters' (such as temperature, acid concentration, etc.) effects on the performance of the REE conversion from solid to liquid. The results of the elemental conversion will be verified by ICP-OES, one of the most accurate instruments in metal elemental analysis. We expect to provide an optimized leaching process with specific conditions that can be replicated to enhance the liquefaction yield of REEs while retaining impurities in solid form. By showing that an organic acid is a viable alternative to stronger mineral acids, it would make the recycling process more sustainable.

Keywords: Acid Leaching; Rare Earth Elements; Sustainable; Critical; Recycling Process

Mentor(s):

Seyedmehdi Sharifian (Engineering); Nien-hwa L Wang (Engineering)

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

Poster Presentation Abstract Number: 1439
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Growth and modeling of nanopillars towards integrated photonic components

Physical Sciences

Author(s):

David S Estrella† (Engineering)

Abstract:

[Abstract Redacted]

Keywords: 3D Phase Field; Cahn-Hilliard; Allen-Cahn; Nanopillars; Finite Element Analysis

Mentor(s):

R Edwin Garcia (Engineering); Haiyan Wang (Engineering)

Other Acknowledgement(s):

Danny Hermawan

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

Poster Presentation Abstract Number: 1440
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Powder Deposition for Polymer Bonded Explosives

Physical Sciences

Author(s):

Bryan Gong†

Abstract:

The need for safer explosives is always sought after given the nature of their use cases. Thus, polymer bonded explosives (PBXs) are used due to their high energy density and improved safety. Conventional methods for forming PBXs involve compacting premade energetic molding powders and polymeric binders, which can lead to defects during pressing. These defects can form into hot spots causing increased sensitivity to shock. Powder deposition is an up-and-coming technology that has been used on the micron scale and could be used to control these defects. It actuates flow by collapsing a powder bridge that forms near the orifice, and given the right powder and nozzle parameter, the bridge can reform to stop flow. The goal of this research is to develop a better understanding of spray patterns and spreading and packing behavior of surrogate materials when depositing powder. Powder deposition was achieved using a custom mounted vibrating plastic hooper. Soda lime glass, sugar, and nylon powders were used to test the effect of various particle sizes (13µm - 212µm) and morphologies. Spray patterns and deposited line dimensions were explored by varying the height of the nozzle tip, voltage of the vibrator, and speed of the nozzle. Images were taken of the resulting powder deposition, and a high-speed camera was used to study the trajectory of powder out of the nozzle tip. These results will be used to determine what the best parameters are for using powder deposition which can be used as a promising alternative for creating PBXs.

Keywords: Powder Deposition; Explosives; Polymer Bonded Explosives

Mentor(s):

Monique Suzanne McClain (Engineering); Andrew Stephen Bok (Engineering)

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

Poster Presentation Abstract Number: 1441
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Summer 2024 Research Assistance: Corn Sampling

Life Sciences

Author(s):

Solomon J Houchen†

Abstract:

Nitrogen(N) deficiency in corn directly impacts grain yield and is one of the most commonly faced problems by corn growers. The uptake of N by corn can be stifled by losses to air and soil, chemical problems like volatilization and denitrification, and the application of too much or too little nitrogen. Application of N to corn comes in many different forms that try to increase the efficiency of N uptake by corn in different ways. Our research focuses on evaluating the effects and efficiency of these different forms of application and of different fertilizers. Research was conducted in many small corn fields at the Agronomy Center for Research and Education(ACRE) and the Pinney Purdue Agriculture Center(PPAC) . Each field tests different products and application methods with many plots in 1 field containing different variables. Some of the other study fields include evaluating the efficiency of different corn hybrids as well as testing experimental products for private agricultural companies.

Keywords: Agriculture; Agronomy; Corn; Nitrogen; Nitrification

Mentor(s):

Daniel Quinn (Agriculture)

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

Poster Presentation Abstract Number: 1442
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Comparative Analysis of Methods for Measuring Mass Transfer Resistance (Rp) from Temperature in Lyophilized Formulations

Physical Sciences

Author(s):

Chi-En Huang† (Engineering)

Abstract:

Lyophilization, or freeze-drying, is essential for producing stable pharmaceutical products with long shelf lives at room temperature. However, optimizing the process remains a challenge due to its inefficiency, cost, and variability. This study focuses on comparing two methods for measuring mass transfer resistance (Rp) in lyophilization, aiming to make the fitting process more accessible and efficient for new users, since lyophilization processes are often designed by professionals without an engineering background. The first method uses a similar approach to LyoPRONTO, an existing tool that includes freezing and primary drying calculators, a design-space generator, and a primary drying optimizer. It calculates heat transfer from shelf to product, using experimentally measured temperatures, and subsequently determines Rp directly from experimental measurements by solving relevant heat and mass transfer equations, then employs a curve fit to give a smooth functional form for Rp. The second approach assumes a functional form for Rp, solves model equations without measurements, and adjusts tuning parameters so that model temperatures match experimental temperatures as closely as possible. Preliminary results and experience indicate that the first method is sensitive to early-time behavior which may not be well-described by the model equations, so the second method can improve the reliability and robustness of Rp measurements. Comparing these methods for representative cycles, we evaluate their accuracy and efficiency in predicting Rp. By documenting and making the better method more accessible, this research addresses inefficiencies in the lyophilization process, guiding the development of more efficient protocols and reducing time and cost.

Keywords: Lyophilization; Freeze Drying; Mass Transfer; Heat Transfer; Primary Drying

Mentor(s):

Isaac Stonewall Wheeler (Engineering); Vivek Narsimhan (Engineering); Alina Alexeenko (Engineering)

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

Poster Presentation Abstract Number: 1443
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Investigation of Bond-splitting Failure of Post-installed rebars in Reinforced Concrete (RC)

Physical Sciences

Author(s):

Nathan Joseph† (Engineering); Edward Vane† (Engineering)

Abstract:

Reinforced concrete (RC) bridges sometimes need to be widened in order to accommodate an increased flow of traffic, and post-installed rebar (PIR) technology is an easy and efficient way to do so. PIR installments are often used in RC construction to add new concrete members onto existing structures without the need for tearing down the existing concrete. PIR systems are convenient to install and can produce stronger bonds than cast-in rebar, and so are very useful in a number of different applications. However, because this technology has only relatively recently been adopted into RC construction codes, research still needs to be done into the optimization of the design process. Existing models used for the design of PIR installations are overly-conservative and often produce unnecessary design requirements. This project aims to produce a more accurate model for PIR systems in order to improve the efficiency of PIR application in RC bridge construction. To do this, pull-out tests will be done using a specially-designed RC specimen to determine the effect of individually varying rebar diameter, embedment depth, splice length, concrete cover, and steel reinforcement on the tensile strength of the PIR system. Using the measured tensile strength and the observed mode of failure, an equation can be developed which more accurately models the system. After an accurate model is developed, it will be tested on an RC bridge widened using PIR technology, proving its applicability to real-world construction projects.

Keywords: [no keywords provided]

Mentor(s):

Margaritis Tonidis (Engineering)

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

Poster Presentation Abstract Number: 1444
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Investigating the Plant Immune Response to Ralstonia Exopolysaccharide

Life Sciences

Author(s):

Shreya Joshy† (Science); Brooke Allison Pilkey‡ (Science); Silas Henry Buchanan‡ (Agriculture)

Abstract:

Ralstonia solanacearum is a phytopathogen that enters through the root vasculature and forms a biofilm called exopolysaccharide (EPS) that blocks water and nutrient intake, causing the plant to wilt. We investigate how exopolysaccharides interact with the plant's immune response and the relationship between carbohydrate-binding proteins in plants, called lectins, and bacterial EPS. Crude tomato lectins were isolated through column chromatography, and these were applied to K60, GMI, and their epsB mutant strains, which produce lower amounts of EPS. The colonies were viewed under a microscope to derive a correlation between levels of agglutination and the presence of EPS. To study how single lectins affect the properties of EPS production, lectins of interest were attached to a promoter with a tag and expressed in E. coli. Further, these will be applied to bacterial strains to examine agglutination. ROS assays are performed to understand how the plant responds to a pathogen, and this assay was used to study if the reactive oxygen species absorbed by the bacteria varied with the amount of EPS present. Roots from resistant and susceptible cultivars of tomato were treated with varying concentrations of elicitors, and the amounts of reactive oxygen species were monitored. To further explore the protective nature of EPS, wild-type, and epsB mutant strains were plated and exposed to hydrogen peroxide, and the zone of inhibition was calculated. Further research needs to be conducted to study the protective nature of bacterial EPS and the role it plays in colonization.

Keywords: [no keywords provided]

Mentor(s):

Rebecca Lynn Leuschen-kohl (Agriculture); Stephen R Lindemann (Agriculture); Rwivoo Baruah (Agriculture); Anjali Iyer-Pascuzzi (Agriculture)

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

Poster Presentation Abstract Number: 1445
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Real-Time Robotic Applications for Autonomous Driving, Drones, and Smart Manufactoring

Innovative Technology / Entrepreneurship / Design

Author(s):

Basil Khwaja† (Engineering)

Abstract:

Vehicles autonomously navigate dynamic environments using advanced sensory and cognitive systems but fall short of tackling new and unfamiliar environments. The objectives of this work are twofold. First, it aims to deploy a real testbed to prototype an autonomous vehicle (AV) and evaluate its performance across various application scenarios. Second, by intentionally pushing the cars to failure through localized environmental updates, we aim to test the system's limits and demonstrate the enhanced benefits of edge computing on the path-planning process. Specifically, the software and hardware stacks of this AV prototype comprise an autonomous navigation stack on the ROS platform, various global and local path-planning algorithms, and physical racing car installations. To assess autonomous navigation performance, we conduct both visual simulations and real-world experiments on the path-planning process using Dijkstra, A*, and RRT algorithms. Utilizing the move base architecture on the ROS platform, we manipulate different parameters to compare changes in the motion control of racing cars, focusing on aspects such as RRT algorithm trajectories and environmental map information. This approach allows us to explore the advantages of edge computing concerning computation offloading. Furthermore, we integrate the MuSHR racing cars with Cisco Wi-Fi 6E networks to investigate the benefits of edge computing by receiving assistance from edge servers for autonomous navigation

Keywords: Autonomous Driving; Path Planning; ROS/MuSHR; Real Experiments; Edge Computing

Mentor(s):

Yuan-Yao Lou (Engineering); Kwang Taik Kim (Engineering)

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

Poster Presentation Abstract Number: 1446
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

AUV Retrieval Manipulator

Innovative Technology / Entrepreneurship / Design

Author(s):

Nils Kiefer†

Abstract:

Research vessels often face delays during the deployment and retrieval of Autonomous Underwater Vehicles (AUVs) at sea. Automating this process using drones can significantly improve efficiency. This project focuses on developing effective gripping mechanisms for drone-based AUV retrieval. The main challenge is to ensure the gripping mechanism is accurate enough to attach to the AUV without compromising the drone's flying ability. Two mechanisms are compared: a hook design and a string-bow design.

The string-bow design offers a wider x-y angle range and greater z tolerance, accommodating variable AUV orientations and rough sea states. Conversely, the hook design requires careful determination of the suitable length to ensure effective attachment. Techniques such as compliant mechanisms with print-in-place hinges, 3D printing, and carbon fiber construction are employed to minimize weight and reduce aerodynamic impact. CAD modeling and finite element analysis (FEA) are used to optimize strength and flexibility, while rapid prototyping allows for quick modifications based on testing results.

Success rates and time metrics from 10 flight tests are used to compare the mechanisms.

Increasing the margin for error when the drone attaches to the AUV is crucial. The gripping mechanism is designed with a larger tolerance for misalignment, ensuring reliable attachment. Physical testing on a scaled-down model simulates real-world conditions, providing insights into performance and reliability. The goal is to create a gripping mechanism that maximizes the margin for future flight algorithms, facilitating precise AUV retrieval and enhancing the efficiency of marine research activities.

Keywords: AUV; Drone; Manipulator; Design; CAD

Mentor(s):

Nina Mahmoudian (Engineering)

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

Poster Presentation Abstract Number: 1447
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Characterization and Improvement of Vegetable Oils as Quenchants for Heat Treatment of Metals

Innovative Technology / Entrepreneurship / Design

Author(s):

Manila Kunwar† (Engineering); Ruey-Bin Tsai‡; Junyeong Ahn‡ (Engineering)

Abstract:

Current high performance quench oils used for the heat treatment of metals are petroleum derivatives and pose a threat to the environment. Vegetable oils are a potential alternative that is more sustainable and less toxic. However, due to the higher cost of bio-based formulations compared to petroleum oils and the low thermal-oxidative stability attributed by the molecular structure of vegetable oils, their use in industrial applications is not favorable. Furthermore, high performance petroleum oils generally provide better cooling performance compared to vegetable oils. This study aims to determine the effects of additives on vegetable oils to ultimately improve their thermal-oxidative properties and formulate a quenchant that provides appropriate and favorable cooling characteristics. Various properties were measured such as boiling point, degradation point, flash point, specific heat capacity, and viscosity of different oils including silicone-based lubricants, ester oils, vegetable-based oils, industrial oils, gear lubricants, and quench salts to analyze the significance of each property on cooling characteristics. By determining the most significant properties, additives can be chosen appropriately to enhance those properties. Some of the additives that are used include brominated vegetable oil, tributyl phosphate, triphenyl phosphate, and alkylated diphenylamine. This study will compare the cooling curves of the improved natural oils with the corresponding pure oil to determine the effect of additives on the cooling characteristics. The extensive database created from this study can further be used for machine learning applications to predict the cooling curve solely from quenchant characteristics.

Keywords: Quenching; Thermal-Oxidative Stability; Additives; Heat Treatment; Sustainability

Mentor(s):

Jeffrey P Youngblood (Engineering); Michael Titus (Engineering); Ching-Chien Chen (Engineering); David R Johnson (Engineering)

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

Poster Presentation Abstract Number: 1448
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Novel neutron-gamma radiation detectors based on PLA biopolymer detector (PLAD) sensor technologies.

Physical Sciences

Author(s):

Qi Heng Law† (Engineering)

Abstract:

Neutron and gamma radiation dosimetry is widely used in various industries, from nuclear power reactor monitoring to food preservation and sterilization. For example, current nuclear reactor power monitoring relies on expensive and low-efficiency (U-235 bearing) fission ion chambers for neutron radiation; and other types of ionization and scintillation-based detectors for gamma-beta radiation. Such conventional systems can be bulky and costly, with prices ranging up to millions of dollars. This research aims to improve a simple and 102-103x lower-cost, ultra-light alternative to existing systems based on renewable corn-soy-based biopolymers. The first method uses the mass loss upon dissolution method. Acetone is first preheated before coming into contact with the biopolymer resin polylactic acid (PLA). Irradiated PLA then dissolves in acetone, and depending on the degree of radiation exposure, the dissolution rate varies. The second method requires PLA completely dissolved in acetone, and the relative viscosity variation becomes a dosimetry metric. Using the mass loss dissolution method, dissolution increases as the dose increases. The temperature of acetone also plays a major role in this technique, as a higher temperature can exponentially enhance dissolution. Hence, it is more suitable for detecting the upper end (100 kGy) of dose. Using the relative viscosity method, higher-dosed PLA will have a lower relative viscosity and is more suitable to detect the lower end (sub-kGy) of doses. In conclusion, this research aims to attain a paradigm shift in radiation dose monitoring – to conduct an otherwise complex and expensive task, to be accomplished at an accelerated pace, at 100-1,000x lower cost with wide-spread applications.

Keywords: PLA; Radiation Detection; Neutron; Gamma

Mentor(s):

Rusi P Taleyarkhan (Engineering); Stepan Ozerov (Engineering)

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

Poster Presentation Abstract Number: 1449
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Designing Fractional Permissions for a Gradual Verifier

Mathematical/Computation Sciences

Author(s):

Craig Liu† (Science)

Abstract:

Static verification is a technique for ensuring software works exactly as intended. It is used in critical software such as control systems for airplanes. However, static verification is arduous and prohibits incrementality, as using it requires writing precise specifications in mathematical logic and all specifications must be written before verification feedback can be received. Gradual verification alleviates these difficulties by allowing incomplete specifications, whose missing parts are then checked dynamically to ensure soundness. The first gradual verifier, Gradual C0, is able to reason about programs that manipulate shared heap memory using permissions. However, Gradual C0's permissions are limited in their expressiveness, as they cannot distinguish between read and write behavior. The ability to do so is important for verifying concurrent programs, since multiple threads often only need to read from the same memory location. To address this, we extend Gradual C0 to support fractional permissions, which associates each heap location with a fraction between zero and one inclusive. If the fraction is nonzero, then it can only be read from, and if it is one, then it can be written to. Arithmetic with the fractions expresses changing between read and write access. We modify Gradual C0's backend verification algorithm to support fractional permissions, adhering to the aforementioned properties. Moving forward, we plan to implement fractional permissions in Gradual C0's specifications and runtime checks.

Keywords: Gradual Verification; Fractional Permissions; Separation Logic

Mentor(s):

Jenna L Wise DiVincenzo (Engineering)

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

Poster Presentation Abstract Number: 1450
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

UGV IoT Deployment System

Innovative Technology / Entrepreneurship / Design

Author(s):

Ismael A Luna†

Abstract:

Even with modern advancements, current agricultural practices may not be sufficient to meet future food demands sustainably. Integrating advanced technologies in precision agriculture is essential to optimize resource use and minimize environmental impact. This research addresses the future demands of global food production by developing autonomous agricultural robots coupled with low-cost Internet of Things (IoT) technologies. We aim to achieve near-perfect crop monitoring and soil management precision by autonomously deploying low-cost IoT sensors to tackle future challenges such as food scarcity and ecosystem disruption. We present a novel robotic sensor deployment system that can be installed on an unmanned ground vehicle, enabling the autonomous deployment of low-cost IoT soil sensors. We hypothesize that an improved electrical and control system for an auger drill will enhance the implementation of autonomous sensor deployment for soil monitoring, leading to more efficient and sustainable agricultural practices. This study details the development of key components, including algorithms for controlling the auger position, a streamlined printed circuit board (PCB) design, and system testing of the sensor dispenser. Our findings demonstrate the successful autonomous deployment of buried IoT soil sensors with the refined deployment system. These advancements in precision agriculture significantly contribute to sustainable and efficient farming practices, addressing critical issues like nutrient deficiencies and plant diseases at a microscopic level, ultimately paving the way for a more resilient and secure global food system.

Keywords: Precision Agriculture; Systems; Robotics

Mentor(s):

David J Cappelleri (Vice President Research); Ki Tae Kim (Engineering); Aarya Deb (Engineering)

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

Poster Presentation Abstract Number: 1451
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Laser Diffraction-Based Particle Size Distribution Analysis of Indoor Settled Dust

Life Sciences

Author(s):

Minh An Nguyen Luu†

Abstract:

Particle size distribution (PSD) analysis of indoor dust in a reliable and time-efficient manner is critical. Traditionally, PSD methods have relied on mechanical sieving (MS). MS, however, has significant drawbacks, being labor-intensive and requiring large sample mass. In contrast, laser diffraction-based PSD analysis (LD) offers better size resolution, accuracy, and automation by measuring the intensity of light scattered by laser beams as they pass through the dust. Despite these advantages, LD-based PSD analysis of indoor settled dust remains limited due to the lack of established methods for converting the relative distribution output of LD to absolute particle mass size distributions. To address this, we are developing a novel approach that combines data from a helium pycnometer of dust bulk density and LD analysis to report particle mass size distributions of indoor settled dust using LD analysis. Our results indicate that LD analysis provides significantly higher size resolution and accuracy compared to MS analysis. Specifically, MS-based analysis of indoor dust could only size 63.1% of particles in the 20-45 µm range, 43.5% in the 45-90 µm range, 56% in the 90-150 µm range, and 32% in the 150-355 µm range when compared to LD-based analysis. By combining data from helium pycnometer with LD analysis, our developed method can report indoor settled dust particle mass size distributions with higher size resolution. This advancement is crucial, as infants can be exposed to environmental toxicants in indoor dust via ingestion and inhalation, processes that are sensitive to the particle size of the indoor dust.

Keywords: Environmental Characterization; Dust Morphology; Particle Size Distributions; Indoor Aerosols

Mentor(s):

Brandon Boor (Engineering); Satya Sundar Patra (Engineering); Nusrat Jung (Engineering)

Poster Presentation Abstract Number: 1452
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Mechanical Properties of UV Curable Polymer-Bonded Explosive Molding Powder

Physical Sciences

Author(s):

Ellen Ma†

Abstract:

The current method of manufacturing molding powder for polymer-bonded explosives (PBXs) involves suspending energetic particles in agitated water and mixing in the dissolved binder before evaporating out the solvent. Unfortunately, this process comes with notable drawbacks, including the long processing times, use of toxic solvents, and the limited number of specialized binder suppliers. Previous work made alternative molding powders using partially cured hydroxyl-terminated polybutadiene (HTPB) as a binder, and mixed it directly with a sugar surrogate to make PBXs. However, there have been issues with inconsistent curing rates and short storage times, and isocyanates are still generally considered toxic. A UV curable binder allows for fine control of curing rates at short time scales and some mixtures can be safer than isocyanates. This research aims to characterize the compressive properties of pressed PBX samples made with a UV curable molding powder based on a difunctional aliphatic polyester urethane acrylate. This study compares sample density and compressive strength across different UV cure times to assess the sample quality. The densities of the samples are measured using the Archimedes method and the samples are subjected to compression testing to collect their stress-strain curves. Based on the processing conditions, the compressive properties and densities could easily be tuned for specific applications. Given the right conditions, samples with sufficient densities and compressive strengths were made, indicating that this method of manufacturing molding powder for PBXs is a promising alternative to the traditional solvent-based method.

Keywords: Compression Test; UV Curable Binder; Molding Powder; Polymer-Bonded Explosive; Plastic-Bonded Explosive

Mentor(s):

Ismar Leonel Chew (Engineering); Monique Suzanne McClain (Engineering)

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

Poster Presentation Abstract Number: 1453
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Improvement in Epichlorohydrin Coupling for More Effective Drug Synthesis

Life Sciences

Author(s):

Louden James Maciag† (Science|JMHC)

Abstract:

As people grow older, their risk of high blood pressure increases, potentially leading to side effects such as kidney disease and heart failure. Due to the prevalence of these diseases, the manufacture of drugs to treat high blood pressure, such as propranolol become increasingly important. Improvements in synthesis of propranolol, that also reduce byproduct formation due to epoxide ring opening in its intermediate is sought. To ensure more effective synthesis, this research aims to eliminate the byproducts that stem from propranolol creation using continuous flow synthesis. Our initial phase consisted of determining the dimensions for our flow apparatus, which derived from a previous lab member's research. Judicious selection of the reactor length and overall reaction time revealed the ability to conserve the epoxide ring and prevent ring opening. Shortening the residence time of the reaction from 60 minutes to 30 minutes was then tested to see how it would affect purity and yield of the sample. Results indicated a drop in purity from 90% to 88% and a decrease in yield from 65.34% to 42.04%. Further work includes using the techniques learned from this experiment to effectively add the epoxide ring to other compounds, such as carboxylic acid derivatives. We plan to do this through the use of a packed bed reactor within the flow apparatus in order to act as a base instead of adding it via syringe to better prevent ring opening within the reaction.

Keywords: Propranolol; Epoxide Ring; Flow Chemistry; Residence Time

Mentor(s):

David Thompson (Science); Marissa Elaine Henager (Science)

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Poster Presentation Abstract Number: 1454
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Quartz Mechanical Characterization and Ballistic Impact Testing

Physical Sciences

Author(s):

Nicole Marie Maneatis† (Engineering)

Abstract:

A challenge faced by the aerospace industry while operating in harsh conditions is solid particle erosion (SPE) damage to sensitive machinery. Many aeronautical vehicles operate in environments where sand and other particles are frequently ingested by the aeroengine from aerosolized or ground exposure. To predict the damage created from the impact of foreign objects on the aeroengine, the response of both the base material and the impacted substrate material needs to be understood. This paper is focused on characterizing the mechanical response of quartz samples following mechanical testing. Because lab-made quartz (fused quartz) is relatively inexpensive to produce and is manufactured into uniform shapes, using fused quartz for mechanical testing can be more cost effective. However, there are no studies examining or quantifying differences in fracture behavior of fused quartz and natural quartz. To determine the difference in the mechanical response between fused quartz and natural quartz, coupon specimens with similar test geometries are machined from both types of quartz. A diamond saw is used to cut large quartz samples while a lapidary machine is utilized for high precision shaping of quartz samples. MTS compression tests and ballistic testing are performed on rectangular prism-shaped samples. Dynamic coupon testing is performed for each respective test at several strain and loading rates. When compared, fused quartz and natural quartz are found to experience a different response. The results suggest the crystal structure differences in single-crystal, polycrystalline (natural quartz), and fused quartz may play a role in fracture behavior.

Keywords: Quartz Mechanical Testing; Quartz Fracture Behavior; Coupon Specimen; Natural Quartz; Fused Quartz

Mentor(s):

Zherui Martinez-Guo (Engineering); Cody Dean Kirk (Engineering)

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

Poster Presentation Abstract Number: 1455
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Reduced modeling of oscillatory flow in soft hydraulic systems

Mathematical/Computation Sciences

Author(s):

Rafael Monteiro Martins Pinheiro† (Science)

Abstract:

In previous studies, a theory of fluid-structure interaction (FSI) between an

oscillatory Newtonian fluid flow and a compliant conduit was developed. These studies developed a reduced model with the goal of analyzing the FSI with reduced computational cost but high fidelity of the underlying physics. Previous simulations of the model only considered a constant flow imposed at the inlet of the soft hydraulic system. This study aims to extend the previous work by incorporating oscillatory flow conditions. In the reduced model will be solved numerically with an oscillatory boundary condition at the inlet and the data will be analyzed to observe the effects of oscillations on the pressure, flow rate, and wall deformation of the soft hydraulic system. In this study, the compliance parameter, which measures the strength of the non-linear flow deformation coupling and the tension and inertia coefficients, which measures the stiffness and weight of the wall will be varied, so we can recognize how they affect the time-averaged pressure distribution. According to previous studies, we hypothesize that nonzero mean pressure averaged over an oscillation cycle is expected due to the nonlinear coupling of the pulsating flow and wall deformation. The reduced model will be used to qualitatively study the dynamic behavior of soft hydraulic systems under oscillatory flow conditions, which has important applications such as in devices that deals with microfluidic operations.

Keywords: Fluid Mechanics; Fluid-Structure Interaction; Simulation; Microfluidics

Mentor(s):

Ivan C Christov (Engineering)

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

Poster Presentation Abstract Number: 1456
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

DashBoard for automatic sensor measurements using LoRa, Chirpstack and web development

Mathematical/Computation Sciences

Author(s):

Nicolas Miguel Murillo Cristancho†; Nicolas Rendon Arias‡; Sehyeon Lim‡

Abstract:

Obtaining and storing a large amount of historical data from sensors automatically is important to achieve efficiency in agricultural industry and electrical networks. Thus, it is desirable to have a graphical user interface accessible through the web to display real-time sensor data and analyze this information over time for predictive purposes. Displaying large amounts of data through the web easily is a challenge. The system needs to connect to multiple devices, each one with a specific geographical location, and handle several measurements per minute. LoRa technology was chosen due to its long communication range and ability to manage multiple transmitting devices without relying on an internet connection. The HTTP protocol was chosen to connect a ChirpStack server with a Web application developed using Angular (a Node.js framework). Ngx-chart (an Angular open-source library) and the Google Maps API were also integrated to visualize historic data through graphs and display device locations on maps. The combination of these technologies made it possible to create a website where gauges, line graphs and maps interact with each other achieving an important objective: display current and historical data from any type of sensors (voltage, temperature, etc.) for monitoring and predictions. The dashboard will be used for multiple Internet-of-Things (IoT) projects, in this case, electrical networks and agriculture.

Keywords: Internet of Things; Remote Sensing; Wireless Communications; Sensors

Mentor(s):

Walter Daniel Leon-Salas (Polytechnic)

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Poster Presentation Abstract Number: 1457
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Multifunctional integrated cooling support structures for future HEP Silicon Tracker Detectors

Physical Sciences

Author(s):

Angie Catalina Parra Ovelencio†; Pedro Daniel Soto Rodriguez‡ (Engineering|JMHC)

Abstract:

[Abstract Redacted]

Keywords: Thermal Conductivity; Composite Materials; Compression Molding; Cooling System; Silicon Detectors

Mentor(s):

Andreas Jung (of Science); Sushrut Karmarkar (Science)

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

Poster Presentation Abstract Number: 1458
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

High School Students in Engineering Design Project: Teamwork and Decisions

Social Sciences / Humanities / Education

Author(s):

Hemisha Shardul Patel† (Science)

Abstract:

To support the growing semiconductor industry, the Purdue Ivy Tech Chips Program (PITCH) initiative helps develop high school students' problem-solving and teamwork skills through engineering design, preparing them as future STEM professionals to tackle global challenges. In this paper, we investigate how rising high school juniors and seniors collaborated and navigated a design challenge as part of the summer camp. Our study focuses on a subset of thirty students (six teams of five) who developed proof-of-concept projects addressing Sustainable Development Goals (SDGs) using MicroBit microcontrollers. Employing a concurrent mixed methods approach, with a predominance of qualitative analysis, we examined student artifacts, think-aloud protocols, and structured interview excerpts to uncover the dynamics of team-based design decision-making processes. Our findings reveal that students actively broaden and acknowledge multiple perspectives and rely on data-driven decision-making. Notably, there was no significant correlation between meticulous documentation of the design process and the quality of the final projects. However, teams with members who experienced higher satisfaction and felt supported often produced better outcomes. These results suggest that interdisciplinary problem statements can nurture diverse interests and that a focus on presenting and exhibiting projects, rather than competing, promotes a cooperative and supportive team environment. Future research should explore the long-term impacts of these educational approaches and refine methods to better support STEM skill development in high school students.

Keywords: Teamwork; Decision Making; High School Students; Engineering Education

Mentor(s):

Yash Ajay Garje (Engineering); Cristian Eduardo Vargas Ordonez (Engineering)

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

Poster Presentation Abstract Number: 1459
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Validation and Analysis for Full Scale Avian Inspired Flapping Wing Aerial Vehicle (FWAV)

Innovative Technology / Entrepreneurship / Design

Author(s):

Milan Edward Rahmani† (Engineering); Sota Yanagisawa‡ (Engineering)

Abstract:

[Abstract Redacted]

Keywords: Flapping Wing UAV; Aerodynamic Performance; Unsteady VLM; Wing Kinematics

Mentor(s):

Abhijnan Dikshit (Engineering); Pavankumar Channabasa Koratikere (Engineering); Leifur Thor Leifsson (Engineering)

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

Poster Presentation Abstract Number: 1460
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Enhancing Bio-based Adhesive Performance for Sustainable Plywood: Optimizing Processing Pressure for Improved Mechanical Strength

Innovative Technology / Entrepreneurship / Design

Author(s):

Paula Sanchez Ulloa†

Abstract:

Considering the pressing issues of resource depletion and greenhouse gas emissions, replacing synthetic adhesives in engineered wood products with sustainable alternatives is becoming increasingly critical. Traditional adhesives like urea-formaldehyde (UF) are effective but contribute to environmental pollution through the constant release of volatile organic compounds (VOCs). Bio-based adhesives, such as those derived from soy flour (SF), mycelium hyphae and bacterial cellulose (BC), offer a greener solution but often struggle with inadequate bond strength, poor moisture resistance, and limited durability. This study focuses on improving the shear strength of mycelium and BC adhesives in 2-ply plywood by optimizing processing pressure. Yellow poplar is selected as the substrate due to its uniform wood structure, which resembles many softwoods used in plywood production, ensuring consistent and reliable results. By varying the processing pressure during adhesive application, the research measures the bond strength, moisture resistance, and durability of these bio-based adhesives. Success in this area could revolutionize the woodworking industry by providing a viable, eco-friendly alternative to synthetic adhesives and reducing reliance on non-renewable resources. Moreover, the insights gained from this study may have broader applications, potentially influencing other sectors reliant on adhesive technologies, such as automotive, packaging, and construction industries, thus contributing to the advancement of sustainable materials science and the promotion of green technologies.

Keywords: [no keywords provided]

Mentor(s):

Xiwei Shan (Engineering); Tian Li (Engineering)

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

Poster Presentation Abstract Number: 1461
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Long-term Effects of Repeated, Episodic Heat Exposure on Cardiac Structure and Function in Aged, Obese Mice

Life Sciences

Author(s):

Paul William Swift† (Engineering|JMHC)

Abstract:

Background: Combined aging and obesity may lead to cardiac hypertrophy and reduced cardiac function, resulting in an elevated risk of cardiovascular disease. Heat therapy (HT) may be a practical, non-invasive therapy to improve cardiovascular health. Aims: We tested the hypothesis that exposure to HT would improve cardiac structure and function in a model of aging and diet-induced obesity. Methods: Male C57BL/6J mice (52 weeks old) were fed a high-fat diet and randomly assigned to receive either HT (39 degrees C; n=6) or a sham treatment (SHAM; 22 degrees C; n=8). The intervention comprised two 30-minute sessions per week for three months, three 20-minute sessions per week for three months, and four 15-minute sessions per week for the remaining five months. Transthoracic echocardiography was performed using a high-frequency ultrasound system before and after the intervention. A young control group (YC; 16 weeks old; n=8) was also assessed for comparison. Results: SHAM, but not HT, had a higher left ventricle (LV) mass (SHAM: 182+/-36 mg vs. YC: 132+/-18 mg, p=0.008) compared to YC. Both SHAM and HT had higher diastolic LV anterior wall thicknesses (SHAM: 1.21+/-0.19 vs. HT: 1.23+/-0.16 vs. YC: 0.976+/-0.072 mm, p=0.005) compared to YC. Exposure to HT had no significant impact on ejection fraction (p=0.32), stroke volume (p=0.88), fractional shortening (p=0.89), cardiac output (p=0.77), LV posterior wall thickness (systolic: p=0.85, diastolic: p=0.65), and LV diameter (systolic: p=0.24, diastolic: p=0.57). Conclusions: Episodic exposure to whole-body heat stress over 11 months does not affect cardiac structure and function in aged, obese mice.

Keywords: Cardiovascular Disease; Heat Therapy; Diet-Induced Obesity; Aging

Mentor(s):

Bruno Tesini Roseguini (HHS); Bohyun Ro (HHS); Luke Schepers (Engineering); Craig Goergen (Engineering); Qifan Song (Science)

Poster Presentation Abstract Number: 1462
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Laser-Induced Graphene Electrochemical Sensing for Low-Cost Point of Care Devices

Innovative Technology / Entrepreneurship / Design

Author(s):

Julia Janina Szela† (Engineering)

Abstract:

Point-of-care (PoC) health screening tools, such as paper-based lateral flow immunoassays (LFIA), are widely used for the categorical detection of viral infections. However, LFIA are ill-suited to quantifying the relative expression of nucleic acids or proteins when identifying a patient’s viral status, lacking appropriate specificity. Enhancing current paper-based methods through the integration of electrochemical techniques would allow for improved quantifiability and specificity of biomolecular binding. Here we used a laser treatment process to make electrically conductive paper traces while avoiding the use of inks or metals. We investigated the effect of laser fluence on resistivity by adjusting varying levels of power and speed, allowing us to characterize the effects of these traces. These traces were designed to press fit into common USB type-C interface, so to leverage the integrated analog-to-digital hardware of smartphones. Using a CO2 laser cutter to create laser-induced graphene (LIG) on paper surfaces not only makes the device disposable, but also allows for the development of a USB-C. We found that characterizing the electrical properties of the LIG contributed to the design of a capacitance-based biosensor that is compatible with a USB type-C interface. With this, it will allow us to measure of capacitance of an antibody bound electrode versus an unbound reference electrode through signal decay time. This technique highlights its promise for developing low-cost and disposable diagnostic products extensible to various healthcare applications.

Keywords: [no keywords provided]

Mentor(s):

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

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

Poster Presentation Abstract Number: 1463
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Morphological characterization of anatomically defined Layer 5B pyramidal neuron subtypes

Life Sciences

Author(s):

Andres Uzcategui† (Engineering)

Abstract:

Cortical layer 5B pyramidal neurons (L5B PN) project to various cortical and subcortical regions, forming the major excitatory output of the neocortex . Morphologically, these neurons are characteristic with bushy basal dendrites and long apical dendrites originating from L5B and extending to the cortical surfaces. The apical dendrites of L5B PNs integrate information across multiple layers of the cortex, generating global dendritic activities, which is critical for sensory perception. Previous research shows correlation between the apical dendrite morphology with diverse patterns of global events, suggesting that morphological difference could allow parsing of distinct integrated information to different downstream pathways. Yet, given the heterogeneity of morphology and electrophysiology across the L5B PN population, the correlation between neuronal morphology and their down-stream projection target remained poorly mapped. This research aims to quantify the morphological differences between PNs based on their projection targets. L5B PNs in the primary somatosensory cortex (S1) projecting to PoM, SC and pons are labeled through retrograde tracing. We used ImageJ and integrated plugins to analyze two- photon imaging datasets from retrograde labeled L5B PNs for morphological analysis and comparison. In a separate cohort of retrograde labeled mice, we imaged cryotome brain slices to quantify the density and co-localization of these anatomically defined L5B PNs groups. In future studies, the reconstructed morphology of the anatomically defined subgroups may be corroborated with their electrophysiological properties to reveal the biophysical basis of subtype-specific computations.

Keywords: Neuroscience; Neuron Morphology; Two Photon Microscopy

Mentor(s):

Krishna Jayant (Engineering)

Other Acknowledgement(s):

Shulan Xiao

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

Poster Presentation Abstract Number: 1464
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Data Staleness in Irmin over Partial Quorum Datastores

Mathematical/Computation Sciences

Author(s):

Kartavya Vashishtha† (Science|JMHC)

Abstract:

[Abstract Redacted]

Keywords: Distributed Systems; Databases

Mentor(s):

Anmol Sahoo (Science); Suresh Jagannathan (Science)

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

Poster Presentation Abstract Number: 1465
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

C to Rust: Manual Conversion Methods and Standardized Dataset Creation

Innovative Technology / Entrepreneurship / Design

Author(s):

Gaurav Vermani† (Engineering)

Abstract:

The strongly and statically typed programming language, Rust, focuses on memory safety and low-level control, as well as incorporating features from functional programming languages. Due to its unique combination of features, it is seen as a safer yet flexible alternative to C, fueling an interest in migrating legacy codebases from C to Rust. This demand has led to the development of C-to-Rust transpilers, such as the C2Rust project, that attempt to convert C syntax to Rust while maintaining the source code semantics. However, such existing tools have an inadvertent drawback: they preserve certain unsafe practices of C, denoting them with the "unsafe" keyword to circumvent the Rust compiler’s safety checks, potentially compromising the language’s memory-safety guarantees.

This research explores methods and standardized patterns for translating C code into safe and idiomatic Rust. Firstly, we manually create mappings for common C code patterns to their safe Rust equivalents. Next, these patterns are used to convert a diverse dataset of C code into line-by-line corresponding Rust code, thereby generating a standardized C-to-Rust codebase. This dataset currently includes programs spanning various categories from data structures and algorithms; and will incorporate vulnerable test cases from the Juliet Test Suite, and pointer-intensive benchmarks from Ptrdist in the future. Future work will also utilize this dataset as a benchmark for establishing metrics to assess current transpilers and for developing an automated transpiler.

Keywords: C; Rust

Mentor(s):

Aravind Machiry (Engineering); Shashank Sharma (Engineering); Ayushi Sharma (Engineering)

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

Poster Presentation Abstract Number: 1466
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Analysis and Improvement of Rank-Ordered Mean Algorithm in Single-Photon LiDAR

Mathematical/Computation Sciences

Author(s):

William Yau†; Weijian Zhang‡ (Graduate)

Abstract:

Depth estimation using a single-photon LiDAR is often solved by a matched filter. It is, however, error-prone in the presence of background noise. A commonly used technique to reject background noise is the rank-ordered mean (ROM) filter previously reported by Shin et al. (2015). ROM rejects noisy photon arrival timestamps by selecting only a small range of them around the median statistics within its local neighborhood. Despite the promising performance of ROM, its theoretical performance limit is unknown. In this paper, we theoretically characterize the ROM performance by showing that ROM fails when the reflectivity drops below a threshold predetermined by the depth and signal-to-background ratio, and its accuracy undergoes a phase transition at the cutoff. Based on our theory, we propose an improved signal extraction technique by selecting tight timestamp clusters. Experimental results show that the proposed algorithm improves depth estimation performance over ROM by 3 orders of magnitude at the same signal intensities, and achieves high image fidelity at noise levels as high as 17 times that of signal.

Keywords: Rank-Ordered Mean (ROM); Single-Photon LiDAR 3-D Imaging; Convex Optimization; Low-Light Imaging; Computational Imaging

Mentor(s):

Stanley H Chan (Science)

Other Acknowledgement(s):

Hashan Kavinga Herath Mudiyanselage

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

Poster Presentation Abstract Number: 1467
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Cleanroom-free Double Nanohole Plasmonic Biosensor Fabrication

Innovative Technology / Entrepreneurship / Design

Author(s):

Matthew T Zegarski† (Engineering)

Abstract:

[Abstract Redacted]

Keywords: Optical Tweezing; Plasmonic Biosensor; Biomolecular Interaction; Colloidal Lithography; Label-Free

Mentor(s):

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

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

Poster Presentation Abstract Number: 1468
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Enhancing Software Failure Analysis through Semantic Similarity and Knowledge Graph Modeling

Mathematical/Computation Sciences

Author(s):

Bryan Zhang†

Abstract:

The increasing complexity of software systems has led to a growing need for effective analysis and prediction of software failures. Understanding the relationships between different software failures is crucial for preventing similar incidents in the future and improving overall system reliability. The FAIL (Failure Analysis Investigation using LLM) database provides a rich source of information, but its vast size poses challenges in identifying related failures. This research aims to automate the identification and retrieval of related failures from the FAIL database using advanced techniques. It begins with semantic similarity analysis using BERT embeddings to capture nuanced similarities among failure events. Subsequently, a knowledge graph is constructed using DGL-KE, integrating models like TransE, TransR, RESCAL, DistMult, ComplEx, and RotatE to model complex relationships between failure events. Finally, relationship prediction for new failure incidents leverages BERT embeddings in conjunction with the most effective graph embedding model, facilitating accurate and efficient retrieval of relevant failure data. Our experiments reveal that the RotatE model performs best in capturing nuanced relationships between failure events, enabling quick and accurate retrieval of similar past incidents. This combined BERT and knowledge graph approach demonstrates effectiveness in automating software failure analysis, offering a scalable solution for identifying patterns and relationships in failure data. By enhancing the understanding of failure mechanisms and supporting proactive risk management, this research contributes to the development of more robust software systems and improved software reliability.

Keywords: Failure Analysis; Semantic Similarity; Knowledge Graph; Software Reliability

Mentor(s):

James C Davis (Engineering)

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

Poster Presentation Abstract Number: 1469
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Automatic Fracture Risk Prediction from HR-pQCT

Life Sciences

Author(s):

Mohammed Abdul Gani Zilani†

Abstract:

Bone fractures are one of the most common orthopedic injuries in the world. To predict the risk of bone fractures, doctors generally use dual-energy X-ray absorptiometry (DXA), plain X-rays, and computed tomography to assess the fracture risk. These imaging technologies cannot produce high-resolution scans and often fail to capture the soft tissues around the bone. Low-quality scans of bones can lead to missed or delayed fracture diagnosis and require attention from trained medical practitioners. This lab aims to develop an automatic risk prediction algorithm using high-resolution peripheral quantitative HR-pQCT, to improve the quality and efficiency of fracture risk prediction. The algorithm will be built using deep learning-based networks. In the initial part of the project, images from the HR-pQCT are manually segmented into regions of inner bone, outer bone, muscle, skin, and fat using the Slicer software. The segmented volumes are then used to develop a prediction model, emphasizing soft tissue around the bone. After running a primitive test with the segmented data, a reasonable difference was found between the healthy and CKD patients' bone microarchitecture and soft tissue organization in the distant tibial region. The algorithm developed from this project will help improve the quality and efficiency of fracture risk prediction with, soft tissues as bio-markers, thereby leading to a better diagnosis for the patients and increased support for the medical practitioner. Using an automatic fracture prediction algorithm, also reduces the number of missed and delayed cases, thereby increasing the quality of treatment for the patients.

Keywords: [no keywords provided]

Mentor(s):

Mohseu Rashid Subah (Engineering); Rachel Kathleen Surowiec (Engineering)

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

Poster Presentation Abstract Number: 1470
Presentation Time: Session 3: 12:00pm-1:00pm

SURF

Fabrication of Temperature-sensitive Additives for PFAS-free Fire Fighting Foam Formulations

Physical Sciences

Author(s):

Jiying Zou†

Abstract:

Aqueous film-forming foams (AFFFs), used extensively by the Department of Defense for extinguishing fuel fires, contain per- and polyfluoroalkyl substances (PFAS). Due to growing environmental and health concerns associated with PFAS, developing safer alternatives has become urgent. PFAS-containing foams cause significant toxicity and persistence issues. This research aims to create a PFAS-free firefighting foam by developing temperature- and pH-responsive additives to enhance foam viscosity and stability. The primary goal is to mitigate foam degradation and improve firefighting performance without affecting foam generation and spreading. The study involves developing a viscosifying additive using pH-responsive polymers combined with temperature-responsive acids. This additive is designed to release at specific moments, enhancing foam stability and addressing related issues. Specifically, poly(methyl methacrylate-co-methacrylic acid) (PMMA-AA) is encapsulated with sodium pyrophosphate. Various concentrations of PMMA-AA solutions were prepared and tested for viscosity changes at different pH levels. The additives' viscosities were evaluated through rheological measurements, and their effects on foam stability and resistance to degradation will be tested. Preliminary results indicate that PMMA-AA solutions exhibit increased viscosity in response to pH changes. Sodium pyrophosphate shows potential in enhancing foam stability by altering the pH of the solution, inducing conformational changes in PMMA, and thereby increasing solution viscosity. Using temperature/pH-responsive additives in firefighting foam formulations could provide a promising approach to developing effective PFAS-free alternatives, addressing the environmental and health concerns associated with traditional PFAS-containing foams.

Keywords: Responsive Additives; pH Adjuster; AFFFs; PFAS; PFAS-free Fire Fighting Foam

Mentor(s):

Carlos J Martinez (Engineering); Nicole Lin Franklin (Engineering)

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

Poster Presentation Abstract Number: 1471
Presentation Time: Session 3: 12:00pm-1:00pm

Characterizing In-vitro Prostate Cancer Cell Responses to Combination Treatment

Life Sciences

Author(s):

Brett Andrew Anderson† (Science)

Abstract:

According to the American Cancer Society, prostate cancer (PCa) is the second-leading cause of cancer-related deaths in American men. Although androgen deprivation therapy (ADT) is effective at lowering the morbidity rate, later stages of this disease will stop responding to ADT and develop into castration-resistant prostate cancer (CRPC). The progression from PCa to CRPC is marked by changes to androgen receptor (AR) target gene expression, wherein AR-target genes, regardless of therapeutic intervention, are independently altered to prevent programmed cell death and allow for uninhibited proliferation. This functional transition is exemplified in CRPC patients who may show near castrate-levels of androgens, but intratumoral androgen levels still remain very high. Our lab recently found that the SWI/SNF chromatin remodeling complex known as GBAF (GLTSCR1/like-containing BRG1/BRM-Associated Factors) is an important regulator of AR-target gene expression and cell viability in CRPC cell models. One GBAF complex subunit, BRD9 (bromodomain containing 9), decreases AR-target gene transcription when pharmacologically inhibited. Given that frontline therapies for CRPC, such as enzalutamide (ENZA), inhibit AR binding in the nucleus, functional inhibition of GBAF via BRD9 degraders may potentiate this mechanism. The purpose of this study was to characterize PCa cell line responses to combination treatment of ENZA and the BRD9 degrader VZ-185. Our results demonstrate that functional inhibition of the GBAF complex via BRD9 degradation enhances the effect of ENZA on CRPC cell models, which suggests that BRD9 may be a potential therapeutic target for future animal studies regarding CRPC treatment.

Keywords: Prostate Cancer; Androgen Receptor; GBAF; BRD9; Enzalutamide

Mentor(s):

Emily Dykhuizen (Pharmacy); Brayden Paul Strohmier (Pharmacy)

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Poster Presentation Abstract Number: 1472
Presentation Time: Session 3: 12:00pm-1:00pm

Hybrid Printing with Continuous and Discontinuous fibers

Innovative Technology / Entrepreneurship / Design

Author(s):

Armando David Galicia Huerta†; Thomas Edgardo Schmitz‡ (Engineering|JMHC)

Abstract:

The hybrid printing project aims to enhance the mechanical properties of manufactured parts in the automotive and aerospace sectors through the combination of short and long carbon fibers. In the automotive and aerospace sectors, the adoption of carbon fiber composites is due to their high strength and lightness, which enhance the efficiency and performance of vehicles and aircraft, while also enabling safer and more aerodynamic designs. This study used pultruded continuous fibers reinforced with polycarbonate (PC) and discontinuous fibers from PC pellets using Extrusion Deposition Additive Manufacturing (EDAM). The goal is to integrate these parts with new functionalities derived from the diverse material properties employed. A hybrid printing process was developed at the Composite Manufacturing and Simulation Center (CMSC). This process incorporates continuous fibers to provide structural rigidity and discontinuous fibers that enable the creation of complex geometries, despite limitations in typical mechanical properties of commercial additive manufacturing materials. The Composite Additive Manufacturing Research Instrument (CAMRI) printer, originally designed for pellet extrusion of discontinuous fibers, was adapted with a co-extrusion nozzle and continuous fiber feeding system, effectively enabling the fabrication of parts integrated with both types of fibers in this study.

Keywords: Hybrid Printing; Continuous and Discontinuous Fibers; Carbon Fibers; Mechanical Engineering; 3D Printing

Mentor(s):

Eduardo Barocio Vaca (Engineering); R Byron Pipes (Engineering)

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

Poster Presentation Abstract Number: 1473
Presentation Time: Session 3: 12:00pm-1:00pm

Chlorophyl Analysis and its Role in Modeling Harmful Algae Blooms

Life Sciences

Author(s):

Race Ethan Medema† (Engineering); Alexandra Cynthia Marlene Britto‡ (Engineering)

Abstract:

The Midwestern United States is home to thousands of lakes and freshwater reservoirs crucial to their surrounding communities' drinking water, irrigation, and recreation. Blue-green algae is exceedingly common in these freshwater bodies and plays a key role in dissolved oxygen content, but population blooms during summer months risk algae concentrations reaching toxic levels. The NASA Remote Sensing of Water Quality Project (RSWQ) aims to develop a prediction model for these Harmful Algae Blooms (HABs) by linking satellite imaging to water and environmental conditions that correspond to toxic blooms. This study uses concentrations of Chlorophyll-a and Pheophytin (Chl-a & Pheo,) two molecules used in algae photosynthesis, as indicators of blue-green algae population trends in Lake Shafer, IN, across the summers of 2023 and 2024. Water samples were periodically taken across 14 locations on Lake Shafer, which were extracted through 0.7 ?m vacuum filtration for Chl-a & Pheo. Field-collected data will be overlaid onto satellite imaging as an effective trend-finding method used in the future prediction model. This study covers only a single variable and water body within the much larger RSWQ project. It paints an important image of the effectiveness of field sampling and provides a snapshot of how a predictive model could function.

Keywords: Water Quality; Water Management; Algae; Harmful Algae Blooms (HABs)

Mentor(s):

Keith A Cherkauer (Engineering)

Other Acknowledgement(s):

Nileshwari Raju Yewle; Isaac Henry Bradford

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

Poster Presentation Abstract Number: 1474
Presentation Time: Session 3: 12:00pm-1:00pm

Digitizing Purdue's Role in Tornado Science: Preserving Materials from the 1974 Super Outbreak in Indiana

Physical Sciences

Author(s):

Lindsey Renee Peterson† (Science|JMHC); Owen Ray Rahman† (Science); Maliyah Ann Smith† (Science)

Abstract:

On 3 April 1974, an outbreak of severe weather produced more than 100 tornadoes across 13 Midwest states, including Indiana. It featured seven F5 tornadoes, a record to this day, and would eventually be known as the 1974 Super Outbreak. In this presentation, we describe our efforts to digitally preserve first-hand accounts and records gathered by Purdue researchers from the 1974 Super Outbreak of tornadoes in Indiana. In the wake of the outbreak, Dr. Ernest Agee, a professor in the Geosciences Department (now EAPS) at Purdue University, started the Tornado Research Project (TRP). The goal of the TRP was to improve the understanding of the formation and movement of tornadoes. The research done on this event would explain the concept of tornado families: i.e., sequences of tornadoes produced by a single parent storm. Along with contemporaneous tornado research, this project laid the groundwork for modern tornado detection and warnings. The TRP materials included questionnaires completed by citizens who witnessed the event, personal photographs, and documents such as letters and newspaper articles. Currently, our team is in the process of safeguarding these pioneering efforts by digitizing the above materials, using best practices for digital archiving. Overall, our objective is to properly preserve the role that Purdue played in tornado research half a century ago.

Keywords: Tornado; Digitization; Archive; Purdue; Indiana

Mentor(s):

Robin L Tanamachi (Science)

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

Poster Presentation Abstract Number: 1475
Presentation Time: Session 3: 12:00pm-1:00pm

Investigating the Role of INO80 in H3K27me3 Homeostasis and Pickle Root Phenotype in Arabidopsis thaliana

Life Sciences

Author(s):

Amanda Renee Schoonmaker† (Agriculture|JMHC); Joshua T Stephenson‡ (Agriculture)

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Joseph P Ogas (Agriculture); Jacob Ryan Fawley (Agriculture); Jiaxin Long (Agriculture)

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

Poster Presentation Abstract Number: 1476
Presentation Time: Session 3: 12:00pm-1:00pm

Exploring Proteome Allocation and Gene Transformation in Paramecium bursaria Photosymbiosis

Life Sciences

Author(s):

Betsy Biju Varghese† (Science)

Abstract:

Photosymbiotic relationships, or symbiotic relationships between heterotrophs and photoautotrophs, are common in ecosystems and have significantly impacted evolutionary paths. One such symbiotic relationship is between the ciliate host Paramecium bursaria and its intracellular green algae, Chlorella. This research aims to use these organisms as a model to study the dynamics of resource allocation in symbiotic relationships via proteome analysis. Preliminary findings indicate that symbiotic P. bursaria has larger yields than its aposymbiotic relatives, suggesting that photosymbiosis, despite its benefits, comes with inherent costs. This study specifically aims to identify the key Chlorella genes important for the symbiotic relationship by comparing the proteome data of symbiotic versus aposymbiotic Paramecium bursaria. Candidate genes identified from this comparison will be genetically manipulated to create transformed Chlorella, which will then be used to re-initiate symbiosis with aposymbiotic Paramecium bursaria. By analyzing the characteristics of these newly established symbiotic entities, the research seeks to confirm the practical roles of these genes in the symbiotic relationship. In conclusion, this research will elucidate important ecological and physiological mechanisms that shape symbiotic connections and pinpoint the genes that have the most significant impacts on symbiotic relationships through targeted genetic transformations, thereby advancing ecological and evolutionary research.

Keywords: Photosymbiont; Paramecium Bursaria; Symbiotic Chlorella; Proteomics; Transformation

Mentor(s):

Dongseok Kim (Science)

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

Poster Presentation Abstract Number: 1600
Presentation Time: Session 4: 1:30pm-2:30pm

SCALE

Optimizing Vector Memory Accesses in a RISC-V Processor

Innovative Technology / Entrepreneurship / Design

Author(s):

William Rowan Cunningham† (Engineering); Maxwell Frank Michalec* (Engineering|JMHC); Om Gupta* (Engineering); Fahad Aloufi* (Engineering|JMHC)

Abstract:

While scalar processors operate on a single element, vector processors operate on multiple elements simultaneously. This form of data-level parallelism in a processor is called Single Instruction Multiple Data (SIMD). Vector processors offer increased data throughput compared to scalar processors, leading to a significant performance boost in data-intensive applications such as image processing or artificial intelligence. RISC-V's "V" vector extension outlines specifications and enables support for SIMD operations. Vectors can be loaded from and stored in main memory; however, memory operations bottleneck the current design's performance. While scalar load and store instructions only make one memory access per instruction, vector load and store instructions make memory accesses for each vector element. This research aims to improve vector unit performance by reducing memory accesses. The read-and-write data lanes between the data cache and load store controller were widened to return the entire cache block. Vector element addresses that match tags and go to the same cache block access memory at the same time. Grouping memory accesses together does not always happen, as coalescing is executed when convenient. After running a suite of custom scalar and vector benchmarks, the total number of cycles for each benchmark will be collected to evaluate performance. Then, the design will be synthesized to determine the maximum clock frequency, power, and area. Future work can focus on throughput improvements between processor interconnects.

Keywords: Computer Engineering; Vector Processors

Mentor(s):

Mark Johnson (Engineering); Cole Aaron Nelson (Engineering)

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

Poster Presentation Abstract Number: 1601
Presentation Time: Session 4: 1:30pm-2:30pm

SCALE

Study of Brain Metal Distributions and Interactions in Relation to Alzheimer's Pathogenesis Using Synchrotron X-ray Techniques

Physical Sciences

Author(s):

Jessica Andrea Gray†

Abstract:

Metals like mercury, lead, and iron may play a part in Alzheimer's disease. However, we still don't fully understand how these metals contribute to the disease. To study this, we need to figure out where these metals are in the brain, how they interact with each other, and how they relate to brain problems. We are using a special X-ray technique called synchrotron micro-X-ray fluorescence (S-µXRF) imaging to look at the metals in the brain and we found that mercury and lead tend to gather together. Also within this study, data analysis was employed to enhance the visibility of synchrotron micro-X-ray fluorescence images for human observation and to determine the presence and location of metals within the brain samples provided.In Alzheimer's brains, it was determined that the mercury and lead groups are bigger and are connected with other metals. We also found that both Alzheimer's patients and healthy people have some mercury and lead in their brains, showing that these metals are all around us. We think that selenium might help to control mercury and lead in the brain, but we need to do more research to see if it's good or bad. We also need to learn more about how mercury and lead group together and how they differ in Alzheimer's and healthy brains. This kind of study can give us new details about how metals affect brain problems, using advanced X-ray techniques.

Keywords: [no keywords provided]

Mentor(s):

Linda Nie (HHS)

Other Acknowledgement(s):

Pavani Devabathini

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

Poster Presentation Abstract Number: 1602
Presentation Time: Session 4: 1:30pm-2:30pm

SCALE

Evaluating the Radiation-Hardness of Varying COTS EEPROMs in a Thermal Neutron Environment

Physical Sciences

Author(s):

Riley James Robert Madden† (Engineering)

Abstract:

Space missions are in need of complex electronic devices to meet high computing demands. These devices must function properly in space radiation environments without significant degradation. An example of one of these complex devices is the electronically erasable programmable read-only memory (EEPROM). Determining commercial off the shelf (COTS) EEPROM devices' resilience in these environments increases the reliability of these spacecraft systems. One component of these radiation environments is thermal neutrons, which are known to disrupt electronic memory systems. This research aims to study the effects of a thermal neutron environment on the degradation of COTS EEPROMs using a Subcritical Assembly to expose the devices to a thermal neutron flux. The failure rate of the EEPROM devices controlled by time and neutron flux will be studied. The goal is first to characterize the spatial distribution of neutron flux within the Subcritical Assembly. This is done through indium foil activation analysis: a process where indium foils are subjected to the neutron flux, and their resulting activity is measured. Since the activity is proportional to the neutron flux, this provides a known flux spatial profile. Using this information, several EEPROMs will be tested at once at varying neutron fluxes and durations. The devices will be initialized, and data will be collected after the irradiation to characterize the degradation. This experiment design allows for observation of varying degradation between different memory capacities, package types, neutron fluxes, and irradiation times. Future improvements include testing of other microelectronic devices and testing in other neutron energy spectra.

Keywords: Radiation Hardening; Microelectronics; Neutron Flux; Neutron Activation

Mentor(s):

Stylianos Chatzidakis (Engineering); Peter Bermel (Engineering); William Stephen Richards (Engineering); Hannah Pike (Student Life)

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

Poster Presentation Abstract Number: 1603
Presentation Time: Session 4: 1:30pm-2:30pm

SCALE

Electron Emission Measurements in Schottky Barrier Diodes Exposed to Ionizing Radiation

Innovative Technology / Entrepreneurship / Design

Author(s):

Nicodemus M O'Brian† (Engineering)

Abstract:

While critical for operation in many radiation environments, such as nuclear reactors and outer space, small-scale electronics are highly susceptible to damage during exposure to ionizing radiation, such as photons and neutrons. Excessive exposure can damage electronics without proper shielding, necessitating replacement or decreasing performance. To understand how ionizing radiation impacts diode electrical performance, we consider Schottky diodes, which are simple, and commonly manufactured devices that are readily studied. To assess ionizing radiation damage, we attached the Schottky diodes to a circuit board after irradiation and measured the current-voltage curve during exposure to a reverse bias voltage for comparison with non-irradiated diodes. These results will elucidate the consequence of ionizing radiation on device performance, particularly performance in the field emission regime, changes in the space-charge-limited current, and device breakdown voltage, to guide the development of radiation shielding to protect the devices.

Keywords: Semiconductor Diode; Solid-State Devices; Radiation Hardening; Space Charge Limited Current; Ionizing Radiation

Mentor(s):

Allen L Garner (Engineering); Cameron James Buerke (Engineering)

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

Poster Presentation Abstract Number: 1604
Presentation Time: Session 4: 1:30pm-2:30pm

SCALE

High-power Energy-dispersive X-Ray Fluorescence used to quantify and identify heavy metals concentrations, as well as the effect of Pb and Ni, in the air of Accra, Ghana.

Physical Sciences

Author(s):

Evan N Reid†

Abstract:

The existence of air and noise pollution in Africa is a growing concern, being that the identity of these particles are unknown, thus their health advantages or disadvantages is unknown as well. The record and identification of these coarse particles in the air is the center of this project. Using a high-power energy-dispersive X-ray fluorescence (EDXRF) device, air filters collected from over two residential sites in Accra, Ghana was used for the assessment of heavy metals concentrations, as well as lead (Pb) and nickel (Ni) speciation in airborne particulate matter (PM10). Particulates, also known as atmospheric particulate matter, are microscopic particles of solid or liquid matter that are suspended in the air.

Types of atmospheric particles include suspended particulate matter, such as respirable and inhalable coarse particles, noted as PM10: coarse particles with a diameter of 10 micrometers (?m) or less; fine particles, noted as PM2.5, with a diameter of 2.5 ?m or less; ultrafine particles, with a diameter of 100 nm or less, and soot. The EDXRF was calibrated for the detection of the particles within these air filters by way of utilizing sample standards spotted at different concentrations for their detection using the XDR machines present in the labs. In order to measure the air particles, air filters are loaded into the XDR machines and run in 5 hour intervals.

Keywords: [no keywords provided]

Mentor(s):

Titiksha Singh (Engineering)

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

Poster Presentation Abstract Number: 1605
Presentation Time: Session 4: 1:30pm-2:30pm

SCALE

Implementation of RISC-V "K" extension for scalar cryptography

Innovative Technology / Entrepreneurship / Design

Author(s):

Abhiram Saridena† (Engineering)

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Cole Aaron Nelson (Engineering); Mark Johnson (Engineering)

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

Poster Presentation Abstract Number: 1606
Presentation Time: Session 4: 1:30pm-2:30pm

SCALE

Theoretical Assessment of the Transition Between Electron Emission Mechanisms for Nonplanar Diodes

Mathematical/Computation Sciences

Author(s):

Alexander Gregory Sinelli† (Science); Sree Harsha Naropanth Ramamurthy‡ (Graduate); Allison M Komrska‡ (Engineering)

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Allen L Garner (Engineering)

Other Acknowledgement(s):

Lorin Irene Breen

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

Poster Presentation Abstract Number: 1607
Presentation Time: Session 4: 1:30pm-2:30pm

SCALE

Assessment of Composite Materials for Radiation Protection using OpenMC Simulations

Mathematical/Computation Sciences

Author(s):

Parker Smith† (Engineering)

Abstract:

Increasing applications in space propulsion and nuclear reactor development necessitate the development of advanced radiation shields to protect sensitive electronics and individuals from ionizing radiation. This research project uses OpenMC, a community-developed Monte Carlo N-Particle (MCNP) simulation tool, to evaluate the effectiveness of various composite materials in mitigating gamma and neutron radiation. OpenMC's capabilities allow for precise modeling of radiation interactions, offering a cost-effective and efficient virtual testing ground that avoids physical experimentation constraints and potential mishaps. We simulate and assess the shielding capacity of different composites, both layered and in mixed powder form, to develop materials that can effectively shield both photons and neutrons. Comparing the simulation results with experimental data, validates the models and confirms the efficacy of the proposed shielding solutions. These results can be used to minimize the risk of radiation-induced damage to critical systems, ensuring their integrity and longevity in hazardous environments.

Keywords: Radiation Shielding; Gamma Radiation; Neutron Radiation; OpenMC

Mentor(s):

Hannah Pike (Student Life); Allen L Garner (Engineering); Stylianos Chatzidakis (Engineering)

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

Poster Presentation Abstract Number: 1608
Presentation Time: Session 4: 1:30pm-2:30pm

SCALE

Composite Material Development for Simultaneously Shielding Neutron and Gamma Radiation

Physical Sciences

Author(s):

Kailyn D Steed†

Abstract:

Personnel and sensitive electronics can suffer adverse side effects in high radiation environments, such as outer space or nuclear reactors. Shielding may be used to reduce radiation exposure; however, the presence of multiple types of radiation complicates the design requirement. Neutrons, which have mass and no charge, are most effectively shielded by materials with similar mass (e.g., hydrogen), while gammas, which are highly energetic with no rest mass, are most effectively shielded by materials with high atomic number. Thus, a single material cannot effectively shield both types of radiation, necessitating additional cost or space. This project studies the feasibility of using composites made by using layers or mixtures of multiple materials, to simultaneously shield neutrons and gammas. Designing composites and evaluating their ability to shield gamma and neutron sources will help determine the optimal shielding materials to ensure the safe operation of electronics while minimizing additional weight and space, which is paramount for both space propulsion and nuclear reactor development.

Keywords: Radiation Shielding; Composite Materials; Gamma Rays; Neutrons; Layering Powder

Mentor(s):

Allen L Garner (Engineering); Stylianos Chatzidakis (Engineering); Hannah Pike (Student Life); Samera Hossain (Engineering)

Other Acknowledgement(s):

Tanya A Faltens

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Poster Presentation Abstract Number: 1609
Presentation Time: Session 4: 1:30pm-2:30pm

SCALE

Assessment of Metal Exposure in Dried Blood Samples from the Health and Retirement Survey

Physical Sciences

Author(s):

Jayla N Wilcox†

Abstract:

Environmental factors, such as metals, significantly impact the exposome, potentially heightening susceptibility to cognitive impairment and Alzheimer's disease and related dementias. This study aims to quantify heavy metals, including lead, cadmium, mercury, arsenic, among others, in dried blood spots (DBS) obtained from participants in the Health and Retirement Survey (HRS). Utilizing energy-dispersive X-ray fluorescence (EDXRF) and advanced analytical techniques, the research aims to characterize and elucidate patterns of metal mixtures present. The DBS samples collected from HRS participants, aged 51 and older, have been preserved for retrospective analysis of body metal levels spanning a 14-year period. To support this investigation, EDXRF was employed for the assessment of heavy metal concentrations in dried blood spots. Although traditionally used for analyzing metals in air filters, recent technological advancements have significantly boosted the sensitivity of EDXRF, enabling precise measurement of lead, cadmium, mercury, and arsenic among the 15,000 participants included in the HRS study cohort. This comprehensive approach facilitates a detailed exploration of metal exposure patterns and their potential implications for health outcomes in older adults.

Keywords: X-Ray; Blood Spot

Mentor(s):

Aaron James Specht (HHS); Christopher W Smith (HHS)

Other Acknowledgement(s):

Tanya A Faltens

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

Poster Presentation Abstract Number: 1610
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Characterization of Vegetable-Based Oils as Sustainable Quench Oil Replacements and Practicality Assessments

Physical Sciences

Author(s):

Junyeong Ahn† (Engineering); Manila Kunwar‡ (Engineering); Ruey-Bin Tsai‡

Abstract:

Quenching is a heat treatment process which enhances hardness and toughness of metal, typically ferrous steel, to a desired level. Due to the low sustainability of the current petroleum-based quenchants, past studies proposed natural oils, such as soy oil or sunflower oil, as candidates for new quench oil replacements. This study aims to characterize the candidates for new quench oil replacements and interrelate the properties to derive general quenching behaviors and to assess the practicality. To determine the quenching mechanism, ASTM D6200 standard is applied to produce cooling curves and cooling rates of each oil. For characterization, degradation point/boiling point, flashpoint, specific heat, viscosity, and chemical composition are measured using thermogravimetric analysis (TGA), flashpoint tester, differential scanning calorimeter (DSC), rheometer, and Fourier-transform infrared spectroscopy (FTIR), respectively. Measured data are collected to establish the database. To determine the practicality of the natural oils, immersion corrosion testing of steel workpiece after quenching in oils of varying degrees of oxidation and fatty acid content have been performed to study the effect of chemical state of oils on corrosion resistance after heat treatment. Future studies will be conducted on refining the ongoing development of machine learning system, which will be an automated tool for navigating the database and produce expected quenching results using the characteristics of the desired quenchant candidate as input and using the identified relationship between the characteristics and quenching behavior as logical process.

Keywords: Heat Treatment; Austempering; Natural Oil; Oil Characterization; Sustainability

Mentor(s):

Jeffrey P Youngblood (Engineering); Michael Titus (Engineering); David R Johnson (Engineering)

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

Poster Presentation Abstract Number: 1611
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Measurement of rare phosphoinositide lipids in Ras mutant cell membranes

Life Sciences

Author(s):

Alex James Alonzo† (Science|JMHC); Jennifer Caraballo‡

Abstract:

The plasma membrane (PM) serves as the barrier between cellular components and the local environment. Composed primarily of phospholipids, the PM is a complex reaction landscape for interactions between proteins, sugars, small molecules, and lipids, and coordinates conversion of stimuli into intracellular responses. Phosphatidylinositol phosphate (PIPs) lipids profoundly impact cellular signaling outcomes despite comprising less than 2 percent of all PM lipids. Unique PIP identities, determined by location and number of phosphate groups, are regulated by enzymes. Dysregulation in pathways involving PIPs is recognized to contribute to many disease states, such as cancer. In such pathways, PIPs can act as either protein activators or substrates, and are constantly engaged, interconverted, and depleted at unknown rates. A fundamental understanding of the distributions and dynamics of PIPs, and their alterations in disease, remains limited due to a scarcity of tools to detect PIPs without altering their normal behaviors. Oncogenic mutations frequently occur in the small GTPase Ras, whose signaling is modulated by PI(4,5)P2 lipid levels. We hypothesize that Ras mutations will affect the distribution of PIPs in the PM. We utilize a novel, peptide-based sensor to quantify absolute densities of PI(4,5)P2 lipids in model and PMs of mouse embryonic fibroblast (MEF) cells with unique Ras mutations. These measurements are supported by an orthogonal colorimetric biochemical assay that measures phosphate content in lipid samples. Our work is poised to illuminate the relationship between PIP distribution and disease states, leading to diagnostic characteristics of cellular fitness.

Keywords: Phosphoinositide; PI(4,5)P2; RAS; Cancer; TIRF

Mentor(s):

Shalini T Low-Nam (Science); Joy Wu (Science); Vinay K Menon (Science)

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

Poster Presentation Abstract Number: 1612
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Versatile Covalent Molecular Cages: From Synthesis to Therapeutic Applications

Life Sciences

Author(s):

Sho Amagai† (Science); Levi M Johnson† (Science)

Abstract:

[Abstract Redacted]

Keywords: Covalent Molecular Cages; Drug Delivery; Peptide Therapeutics; Selective Recognition; Suziki Miyaura Cross Coupling

Mentor(s):

Severin Thomas Schneebeli (Science); Kyle Timothy Faivre (Science)

Other Acknowledgement(s):

Ke Xu; Anthony Gabriel Mena

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

Poster Presentation Abstract Number: 1613
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

The Effect of Zeolitic Acids on the Formation of Hydronium Ions in Liquid Water

Physical Sciences

Author(s):

Arjun Singh Bhadoria† (Engineering|JMHC)

Abstract:

[Abstract Redacted]

Keywords: Zeolite; Acid Dissociation; Cellulose Hydrolysis; Water; H3O+ Concentration

Mentor(s):

Rajamani P Gounder (Engineering); Enrique Iglesia (Engineering); Ryoh-suke Sekiya (Engineering)

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

Poster Presentation Abstract Number: 1614
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Automated Testing Toolbox for Power Amplifiers and Antennas in Communication Systems

Physical Sciences

Author(s):

Jose Abraham Bolanos Vargas† (Engineering)

Abstract:

The telecommunications industry is facing increasing energy consumption demands. Next-generation communication systems, i.e., 5G, require stringent performance specifications to meet the growing data requirements. Testing power amplifiers (PAs) and antennas, crucial components in these systems, is labor-intensive and time-consuming due to repetitive changes in testing parameters. Such solutions exist, namely commercial equipment, however, they are expensive and restricted. This research addresses the challenges of manual testing of power amplifiers and antennas by developing an automated toolbox. The toolbox was packaged as a MATLAB application to interface with the existing equipment in the ARES Lab, utilizing the built-in communication protocols provided by the equipment to establish control and acquire data. The toolbox was designed with a user-friendly interface that allows users to control the testing parameters. The toolbox automates parametric frequency, bandwidth, and input power sweeps for PA testing. It also includes features to control the anechoic chamber positioners for antenna pattern measurements. Comprehensive data sets are generated, and visuals provide valuable insights into the performance of the PA and the antenna radiation patterns. This enables efficient data acquisition and eliminates the need for manual labor. The developed software solution enhances collaboration, reproducibility, and knowledge sharing within the research community. The automated testing toolbox offers an efficient, cost-effective alternative to expensive commercial solutions. Future work involves expanding the toolboxes, adding more utilities to the application, standardizing the code, and extending compatibility to multiple test equipment models.

Keywords: PA; Antenna; VISA; Automated Toolbox

Mentor(s):

Dimitrios Peroulis (Purdue University); Alex David Santiago Vargas (Engineering)

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

Poster Presentation Abstract Number: 1615
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Total Synthesis of Anti-Cancer Dihydrogarofuran Natural Products

Physical Sciences

Author(s):

Riley N Brown† (Science)

Abstract:

Dihydro-beta-agarofurans are a class of eudesmane terpene natural products demonstrating potent biological activities ranging from reversing multi-drug efflux, anti-inflammatory effects, anti-cancer and tumor suppression abilities. Isolating this class of natural products from natural sources is low yielding hindering the full in vitro and in vivo exploration of their capabilities. A synthetic approach to their preparation, capable of producing material in quantities necessary for biological study would enable mechanistic research into their pharmacology. The authors have established a concise diastereoselective route to the octalin core, solving the key stereotriad problem on a meso-substrate through consecutive alkoxy anion-directed conjugate additions followed by ring-closing metathesis. This product is then subjected to an Iridium-mediated photoredox acyl cyclization followed by Grignard addition and subsequent closure to form the tetrahydrofuran ring that is characteristic of the dihydro-beta-agarofuran family. From this point, preparation of 2-3 natural products with anti-cancer and tumor suppression abilities will be synthesized. All intermediates and products will be analyzed by both hydrogen and carbon NMR spectroscopy, and mass spectrometry to confirm their structure.

Keywords: Natural Products; Biological Activity; Total Synthesis

Mentor(s):

Abram J Axelrod (Pharmacy)

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Poster Presentation Abstract Number: 1616
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Two Channel Low Frequency Alternating Currents to Achieve Nerve Conduction Block

Life Sciences

Author(s):

Nicholas Herschel Burris† (Engineering)

Abstract:

The nervous system is composed of nerve fibers that transmit information through pulse code modulated bioelectric solitons called action potentials (AP) that travel along the nerve fiber. Being a soliton, APs are robust and stable, making them difficult to block using electrical blocking stimuli, although they can be chemically blocked using Na+ channel blockers such as lidocaine. A recently discovered electrical method to block is using sinusoidal low frequency alternating current (LFAC) stimulation. LFAC produces low threshold electrical nerve conduction block (NCB), but full time NCB (ftNCB) is not possible through a single bipolar cuff electrode. FtNCB requires at least two-channels of phased LFAC stimulation. This research aims to implement ftNCB using two-channels LFAC. Software to control the stimulation parameters to achieve ftNCB was implemented to automatically interrogate different phase delays and amplitudes. In-vivo experiments on earthworms using single channel LFAC show that block was conducted to be followed by planned two-channel experiments. Analysis of the data involved digital signal processing using several MATLAB scripts to visualize effects of LFAC. The preliminary results revealed that the updated software can modulate sinusoidal phase and amplitude to interrogate and determine whether ftNCB can be achieved using two-channel LFAC.

Keywords: Nerve Block; Conduction Block; Electrical Stimulation; Low Frequency Alternating Current Block

Mentor(s):

Awadh Mubarak M Al Hawwash (Engineering); Ken Yoshida (Engineering)

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Poster Presentation Abstract Number: 1617
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Using Engagement and Progress Metrics to Predict Team Performance through Communication Analysis

Social Sciences / Humanities / Education

Author(s):

Yuyuan Cao†

Abstract:

Team communication is essential for achieving optimal performance. Effective communication enables teams to succeed effortlessly and promptly. To achieve effective communication, it is crucial to first understand the contributing factors. Previous research has quantified communication by categorizing speech actions and calculating their frequency and percentage to determine which categories lead to effective or ineffective outcomes. While effective, this method does not differentiate between active and passive engagement. To address this gap, we developed a new metric, the engagement ratio, to explore its potential influence on team performance. Additionally, we noted that the effectiveness of certain communication categories varies by context. Consequently, we introduced the team progress metric to assess whether each sentence is timely and informative. We tested these metrics using the game "Keep Talking and Nobody Explodes," designed to build a shared vision between an expert and a defuser. A total of 48 participants took part in the study, with each team defusing a bomb within 5 minutes over two rounds per participant. We collected, transcribed, and coded communication data during gameplay, ensuring interrater reliability. Our findings reveal that the engagement ratio is higher for poor-performing experts than for high-performing ones, indicating that members of high-performance teams are more actively engaged. Moreover, high-performance teams exhibit significantly more forward communication and less sideways and backward communication, suggesting that they focus more on task-related discussions and make fewer mistakes. These insights underscore the importance of active engagement and context-appropriate communication for team success, highlighting the practical implications for improving team performance.

Keywords: Team Communication; Team Performance; Engagment Ratio; Communication Entropy

Mentor(s):

Denny Yu (Engineering); Jingkun Wang (Engineering)

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

Poster Presentation Abstract Number: 1618
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Harnessing Real-Time Sensor Data: A Novel Approach to Quality Control in Manufacturing

Mathematical/Computation Sciences

Author(s):

Belen Noemi Carrasco Grandes†

Abstract:

[Abstract Redacted]

Keywords: Bayesian Networks; Functional Data Analysis; Real-Time Sensors; Manufacturing; Machine Learning

Mentor(s):

Manni Zhang (Engineering); Ana Estrada Gomez (Engineering)

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

Poster Presentation Abstract Number: 1619
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Zebrafish Non-Homologous End Joining Knock-In

Life Sciences

Author(s):

Daniel Matthew Chambers† (Science)

Abstract:

Zebrafish are an attractive organism to perform in vivo cell biology experiments owing to their high productivity and transparency in early development stages. Visualization of proteins has been mostly conducted by overexpression under specific promoters. However, to bypass the artificial expression and function of genomic overexpression, our group aims to reveal the intrinsic expression of genes with a fluorescent tag knock-in (KI). Reported accurate KI methods utilizing homology directed repair method and ?C31 integrase-mediated transgenesis are known for their low efficiency and time-consuming nature. This project reports a highly efficient KI method with Non-Homologous End Joining DNA repair method. We used this mechanism to specifically tag actin fiber proteins at the c-terminus by inserting the designed DNA construct into the non-coding regions of the Zebrafish genome. Tagging actb1 with green fluorescent protein (GFP) enables visualization of actin dynamics in vivo. The reported method will pave the way for future endogenous protein tagging projects at different loci with a higher DNA integration efficiency.

Keywords: Zebrafish; Non-Homologous End Joining; Actin; Intrinsic; Knock-In

Mentor(s):

Chang Ding (Science)

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

Poster Presentation Abstract Number: 1620
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

On-chip Phase Calibration Circuits With Integrated Photonic Bragg Gratings

Physical Sciences

Author(s):

Ethan Chieng Chiao† (Engineering)

Abstract:

Bragg gratings are a type of periodic waveguide structure commonly used in optical signal processing applications because they can be easily designed to attain a desired frequency response. A Bragg grating consists of a periodic modulation in the refractive index of the waveguide. This modulation can be observed in the width or thickness of the waveguide. On a silicon photonics platform, Bragg gratings have been used as nearly transparent counter-directional couplers in fully integrated phase calibration systems. This is essential for applications like integrated Fourier transform pulse shaping or optical beam steering for calibration of the relative phase between optical comb lines or spatial emitters, respectively. The goal of this work is to construct a phase interrogator with Bragg gratings suitable for integration with existing Fourier transform pulse shapers. Simulations were first performed using a custom python-based transfer matrix method solver, which generates the frequency response for arbitrary uniform Bragg grating geometries. When known parameters were used, the resulting responses matched expectations. Efforts then transitioned and are currently focused on physical modeling with Ansys Lumerical simulation tools like finite difference time domain (FDTD) and eigenmode expansion (EME) methods. These methods simulate the device geometry following Maxwell's equations. In order to validate the Bragg grating performance, results should align closely between both physical modeling and script simulation. Designs will need to be optimized for weak reflection over broad bandwidth with low optical loss. The performance will be evaluated through circuit-level simulations using the models created in the FDTD and EME simulations.

Keywords: Silicon Photonics; Bragg Gratings

Mentor(s):

Jason Dwight McKinney (Engineering); Lucas Michael Cohen (Engineering)

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

Poster Presentation Abstract Number: 1621
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Enhancing Robotic Ultrasound Image Quality Assessment

Innovative Technology / Entrepreneurship / Design

Author(s):

Hyunsang Cho† (Engineering); Christopher Li Gou‡ (Science); Aditya S Hebbani‡ (Engineering)

Abstract:

[Abstract Redacted]

Keywords: Medical Robotics; Deep Reinforcement Learning; Medical Image Segmentation; Image Quality Assessment; Ultrasound Imaging

Mentor(s):

Richard M Voyles (Polytechnic)

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

Poster Presentation Abstract Number: 1622
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

ANSI-C Bounded Model Checking for security verification in Contiki-NG network stacks

Mathematical/Computation Sciences

Author(s):

Owen J Cochell†

Abstract:

Embedded systems suffer from a lack of memory safety features. Hence, they are vulnerable to any memory corruption vulnerabilities that are present in their firmware. Furthermore, their firmware is commonly written in memory-unsafe languages like C and C++, which increases the likelihood of memory corruption vulnerabilities and affects the safety of these systems. Consequently, it is important to find and fix any memory corruption vulnerability in the firmware before they are deployed to production embedded systems.

Ansi-C Bounded Model Checking (CBMC) is a promising technique for verifying that firmware is free from memory corruption vulnerability, or exposing any such vulnerability in the firmware. To be effective, CBMC relies on harnesses that correctly model the firmware and execute with acceptable duration. However, no automation is available that can easily develop harnesses that enable sound, precise, and fast verification.

This project aims to identify a set of guidelines that can aid in developing harnesses that enable sound, precise, and fast CBMC verification. We do this by developing harnesses for software components in the Contiki-ng network stack. We inject 24 known vulnerabilities into the Contiki-ng stack implementation and iterate on the harnesses until they can uncover the injected vulnerabilities.

From our experiences writing CBMC harnesses, we have identified the steps required to generate harnesses that are sound, precise, and fast, and the challenges that make harness development challenging. We have also found and reported 2 zero-day vulnerabilities, and we are currently investigating 15 identified vulnerable behaviors. Finally, the lessons from our experience will guide the design of an automated tool that will make the development of correct CBMC harnesses easier.

Keywords: C; CBMC; Networking; Security; Formal Analysis

Mentor(s):

Paschal Chukwuebuk Amusuo (Engineering)

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

Poster Presentation Abstract Number: 1623
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Effect of Heteroatom Doping on the Size, Stability, and Electronic Properties of TM6E8(L)6 Nanoclusters

Physical Sciences

Author(s):

Wyatt Paul Crain† (Science)

Abstract:

Nanoclusters have garnered significant interest due to their varied electronic and magnetic properties, making them promising candidates for a range of applications. In this study, we investigated the effects of bidentate ligands and chalcogenide elements on first-row transition metal chalcogenide clusters, focusing on core atoms such as Fe and Co. Our primary objective was to understand how these core atoms and their ligands influence the electronic and magnetic properties of the nanoclusters. We synthesized the transition metal chalcogenide clusters and employed mass spectrometry and collision-induced dissociation to gather analytical data on the mass-to-charge (m/z) ratio. This provided insights into the synthesized compounds and their structural characteristics. Our findings indicate distinct variations in stability and electronic structure among the different metal chalcogenide clusters, particularly highlighting the stability and tunability of iron and cobalt chalcogenide clusters. This study provides a deeper understanding of the nanoclusters' properties, which could be pivotal for future applications. Potential uses of these nanoclusters include roles as catalysts, in microelectronics, and for optical data storage. The implications of this research are significant, suggesting that these nanoclusters can be developed to be less toxic, highly reactive, and stable, thereby providing sustainable and versatile options for development in chemistry and material science.

Keywords: Ions; Ligands; Mass Spectrometry; Cluster Chemistry; Metal Clusters

Mentor(s):

Julia Laskin (Science); Xilai Li (Science)

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Poster Presentation Abstract Number: 1624
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Behavior of Steel-Plate Composite T-Shaped Connections

Innovative Technology / Entrepreneurship / Design

Author(s):

Miles T Davis†

Abstract:

Steel-plate composite (SC) walls are made of two parallel steel plates connected by shear reinforcement with concrete infill. Compared to conventional reinforced concrete (RC), SC structures exhibit favorable behavioral properties (high strength and ductility) and efficient construction processes. When designing a structure using SC, joints are critical regions where slabs and walls intersect. The joint must be stronger than the connected elements for SC structures to develop slab or wall strength capacity and ductility. This paper discusses the behavior, testing, and analysis of SC T-shaped fully restrained moment connections. Fully restrained moment connections have sufficient flexural capacity to transfer moment demands while undergoing rotation. A T-shaped connection was destructively tested to failure to collect data on the specimen's rotation, displacement, and load capacity. The collected data was analyzed to determine specimen moment-rotation behavior and ultimate moment capacity. A greater understanding of the moment connections will assist with providing design recommendations for SC connections. Future research may include investigating the behavior of simple SC T-shaped connections and different reinforcement arrangements within the SC walls.

Keywords: Steel-Plate Composites; SC; T-Joints; Moment Connections; Large-Scale Testing

Mentor(s):

Morgan Renee Broberg (Purdue University); Sean Dankoski (Engineering); Kaitlyn Amber Kondos (Engineering)

Other Acknowledgement(s):

Amit Varma

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Poster Presentation Abstract Number: 1625
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Differentiation of neutrophils for cancer cell killing assay

Life Sciences

Author(s):

Haozhen Dong†

Abstract:

[Abstract Redacted]

Keywords: Neutrophil; Differentiation; Immunotherapy; Cancer

Mentor(s):

HUIYANG LI (Engineering)

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Poster Presentation Abstract Number: 1626
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Using Organoids as a Model System to Study Intestinal Epithelial Growth and Morphogenesis

Life Sciences

Author(s):

Abigail J Dressman† (Engineering)

Abstract:

With its central role in digestion and nutrient absorption, the intestinal epithelium is arguably one of the most critical components of the gastrointestinal system. Studying this specialized tissue in the native context of living organs, however, presents significant challenges due to its anatomical complexity and cellular heterogeneity. This necessitates the development of physiologically relevant, context-specific experimental models for research purposes. To address this need, we introduce intestinal organoids as a model system that emulates an anatomical unit of the intestine responsible for essential functions such as nutrient absorption and maintaining homeostasis. Specifically, our system uses living intestinal stem cells grown in a three-dimensional environment to recreate the intricate architecture of the intestinal epithelium, including the villi and crypt structures. Using intestinal organoids, we demonstrate in vitro reconstruction of this intestinal epithelium that mimics the stages of intestinal development from the formation of the gut tube to the patterning of crypt-villus regions. We demonstrate the utility of this model system by i) measuring organoid growth and ii) analyzing budding morphologies in intestinal organoids.

Keywords: Organoids; Intestinal Epithelium; Morphogenesis

Mentor(s):

Sunghee Park (Engineering)

Other Acknowledgement(s):

Hoi Joong Youn

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

Poster Presentation Abstract Number: 1627
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Benchmark Dataset for Fixing Software Vulnerabilities

Mathematical/Computation Sciences

Author(s):

Samuel Duprey† (Science)

Abstract:

[Abstract Redacted]

Keywords: Software Vulnerabilities; Benchmark Framework; Test Evaluation; Cybersecurity; GitHub Issues

Mentor(s):

Yi Wu (Science); Lin Tan (Science)

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

Poster Presentation Abstract Number: 1628
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Applications of Atomic Force Microscopy to Assess the Mechanics of Oocytes

Life Sciences

Author(s):

Defne Ekici† (Engineering)

Abstract:

Calcium-induced actin remodeling is an essential mechanism that supports successful meiotic progression and fertilization. Micropipette aspiration (MPA) studies have demonstrated that oocyte cell membranes undergo significant cytoskeletal changes throughout maturation. We suspect that these cytoskeletal changes are a result of calcium signaling within the cell. Atomic Force Microscopy (AFM) is an imaging method that allows for mapping of the sample image, a mechanical readout of the actomyosin cytoskeleton, and measurement of the force between the tip of the cantilever and the sample. Force Spectroscopy is an AFM technique in which the cantilever and tip of the AFM is brought directly into contact with the substrate, known as indentation, and then retracted. To estimate the material properties of an oocyte from the force displacement data, Hertzian Contact conditions must be assumed. There are two potential contact models for this system: Sphere-on-Sphere contact and Sphere-on-Plane contact. MATLAB technologies were utilized to simulate the contact models, obtain force-displacement curves, and compare the differences in the two. Given that the percent difference in contact diameter between both models is relatively low (4.88 % difference), Sphere-on-Plane Hertzian simplifications are applicable to an oocyte and a spherical AFM tip. The respective Sphere-on-Plane model will be used to estimate the elastic modulus of oocytes from prophase I through metaphase II.

Keywords: Atomic Force Microscopy; Biomechanics; Oocytes; Developmental Biology; MATLAB

Mentor(s):

Deva Chan (Engineering); Janice Perry Evans (Science)

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Poster Presentation Abstract Number: 1629
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Developing Ultra Low Power Depth Sensing Through Differential Defocus

Innovative Technology / Entrepreneurship / Design

Author(s):

Alan Fu† (Engineering)

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Junjie Luo (Engineering); Qi Guo (Engineering)

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

Poster Presentation Abstract Number: 1630
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Investigation of ionocaloric refrigeration cycle: Thermodynamic model analysis and proof of concept

Physical Sciences

Author(s):

Zhichen Guan†

Abstract:

Current air conditioning in buildings relies on the vapor compression cycle. Hydrofluorocarbons (HFC) are one of the most common refrigerants used in the vapor compression cycle, but they have significant environmental impacts through their global warming potential (GWP). Other systems that use hydrofluoroolefins (HFOs) exhibit low efficiency. Thus, the quest for highly efficient and environmentally friendly refrigerants has become a pressing issue. Ionocaloric effect — the temperature lift crafted by adding ions surrounding a solid phase — is a potential solution to the problem. This research aims to investigate the ionocaloric effect both theoretically and experimentally. The goal is to utilize the ionocaloric effect to develop an environmentally friendly and energy-efficient cooling cycle. We modeled the adiabatic temperature change of isenthalpic and isentropic mixing. The model determines the thermodynamic property of the mixing process. In terms of the experiment, we used a home-built adiabatic chamber to measure the temperature change. We compared the performance of two systems: ethylene carbonate + sodium iodide and ethylene carbonate + zinc chloride. Result shows that ethylene carbonate + sodium iodide has larger temperature span than ethylene carbonate + zinc chloride. The superior performance of the ethylene carbonate + sodium iodide

system can be attributed to the higher solubility and greater entropy change of sodium iodide in ethylene carbonate. Comparison between experimental adiabatic temperature change and thermodynamics model reveals that the mixing process approximates an isentropic process. Future studies include separating the salt from the system to achieve the whole ionocaloric refrigeration cycle.

Keywords: Ionocaloric Effect; Refrigeration Cycle; Thermodynamics Modeling

Mentor(s):

Mateo Roldan Carvajal (Engineering); David Warsinger (Engineering); Davide Ziviani (Engineering)

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Poster Presentation Abstract Number: 1631
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Increasing the Expressibility of a Gradual Verifier

Mathematical/Computation Sciences

Author(s):

Priyam Gupta† (Science|JMHC)

Abstract:

Current static verification tools provide unmatched guarantees about code, however, they burden users with the task of writing complete and complex specifications. Gradual verification eases this burden by combining static (compile time) and dynamic (run time) verification techniques to support the incremental specification and verification of code. Gradual C0 is the first practicable gradual verifier for realistic heap-manipulating programs, allowing users to write incomplete specifications and providing earlier feedback with run-time checks. However, Gradual C0 currently lacks support for certain constructs, making it less expressive than its underlying static verifier, Viper. In particular, it lacks expressibility in specifying relationships amongst nodes in recursive heap data structures like trees and lists, which are fundamental constructs widely used in software development for efficient data management. Because of this limitation, users have to come up with complex roundabout solutions for specifying properties such as the sortedness of a linked list or a binary search tree. This paper details the design for implementation of Viper's unfolding expressions in Gradual C0 that will increase its specifications' expressibility. The design maintains Gradual C0's efficiency and minimizes run time checks by preserving heap information where possible during evaluation of these expressions. Support for unfolding expressions will pave the way for adding pure functions to Gradual C0 which will bring the verifier's expressibility very close to current static verifiers like Viper, making verification technology more usable and mainstream.

Keywords: Gradual Verification; Implicit Dynamic Frames; Recursive Predicates; Viper

Mentor(s):

Jenna L Wise DiVincenzo (Engineering)

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

Poster Presentation Abstract Number: 1632
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Optimizing Nanobubble Shell Properties for Enhanced Cardiovascular Ultrasound Imaging

Life Sciences

Author(s):

Ana S Hernandez† (Engineering); Stephanie Maureen Poore† (Engineering)

Abstract:

Cardiovascular ultrasound imaging is critical for diagnosing and monitoring heart diseases. Nanobubbles (NBs) have been introduced as ultrasound contrast agents (UCAs) to enhance image clarity and acoustic response. Despite recent advancements, limited research has been done to measure how the NB shell properties influence their detection by ultrasound (US). The goal of this project was to lessen this gap in research by evaluating the behavior of NBs as UCAs in response to alterations in shell composition. Building on previous studies about phospholipid-stabilized nanobubbles, which demonstrated the influence of membrane flexibility on the pressure threshold required for significant acoustic signal amplification, this project investigated how shell elasticity affects NB size distribution and echogenic behavior. The membrane elasticity was altered by adding differing ratios of propylene glycol and glycerol, due to their ability to modify the shell's elastic properties. Additionally, the lipid composition was altered by introducing a cis bond in the primary lipid, C-22. Size was quantified using DLS and the contrast was measured using qualitative image analysis of the US images. A key finding was that stiff NB-UCAs exhibited a longer shelf life but a low echogenic behavior while flexible NB-UCAs had more optimal echogenic behavior but a shorter shelf life. By optimizing the shell properties of UCA shells, this research aims to enhance the diagnostic and therapeutic capabilities of cardiovascular ultrasound imaging. This research could lead to significant improvements in the accuracy and effectiveness of cardiovascular diagnoses, ultimately contributing to better patient outcomes.

Keywords: Cardiovascular Ultrasound Imaging; Nanobubbles; Ultrasound Contrast Agents (UCAs); Shell Properties; Echiogenic

Mentor(s):

Luis Solorio (Engineering)

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

Poster Presentation Abstract Number: 1633
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Optimizing the Transition to Clean Energy in the US MISO Region Power Grid

Mathematical/Computation Sciences

Author(s):

Hsin-Wei Hsieh† (Engineering)

Abstract:

In response to the US Climate Goals for 2050 and reducing pollution from fossil fuel-fired power plants, an optimization study of the power grid is necessary in the US Midwest Region to transition to renewable energy sources. The region faces significant challenges, including extreme weather, pollution, and increased electricity demand from electric vehicles, data centers, and manufacturing. This research addresses integrating renewable energy sources into the existing power grid, aiming to maximize renewable energy usage while maintaining reliability and efficiency. Data on power generation, substation locations, and energy consumption were analyzed using Geographical Information System (GIS) and optimization algorithms, leveraging BreakThrough Energy's open-source tool for power flow analysis. The results analyze various pathways comprising a mix of wind, solar, and hydro energy to significantly reduce emissions while maintaining grid stability and cost-effectiveness. The research's outcomes will provide a roadmap for policymakers and utility companies to achieve environmental goals without compromising on economic viability. This work underscores the importance of strategic planning in the energy sector and highlights the potential for renewable energy to meet future demands. Future research should explore the broader economic and social implications, including job creation, energy prices, and long-term sustainability of the power grid, ensuring a comprehensive approach to energy transition.

Keywords: US Climate Goals; Optimization; Power Flow Analysis; Reduce Emissions; Grid Stability and Cost-Effectiveness

Mentor(s):

Sivaranjani Seetharaman (Engineering)

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

Poster Presentation Abstract Number: 1634
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Biodegradable Hexagonal Boron Nitride Films for Bio-Inspired Radiative Cooling

Innovative Technology / Entrepreneurship / Design

Author(s):

Ricardo Andrews Huertas†

Abstract:

As global temperatures continue to rise, developing alternative cooling technologies that reduce energy usage is necessary. Radiative cooling in systems can be enhanced by increasing solar spectrum reflectance and atmospheric sky window emissivity. These permit the reflection of solar irradiation and the emission of thermal energy to deep space, respectively. Radiative cooling technologies so far have been used for applications such as housing, vehicle cooling, and water harvesting. However, there remains room to use our understanding of radiative cooling to further reduce environmental impact by developing biodegradable and multifunctional radiative cooling materials. Thus, we propose nanocomposite radiative cooling films composed of a naturally occurring, biodegradable matrix and a hexagonal boron nitride (hBN) nanoparticle reinforcement that also serves to improve solar reflectance. The resulting films are inspired by biological systems via their composition and biodegradability. To develop more optimized films, the effects of varying hBN volume concentration on solar reflectance and mechanical durability are studied. Reflectance is lower, and absorptance is higher with a higher volume fraction of matrix material due to less reinforcement. Transmittance trends are influenced by increased porosity in films with decreasing reinforcement volume, causing scattering at material-pore interfaces. Decreasing the volume fraction of nanoplatelet-shaped reinforcement material makes films more ductile and flexible, potentially reducing mechanical properties like yield strength and toughness. The results could help to achieve below-ambient cooling with biodegradable films for application in buildings, fabrics, wearables, aerospace, and automotive industries.

Keywords: Global Warming; Radiative Cooling; Hexagonal Boron Nitride; Sky Window; Solar Spectrum

Mentor(s):

Xiulin Ruan (Engineering); Andrea Lorena Felicelli (Engineering); Ioanna Katsamba (Engineering)

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

Poster Presentation Abstract Number: 1635
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Nanoscale Heat Transfer in Semiconductor Thin Films

Physical Sciences

Author(s):

Junwoo Jang† (Engineering)

Abstract:

As the miniaturization of electrical devices progresses without sacrificing computational power, the importance of effective thermal management is becoming more critical. One way of controlling the heat produced in these devices is to use materials with high electrical and thermal conductivity. One such candidate is MXenes, a new family of two-dimensional compounds that consist of transition metal carbides, nitrides, or carbonitrides. Its characteristics are highly dependent on the synthesis procedures and comprised elements. While much research has been conducted to investigate the properties of Titanium-based MXenes to understand energy transfer within the material, no studies have investigated the thermal energy transport of Tantalum-based MXenes, as it is a material that has been synthesized recently. This project aims to identify the pure temperature-dependent thermal conductivity of Tantalum-based MXenes and compare it to Titanium-based MXenes. Samples are prepared on gold substrates, and micro-Raman thermometry is utilized to correlate Raman scattering shift peaks and temperature rise in the material. A heat transfer model is solved to extract the in-plane thermal conductivity. This analysis also yields insight into impurities, grain boundaries, and other phenomena within the thin film. The understanding of energy transport within MXenes is crucial for its utilization in complex environments with varying temperatures and to enhance its overall performance.

Keywords: Tantalum Based Mxene; Thermal Conductivity; Micro-Raman Thermometry; Heat Transfer Modeling; Nanotechnology

Mentor(s):

Neil Ghosh (Engineering); Xianfan Xu (Engineering)

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

Poster Presentation Abstract Number: 1636
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Enhancing Cello Performance through Real-Time Posture Evaluation

Mathematical/Computation Sciences

Author(s):

William P Jiang† (Science|JMHC); Shrinand Perumal* (Science); Shivam Hemal Trivedi*

Abstract:

When practicing, professional string musicians must pay attention to various aspects of their playing, including intonation, tempo, and posture. Our research aims to aid cello players in their practice by accurately detecting any deviations in posture and reporting them to the user. This enables them to both enhance their musical ability and reduce injuries caused by incorrect posture. Using recorded video data in the form of .mp4 files, body-pose detection is done using Google's MediaPipe framework and instrument-component (bow and string) detection is done using YOLOv8, a real-time object detection algorithm. Deviations in posture are detected by comparing this data with sample performers' postures in video training data. The current prototype indicates that using these tools, the hand positions of the cellist along with the bow and strings of the cello can be tracked in real time. Our long-term goal is to create an Evaluator app that will present several advantages for string players, including instantaneous feedback, consistent and objective analysis, enhanced precision in identifying subtle deviations that might be missed by the human eye, and the ability to practice independently without the constant need for a teacher or coach.

Keywords: Neural Networks; Real-Time Tracking; Roboflow; Mediapipe; YOLOv8

Mentor(s):

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

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

Poster Presentation Abstract Number: 1637
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Phenotypic characterization of an SCN2A variant found in a child with autism using hiPSC-derived cortical organoids

Life Sciences

Author(s):

Hina Leilani Kadono† (Science|JMHC)

Abstract:

The SCN2A gene encodes for the voltage-gated sodium channel alpha subunit NaV1.2, which is widely expressed in the brain and essential for neuronal function. Approximately 300 genetic variants within the SCN2A gene have been identified, many of which are linked to neurodevelopmental disorders such as autism spectrum disorder (ASD) and epileptic encephalopathy (EE). However, the mechanisms underlying the effects of many of these variants remain not fully understood. Our research aims to gain a deeper understanding of one of these variants by investigating a novel splice-site variant in SCN2A identified in a child with ASD. To characterize the phenotypes associated with this variant, we introduced the splice-site variant into a reference human induced pluripotent stem cell (hiPSC) line, which was then differentiated into cortical organoids expressing the NaV1.2 channel. We generated three batches of organoids: one homozygous for the variant, one heterozygous for the variant, and a wild-type batch not carrying the variant. For this study, these organoid batches were subjected to immunocytochemistry to identify differences in neural rosettes, which are key morphological characteristics of cortical organoids as they are developmental markers of neuroprogenitors in differentiating hiPSCs. Currently, we are focusing on quantifying the number of rosettes and analyzing their sizes within these organoids. By comparing data obtained from the organoids carrying the variant with the wild-type organoids, we aim to identify significant differences. Our findings will reveal the phenotypic changes caused by this splice-site variant, which will aid in the future development of personalized therapeutic interventions.

Keywords: Autism; Sodium Channel; SCN2A; hiPSC; Organoid

Mentor(s):

Yang Yang (Pharmacy); Manasi Suchit Halurkar (Pharmacy)

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

Poster Presentation Abstract Number: 1638
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Modeling of additive manufacturing powder for laser powder bed fusion applications.

Mathematical and Computation Sciences

Author(s):

Jake Kim† (Engineering)

Abstract:

Additive manufacturing (AM) has shown rapid advancement in recent years, emerging as a prominent manufacturing technique due to its versatility, precision, and cost effectiveness. Among the many additive manufacturing methods is powder bed fusion. A bed of fine particles, usually in the micron range, is spread across a platform and each layer is selectively fused using a laser which precisely melts and bonds particles together. The quality of AM builds depend on the uniformity of the spreading process, where uneven spreading can lead to defects in manufactured parts and compromised structural integrity. Spreading depends on boundary-layer rheology, which is affected by the substrate boundary conditions, distributed particle morphology in the spreading layer, and processing parameters such as layer thickness and shear rate. In one aspect, this study uses Discrete Element Modeling simulations to investigate effects of local boundary conditions on spreading rheology. In another aspect, we consider the practical implications of boundary-layer rheology and particle morphology for powder reuse in the laser powder bed fusion process.

Keywords: Additive Manufacturing; Morphology; Rheology; Substrate

Mentor(s):

Dina Wael Samir Khattab (Engineering); Xiaoling Shen (Engineering)

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

Poster Presentation Abstract Number: 1639
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Controls Design for Regulating Flow in a Single-phase Cooling Loop

Innovative Technology / Entrepreneurship / Design

Author(s):

Mason J Kramer† (Engineering|JMHC)

Abstract:

Over-actuated systems are present in many modern applications (i.e. air vehicles, automotive, robotics) due to redundancy or performance. This means that there exist many possible control actions that can achieve the same reference setpoint(s). As such, there exists a need to optimize these control actions around some given metric. This work describes the design, implementation, and validation of a proposed control strategy in an over-actuated single-phase cooling loop such that two objectives are met: (1) target mass flow rates in two fluid branches are achieved as a result of the control actions and (2) the set of control actions selected minimizes power consumption. The system is modeled using the pressure drop across each fluid branch. From the model, mass flow rates at varying control states are used to determine the possible space of control actions. The power consumption can then be modeled as a function of the control actions in order to identify the combination of mass flow rates that minimizes this quantity. The control strategy is tested on a scale system consisting of two controllable flow rates and three available control actions. Future directions involving optimization with respect to different metrics, beyond power consumption, are also discussed.

Keywords: Controls Design; Over-Actuated; Thermal Fluid System; Power Consumption

Mentor(s):

Demetrius Gulewicz (Engineering); Neera Jain (Engineering)

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

Poster Presentation Abstract Number: 1640
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Molecular Mechanisms of Adenylyl Cyclase-Calmodulin-Forskolin Binding in Adenylyl Cyclase 1

Life Sciences

Author(s):

Shreya Krishnan† (Engineering)

Abstract:

Mammalian adenylyl cyclase isoform 1 (AC1), which synthesizes the cell signaling molecule cyclic adenosine monophosphate (cAMP), is key in synaptic plasticity and long-term chronic pain syndromes, and it is linked to drug abuse. Understanding mechanisms governing AC1 behavior can improve drug development for multiple disease pathways. The protein calmodulin (CaM) and the small molecule forskolin (Fsk) stimulate AC1. Per prior research, CaM can preserve AC1 function when the AC1 Fsk binding pocket contains mutations. As no direct contacts exist between CaM and Fsk binding pockets, this suggests that CaM and Fsk binding cause global conformational changes to AC1; however, such mechanisms have not been investigated. This study developed a computational model for AC1 to determine how the cofactors CaM and Fsk individually and jointly affect AC1 structure, and whether the joint effect of the cofactors differs from the individual effects. Four systems were simulated using Desmond Molecular Dynamics simulations: AC1 bound to no cofactors, AC1-CaM, AC1-Fsk, and AC1-CaM-Fsk. Visualization of vectors quantifying movement through each simulation demonstrated that CaM and Fsk reduced movement of the binding region for AC1 substrate, increasing stability of interactions and elucidating a possible mechanism of AC1 activation. Principal component analysis visualizations and contributions of amino acids to key AC1 movements will be compared to investigate the synergistic effects of CaM and Fsk on AC1 structure and activity. By ascertaining the underlying mechanisms of AC1 protein-protein interactions, these findings can provide new drug targets for novel treatments for AC1-associated diseases including migraines, inflammation, and drug abuse.

Keywords: Adenylyl Cyclase 1; Forskolin; Calmodulin; Molecular Dynamics

Mentor(s):

Jianing Li (Pharmacy); Talon Hicks (Office of the Provost)

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

Poster Presentation Abstract Number: 1641
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Artificial Intelligence in Music Transcription

Mathematical/Computation Sciences

Author(s):

Elan Landau†

Abstract:

Music Transcription is a process of converting audio into a symbolic representation. Automatic Music Transcription (AMT) promises to enable improved accessibility for musicians as well as enabling and superseding other technologies. Several methods have been developed in the field of AMT. This research explores these different approaches. The approaches that we found that show the most promise for AMT are identified along with their challenges and limitations. Machine learning (ML) shows promise among AMT schemes due to the room for growth while achieving state-of-the-art AMT performance. ML techniques such as sequence-to-sequence transformers and convolutional neural networks have been found particularly effective for performing AMT. Issues with these techniques include context length limitations, imprecision, inaccuracy, and large data requirements. We identify some techniques applied to ML in other domains, such as natural language processing. We repurposed these techniques to overcome some of the challenges encountered when applying ML to AMT. New ML architectures are identified that enable improved scaling of ML models to larger contexts. Methods for data augmentation are identified to enable more effective training on small feature sets. Future work will involve applying the identified strategies and comparing AMT effectiveness with the new strategies vs without.

Keywords: Automatic Music Transcription; Machine Learning; Music

Mentor(s):

Yung-Hsiang Lu (Engineering)

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

Poster Presentation Abstract Number: 1642
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Novel Molecular and Cardiac Imaging Paradigms for Precision Medicine in Aortopathy

Life Sciences

Author(s):

Ahhyun Lee†

Abstract:

Thoracic aortic aneurysm (TAA) is a degenerative aortopathy that is associated with significant morbidity and mortality. A standard technique for diagnosing and tracking TAA is the manual measurement of aortic diameters using transthoracic 2-D echocardiography, typically in the parasternal long axis (PSLAX) view. However, these measurements are susceptible to user variability due to the translation of the vessel and the pulsatile expansion and contraction of the aortic root during the cardiac cycle. The objective of my work is to help develop a novel automated aortic root echocardiography feature-tracking algorithm to overcome these constraints. This algorithm employs standard clinical 2-D echocardiography data to derive detailed properties of the aortic root, including diameter, strain, and strain rate at discrete locations. By stabilizing the translational movement of the aortic root within a standard PSLAX view, the algorithm tracks the aortic wall frame-by-frame and records in-plane aortic diameter tracings across multiple cardiac cycles. To enhance accessibility, an improved Graphical User Interface (GUI) based on this algorithm was developed using MATLAB. My efforts will enable efficient analysis of clinical data as well as easy integration into clinical workflows. Furthermore, it will provide a user-friendly interface that makes it simple for medical professionals to input data and quantify metrics, improving the efficiency of aortic aneurysm diagnosis and monitoring. Future efforts will involve improving the algorithm and implementing additional automation using machine learning techniques in order to increase diagnostic accuracy and efficiency.

Keywords: Thoracic Aortic Aneurysm; Echocardiography; Feature-Tracking Algorithm; Graphical User Interface

Mentor(s):

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

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

Poster Presentation Abstract Number: 1643
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

An Analytical Approach to Multifingered Grasp Synthesis

Mathematical/Computation Sciences

Author(s):

Richard Li† (Science|JMHC)

Abstract:

Modern methods of finding stable grasp configurations for robot hands commonly use learning models to determine force closure contact point sets. To improve runtime for feasibility for real world use, some methods also incorporate analytical algorithms to filter and refine grasp configurations before processing in the learning model. However, most of the literature on these algorithms focus on parallel jaw grippers. These grippers have more straightforward algorithms, often using antipodal grasp criterion to take advantage of the two-contact point nature of the gripper. This study addresses the issue of finding and verifying force closure contact points for multiple fingered grippers by leveraging available information from object mesh and gripper models to quickly synthesize stable grasp configurations using an analytical algorithm. We use a signed distance format gripper representation combined with a point cloud representation of an object to optimize grasp configurations based upon force closure equation approximations. Previous papers indicate it is possible to find stable grasp configurations with object and gripper models within milliseconds on a modern desktop. We verify this using our variation of these equations with various object and gripper configurations. This research improves upon the feasibility for data driven robotic grasping of novel objects by optimizing the process of finding stable contact point sets to reduce runtime and complexity.

Keywords: Robotic Grasping; Grasp Synthesis; Force Closure; Optimization; Smart Manufacturing

Mentor(s):

Hojun Lee (Engineering)

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

Poster Presentation Abstract Number: 1644
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Translational Deep Learning in Pathology: Evaluating Models for Ground Truth Prediction Across Species

Mathematical/Computation Sciences

Author(s):

Madison Sarah Loiselle† (Engineering)

Abstract:

Analysis of histopathology slides is a time consuming and laborious task for pathologists. Deep learning models have the potential to aid pathologists in making swifter and more accurate diagnoses for patients. However, a roadblock in the field of clinically applicable veterinary deep learning is data scarcity. The purpose of this research is to assess the performance of deep learning models for digital pathology that are trained on human data, tested on veterinary data and vice versa. If successful, this approach could provide resources to the veterinary setting, in which less curated data is available for model development. In addition, our results are expected to have implications for translational research by connecting histomorphological patterns across species. As a proof-of-principle, we will evaluate two different digital pathology use cases: (1) Classification of healthy tissue types from different organs and (2) Classification of cancer entities. Veterinary (canine, murine) and human data were gathered from a wide variety of publicly available datasets.

At this point, the data for first and second use cases have been preprocessed using the Solid Tumor Associative Modeling in Pathology (STAMP) pipeline and solely Macenko color normalization. As a next step, the classification models will be trained on human data and validated using 5-fold cross-validation on human data, and subsequently tested on an external set of animal data. This approach will subsequently be repeated in reverse form; with models being trained on veterinary data and tested on both veterinary and human data. The performance of each model will be evaluated with standard classification metrics including AUC, accuracy, specificity, and sensitivity. Overall, we expect this study to provide an understanding of the cross-species applicability of digital pathology models between humans and animals.

Keywords: Histopathology; Deep Learning; Pathology

Mentor(s):

Fiona Kolbinger (Engineering)

Other Acknowledgement(s):

Muhammad ibtsaam Qadir

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

Poster Presentation Abstract Number: 1645
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Designing Methods for Generating PVC-coated Magnetic Beads for High-throughput Microbiome Propagation

Life Sciences

Author(s):

Mallory A Luse† (Agriculture)

Abstract:

The study of microbiome function, the biochemical activity of microbial communities, requires high throughput experimental platforms to robustly characterize assembly and biological interactions. One way to achieve sufficient scale is to use liquid handling robots which offer efficient and reproducible programmable experiments, but even as an increasingly common research tool, they have yet to be adapted to handle solid materials. Generalizable methods have been devised to adapt a liquid handling robot to control a magnet, enabling work with solid substrates to study biofilm formation. Many microbes grow on solid surfaces which are ubiquitous in ‘built environments,’ including hydroponics facilities. For this application, a method has been developed to generate polyvinyl chloride (PVC) coated stainless steel spheres (1, 1.5, and 3 mm diameter) while validating the surface properties against PVC used in hydroponics growing troughs. Through experimentation with the following fabrication parameters: dip coating vs. impregnation with iron fillings, solvent used in coating (THF vs. PVC), PVC concentration (6% vs. 8%), multiple coats, and annealing conditions; early results indicate promising success for dip coating with a coat of 8% followed by 6% PVC as it had been the most effective in maintaining an even coating around the exterior. More in-depth testing with solvent coatings and annealing processes is underway based on these results. The short-term goal is to automate the analysis of biofilm growth on PVC surfaces for developing safer hydroponic and home water systems, while long-term this aims to adapt liquid-handling robots to study the microbiome on diverse solid materials.

Keywords: Microbiome; Solvent Coating; Dip Coating; Liquid Handling Robots

Mentor(s):

Jeffrey P Youngblood (Engineering); Roland Conrad Wilhelm (Agriculture); Caitlin Rose Proctor (Engineering); Xilong Wang (Science); Arval Viji Elango (Agriculture)

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

Poster Presentation Abstract Number: 1646
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Exploring the dynamics of breast cancer metastasis in relation to the high throughput magnetic actuation platform and lung respiration rates

Life Sciences

Author(s):

Maria Macias† (Engineering); Angelica Sofia Gonzalez-Ng* (Engineering)

Abstract:

[Abstract Redacted]

Keywords: Breast Cancer Metastasis; Magnetic Actuation; Lung Respiration Rates

Mentor(s):

Madison Mckensi Howard (Engineering); Luis Solorio (Engineering)

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

Poster Presentation Abstract Number: 1647
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Characterizing Microbial Water Quality in Rural Wells

Life Sciences

Author(s):

Lillian Grace Maldia† (Engineering)

Abstract:

The United States Government does not regulate private domestic wells; therefore, owners are responsible for their drinking water safety. While testing water quality is important, it is commonly neglected due to cost and time, and especially little is known about the microbial water quality outside of fecal pathogen risks following flooding. This study employed citizen-science to examine water quality and determine the impact of seasons on well water quality. Over the last year, 37 private well owners in Indiana provided 121 samples sourced from kitchen sinks and outdoor spigots. Six wells, previously sampled in April 2023, November 2023, and February 2024, will be resampled from kitchen sinks (hot and cold water samples) and outdoor spigots in July 2024. Continued sampling from these wells is expected to detect seasonal water quality deviations. All samples were measured for cell count, pH, dissolved oxygen, coliform, metals, nutrients, and extracted DNA. Most samples will be sequenced to quantify microbial communities. The DNA samples will be used to quantify bacteria Pseudomonas aeruginosa, Legionella pneumophila, and Mycobacterium with qPCR (quantitative Polymerase Chain Reaction) analysis. The results from April and November sampling events were returned to the well-owners to enhance their understanding of quality risks and treatment efficacy. The July 2024 results are expected to reinforce the well water safety but may show seasonal deviations in water quality. While most samples were safe to drink based on EPA water quality standards, microbial data provides a first of its kind baseline for rural Indiana water.

Keywords: Drinking Water; Pathogens; Safety; Well Water; Microbiome

Mentor(s):

Caitlin Rose Proctor (Engineering)

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

Poster Presentation Abstract Number: 1648
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Extinction Velocities of Droplet Flames in Forced Convection

Physical Sciences

Author(s):

Nashe Bumi Mucharambeyi† (Engineering)

Abstract:

[Abstract Redacted]

Keywords: Droplets; Sprays; Combustion; Fuel

Mentor(s):

Jay Gore (Engineering); Dileepan Velu (Engineering)

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

Poster Presentation Abstract Number: 1649
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Measurement of Vulnerable Road User Micro Doppler Signatures

Innovative Technology / Entrepreneurship / Design

Author(s):

Siddharth Murali†

Abstract:

Many modern autonomous safety systems, such as the Autonomous Braking System (AEBs) rely on cameras, LIDAR and radar data to detect the presence of Vulnerable Road Users (VRUs). One major problem that these systems face, however, is that they can only detect the presence or absence of an object, and not its identity. This limitation makes it impossible to engineer a custom response for each object, which is often a necessity when dealing with different road users. In order to overcome this limitation, this research proposes identifying VRUs by their unique micro-doppler signature patterns. Micro-doppler signature patterns are unique patterns generated by the relative internal motion between different parts of the object. Identifying patterns in the micro-doppler patterns of different objects allows for object identification and classification. However, this hypothesis remains largely unverified experimentally. This project uses a DRVEGRD 152 radar to record and analyze the micro-doppler radar data to verify the hypothesis and to develop a method for object detection, identification and classification. The radar is attached to a vehicle along with a calibrated camera for data collection. Data for various VRU scenarios is then recorded and analyzed using SmartMicro's DriveRecorder software. The project validates the hypothesis that Vulnerable Road Users can be uniquely classified through micro-doppler signatures by analyzing collected data in controlled environments. Viability of the hypothesis is then tested against data collected in non-controlled environments. Proving the validity of the hypothesis allows for future research and development into the use of micro-doppler signatures in object identification and classification.

Keywords: Micro-Doppler Effect; Vulnerable Road Users; Object Identification

Mentor(s):

Stanley Yung-Ping Chien (Purdue University)

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

Poster Presentation Abstract Number: 1650
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Adaptive Hopf Oscillator based Central Pattern Generator for autonomous operation of a Subterranean Robot with Whegs

Innovative Technology / Entrepreneurship / Design

Author(s):

Jihyo Park† (Engineering)

Abstract:

Agricultural drain tiles, spanning a network of 56 million hectares in the Midwest and Southern United States, are essential for agricultural productivity. These tiles, buried six feet below the surface, offer a unique gateway to the subterranean environment. Despite their extensive reach and significant impact, effective tools for directly mapping and monitoring drain tiles are lacking. The corrugated structure and uneven terrain of these tiles necessitate adaptive locomotion capabilities. Traditional vision- and LiDAR-based systems for mapping and locomotion are limited by the feature-sparse and repetitive nature of the drain tile environment.

In this research, we present a novel robotic platform specifically designed for the drain tile environment, utilizing wheg (wheel with legs) locomotion. We employ a central pattern generator with Hopf oscillators to create rhythmic movements of the whegs, enabling them to mesh with the corrugations for enhanced traction. This neuromorphic architecture is deployed directly on the robot, providing superior autonomous control in the challenging drain tile environment. We evaluate the effectiveness of our approach against standard robotics SLAM methods, including ORB-SLAM3 and monocular SLAM, as implemented in standard ROS packages. Performance metrics such as system footprint, latency, and overheads are compared.

This work demonstrates the practical feasibility and effectiveness of our subterranean robot for large-scale monitoring of drain tiles. Overall, this research introduces a novel robot and system for studying the drain tile environment, illuminating the subterranean soil microbiome in unprecedented ways.

Keywords: [no keywords provided]

Mentor(s):

Upinder Kaur (Engineering)

Other Acknowledgement(s):

Yuanmeng Huang

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

Poster Presentation Abstract Number: 1651
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Elucidation of Tomato Immune Responses in Response to Ralstonia Exopolysaccharides

Life Sciences

Author(s):

Brooke Allison Pilkey† (Science); Shreya Joshy‡ (Science); Silas Henry Buchanan‡ (Agriculture)

Abstract:

The soilborne bacteria Ralstonia solanacearum is the causal agent of bacterial wilt disease in a number of host plants, including tomatoes. Ralstonia results in significant crops losses each year, and is one of the most damaging bacteria that infects plants. Ralstonia produces exopolysaccharides (EPS), a known virulence factor, that accumulates and clogs the xylem of plants. This results in water transport being inhibited, leading to wilting symptoms. However, much about how tomatoes respond to EPS, and how EPS may help Ralstonia evade tomato defenses, is unknown. To investigate this relationship, lectins will be isolated from tomatoes through column chromatography. Lectins, carbohydrate binding proteins, bind Ralstonia and decrease EPS production. Two strains of Ralstonia, K60 and GMI1000, will be exposed to the lectins and observed under a microscope to see if agglutination occurs. Agglutination, a clumping of the bacteria, inhibits motility and adhesion leading to decreased virulence. Mutant strains of K60 and GMI1000, which produce significantly less EPS because of a mutation in the epsB gene, will also be exposed to lectins to determine if EPS prevents agglutination. To further characterize the relationship between EPS and plant defenses, reactive oxygen species (ROS) assays will be performed. ROS are produced by tomatoes after Ralstonia infection. Tomato roots will be exposed to WT and mutant Ralstonia strains. Measuring ROS levels can provide insight into the potential for EPS to provide a protective effect against antimicrobial ROS for Ralstonia. Further research aims to collect and compare data from resistant and susceptible tomato cultivars.

Keywords: Tomato; Bacterial Wilt; Ralstonia solanacearum; Exopolysaccharides

Mentor(s):

Rebecca Lynn Leuschen-kohl (Agriculture); Anjali Iyer-Pascuzzi (Agriculture); Stephen R Lindemann (Agriculture); Rwivoo Baruah (Agriculture)

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

Poster Presentation Abstract Number: 1652
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Establishing Temporal Bone Quality Changes in Progressive Chronic Kidney Disease: A Focus on Bone Water

Life Sciences

Author(s):

Gayatri Pradeep†

Abstract:

Chronic Kidney Disease (CKD) describes the gradual deterioration of the structure and function of the kidney. As renal function declines, the risk of bone fracture escalates, increasing morbidity and mortality rates. The current gold standard for fracture risk evaluation is dual-energy X-ray absorptiometry; however, its efficacy is questionable as fractures occur despite CKD patients displaying healthy bone mineral densities (BMD). This highlights the importance of utilizing alternative biomarkers such as collagen and water to predict fracture risk. This study utilized 80 samples of rat tibiae (40 normal and 40 Cy/+ with n=8 harvested at 22, 25, 28, 31, and 34 weeks) to run through thermogravimetric analysis (TgA). The weight loss curve was analyzed with each peak representing loss of free water, bound water, organic proteins, and structural water respectively. 0.35 mm cross sectional slices of the distal end of the tibiae were obtained to undergo analysis using Fourier Transform Near-Infrared Spectral Imaging (FT-NIRSI). Each cross-sectional slice was heated to 60 °C (free water peak) and 110 °C (loosely bound water peak) and spectral images were taken to observe changes in bone water localization. Additionally, a PTH ELISA assay was run on cardiac serum to measure parathyroid hormone (PTH) levels. Results obtained from the TgA indicated that Cy/+ rats displayed significantly higher levels of free water at 22 and 24 weeks, lower levels of loosely bound water at 25 and 34 weeks, and lower levels of collagen water at 31 weeks. The analysis of FT-NIRSI and PTH ELISA results are underway.

Keywords: Bone Imaging; Chronic Kidney Disease

Mentor(s):

Rachel Kathleen Surowiec (Engineering)

Other Acknowledgement(s):

Wikum Roshan Bandara Ranasinghe Mudiyanselage

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

Poster Presentation Abstract Number: 1653
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Identifying Radiation Particles through Acoustic Shock Signals: A Deep Learning Perspective

Physical Sciences

Author(s):

Abhishek Raj†

Abstract:

Accurate, cost-effective, and near real-time detection and identification of neutron vs. alpha radiation is critical for many applications, including national security, nuclear medicine, energy, and search for dark matter. Conventional ionization and excitation-based neutron/alpha detectors are also sensitive to gamma and beta particles and can become saturated, making them ineffective for capturing and distinguishing neutron and alpha radiation. The centrifugally tensioned metastable fluid detectors (CTMFDs) enable gamma-beta blind detection of neutrons and alpha particles. However, deciphering between the interactions presents a hurdle. To overcome this limitation, this research aims to develop an AI-based solution to discern neutron and alpha particles, by analysing acoustic shock spectra resulting from femto-scale radiation interactions. In CTMFDs, the femto-scale interaction of neutron and alpha radiation with tensioned metastable state atomic nuclei of sensing fluids produces rapid-growing bubbles. These shock spectra are not amenable to standard signal analysis. However, machine learning methods provide confidence in identifying these particles with greater than 90% accuracy. The acoustic shock signals accompanying the experimentation with neutron and alpha particles were recorded separately and converted into spectrograms. Various convolutional neural network architectures have been investigated to accurately classify the acoustic signatures of radiation particles, allowing us to record and classify neutron vs. alpha interactions with any given detection event in near real-time. A convolutional neural network had been designed, achieving ~99.2% accuracy. Further work involves studies to discriminate energetically diverse neutron sources and understand the underlying physics of interactions that give rise to unique acoustic signatures on the formation of transient cavitation events.

Keywords: Neutron Detection; Alpha Radiation; Centrifugally Tensioned Metastable Fluid Detectors; Acoustic Shock Spectra; Convolutional Neural Network

Mentor(s):

Rusi P Taleyarkhan (Engineering); Bailey Alexander Christensen (Engineering); Stepan Ozerov (Engineering)

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

Poster Presentation Abstract Number: 1654
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Accurate Surface Temperature Collection for Lithium-Ion Batteries

Physical Sciences

Author(s):

Sidney Evan Ryan† (Engineering); En-Hua Chang‡ (Engineering)

Abstract:

As many countries strive towards carbon neutrality, electric vehicles (EVs) have become the forefront of research. One of the major challenges faced by EV manufacturers is battery thermal management systems (BTMSs). EVs contain lithium-ion batteries (LIBs) that produce heat as a byproduct of their charging and discharging cycles. Accurately measuring the surface temperature of LIBs throughout their applications is essential for creating safe and reliable vehicles. The present work aims to investigate the effectiveness of different methods for measuring LIB temperatures. The experimental procedure mainly consists of measuring the external temperature of various 18650 LIBs placed within different dielectric fluids. The fluids will be deionized water, AmpCool® AC-110, and fluids from our collaborator, Valvoline. Thermocouples are mounted along the exterior of the LIBs before they are submerged in fluids. Different configurations will be investigated by varying the orientation, location, thermal interface materials (TIMs), and contact methods. It is observed that mounting the thermocouples at XXX orientation provided the most accurate data for the LIBs at a discharge rate of 4/5 C. Utilizing TIM with/without XXX tape proved to be beneficial to recording more accurate and consistent data. This research will serve as a foundation for understanding proper temperature collection in real case scenarios. Future research can use these results towards generating more accurate data in research and automotive applications.

Keywords: Electric Vehicles; Immersion Cooling; Lithium-Ion Batteries; Thermocouples; Natural Convection

Mentor(s):

Amy M Marconnet (Engineering); Piyush Mani Tripathi (Engineering)

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

Poster Presentation Abstract Number: 1655
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Additive Manufacturing with Hybrid Continuous and Discontinuous Fiber Systems

Innovative Technology / Entrepreneurship / Design

Author(s):

Thomas Edgardo Schmitz† (Engineering|JMHC); Armando David Galicia Huerta‡

Abstract:

Additive manufacturing (AM) of fiber-reinforced thermoplastic composites has recently received great interest in recent years as it enables faster prototyping, design flexibility, and reduced material waste. AM with discontinuous fiber is fast but lacks the strength benefit of continuous fiber. In contrast, AM with continuous fiber can produce prints with significantly higher stiffness and strength but have limited application due to low print speed and poor layer adhesion. To address this gap in AM technology, this research combined both discontinuous and continuous fiber printing through coextrusion to achieve a hybrid material which can undergo high print speeds and achieve high mechanical strength. The ratio of discontinuous to continuous fibers and the printing parameters were optimized for strength, stiffness, and consolidation through modeling and experimental trials. Tensile tests and microscopy were performed to determine the mechanical properties and observe any defects in printed samples. The results show a final material which can undergo a maximum print speed of 2000 mm/s and has a mechanical strength between those of continuous and discontinuous fiber. The material also demonstrates improvement compared to the dual extrusion method, which produces weaker interlayer bonds, thus achieving improved print quality when compared to related studies. This hybrid discontinuous and continuous AM technology offers a balance between speed and mechanical performance expanding the potential applications of additively manufactured fiber-reinforced thermoplastic composites in fields including aerospace, automotive, and robotics.

Keywords: Additive Manufacturing; Carbon Fiber; Mechanical Engineering

Mentor(s):

Eduardo Barocio Vaca (Engineering); Harry Kangseok Lee (Engineering)

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

Poster Presentation Abstract Number: 1656
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Modeling Applications of High-Temperature Heat Pumps for Industrial Use

Mathematical/Computation Sciences

Author(s):

Audrey Ye-Ning Schuster† (Engineering|JMHC)

Abstract:

In the United States, the industrial sector contributes to a significant portion of greenhouse gas (GHG) emissions, with many of the emissions coming from the burning of fossil fuels such as natural gas to produce process heat. Implementing industrial high-temperature heat pump (HTHP) technology is a key component to electrification and decarbonization of industrial processes, which will in turn lead to the reduction of GHG and slowing of global warming. This research aims to determine what processes could utilize HTHPs, and to compare the current carbon emissions with the carbon emissions required to operate a heat pump utilizing the current US electricity grid. In order to find where current emissions are coming from, the Python Pandas library is used to analyze the data available through the Environmental Protection Agency's facility level information on greenhouse gasses tool. Data regarding location of emissions, current types of heating units, fuel type, plant capacity, and temperatures for different processes are compiled with the goal of determining which current heat processes could be replaced by an HTHP. The results will allow for a better understanding of the emissions produced by current fossil fuel based heating, contributing to a more thorough techno-economic analysis of HTHPs.

Keywords: [no keywords provided]

Mentor(s):

Rebecca Ciez (Engineering)

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Poster Presentation Abstract Number: 1657
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Measurement of Zeotropic Refrigerant Fractionation with Lubricants During Phase Change

Physical Sciences

Author(s):

Alexander Joseph Spilotro† (Engineering)

Abstract:

The institution of new legislation restricting the use of high global warming potential (GWP) refrigerants has prompted the HVAC&R industry to transition from high GWP hydrofluorocarbons (HFCs) to lower GWP alternatives. Mixtures of refrigerants to reduce the GWP of a working fluid have proven to be one feasible alternative. However, some of these refrigerant mixtures exhibit zeotropic behavior, leading to challenges in their implementation. Fractionation during phase change, two-phase heat transfer losses due to temperature suppression, and influences of non-uniform oil solubility on compressor performance have been studied previously. However, an experiment analyzing and comparing various in-line measurement devices to characterize these behaviors in a vapor compression cycle, which would reduce trepidation surrounding broad scale implementation, has not been carried out. A comprehensive investigation of these behaviors, along with a comparison of varying sensor techniques to determine the necessity of instituting high-accuracy measurement systems in the field, is to be carried out. In order to accurately quantify tradeoffs in cost and accuracy of the sensors that could be applied in the field, a highly accurate measurement reference system is needed. This report focuses on determining the most accurate and feasible reference measurement technique and designing a methodology to carry this measurement out in the context of the analysis of low-GWP zeotropic mixtures with compressor lubricants in vapor compression cycles. The high-level measurement techniques provided in this work yield an analysis of zeotropic refrigerant behavior in vapor compression cycles, facilitating further implementation of low GWP refrigerants into the field.

Keywords: Zeotropic Refrigerants; Fractionation; Vapor Compression Cycle; Measurement Systems

Mentor(s):

Riley Bradley Barta (Engineering); Joshua Michael Cox (Engineering)

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

Poster Presentation Abstract Number: 1658
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Development of Magnetic Bead-Based Active Microrheology Prototype for Probing and Measuring Mechanical Properties of Biological Matter

Mathematical/Computation Sciences

Author(s):

Madeline Jane Stevenson† (Engineering); Luhao Xu* (Engineering); Shlok Rajesh Kulkarni* (Engineering|JMHC)

Abstract:

Microrheology has emerged in the past few decades as an effective technique for understanding the mechanical properties of various materials and systems. Numerous studies have documented that diseased cells exhibit lower elasticity and higher viscosity compared to healthy cells. The cytoplasm, a complex heterogeneous solution, results in differences in subcellular measurements compared to overall tissue viscoelasticity. Accurate comparisons between individual cells require nanoscale precision. This project seeks to develop a form of active microrheology that utilizes a magnetic field to induce the motion of target particles. An arrangement of eight permeant magnets generates the magnetic field, monitored via a Hall sensor. Injected superparamagnetic fluorescent beads elongate cells in the direction of the magnetic field without disrupting living tissue. An adapted LabVIEW program detects magnetic particles and measures the viscoelasticity of the cells over time. The platform mounts onto a confocal microscope with a linear actuator to alter the magnetic field. Materials of known mechanical properties will be used as benchmarks to assess the device's accuracy, with initial performance tested through water trials. Challenges include minimizing the weight-bearing load and generating a sufficient magnetic field to manipulate the sample. A successfully designed active microrheology system would be powerful in characterizing the viscoelastic properties of biological matter and cells.

Keywords: Active Microrheology; Viscoelasticity; Magnetic Beads; Particle Tracking; Permanent Magnets

Mentor(s):

Arezoo Ardekani (Engineering); Harsa Mitra (Engineering)

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

Poster Presentation Abstract Number: 1659
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Chemogenetic Tools in Zebrafish: Visualizing and Manipulating Bioelectric Activity

Life Sciences

Author(s):

Maitreyee Panini Telang† (Science)

Abstract:

Bioelectricity refers to the endogenous electrical signals generated and mediated by the movement of ions across the cell membrane. Bioelectricity plays crucial physiological roles in various biological systems and processes, such as embryonic development, regeneration, and cancer. Researchers have been using chemogenetic tools, DREADDs (Designer Receptors Activated by Designer Drugs), and GEVI (Genetically Encoded Voltage Indicators), to manipulate and visualize in-vivo bioelectric activities in primate and murine models. Zebrafish have extensively been used for studying embryonic development and modeling diseases due to their advantages in tractable genetics and early embryo transparency. However, these tools are not available in zebrafish. To visualize and manipulate in vivo bioelectricity, this study aims to apply and validate the function of DREADD and GEVI in the zebrafish model. We have generated a series of transgenic zebrafish lines. Each fish line contains a DREADD and a GEVI component under the UAS promoter, and the transgene insertion has been validated by PCR. This study aims to validate the GEVI reporter of the transgenic fish lines by crossing UAS-DREADD-GEVI fish lines with tissue-specific Gal4 fish lines. Our experiment shows that GEVIs are visible in some fish lines and indicates the tools can be employed to control membrane potential in zebrafish. We expect these zebrafish lines will serve as a valuable resource for research in bioelectricity across fields like neuroscience, cardiology, and developmental biology.

Keywords: Bioelectricity; DREADD; GEVI; Zebrafish

Mentor(s):

GuangJun Zhang (Veterinary Medicine); Ziyu Dong (Science)

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

Poster Presentation Abstract Number: 1660
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

Cob Structural Testing for Automated Earth Construction

Innovative Technology / Entrepreneurship / Design

Author(s):

Ilene Trach† (Engineering); Case T Vandevelde† (Engineering)

Abstract:

[Abstract Redacted]

Keywords: Cob

Mentor(s):

Yu Wang (Engineering)

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

Poster Presentation Abstract Number: 1661
Presentation Time: Session 4: 1:30pm-2:30pm

SURF

3D printing earth and structural testing of the samples

Physical Sciences

Author(s):

Case T Vandevelde† (Engineering); Ilene Trach† (Engineering)

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Yu Wang (Engineering)

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

Poster Presentation Abstract Number: 1662
Presentation Time: Session 4: 1:30pm-2:30pm

VIP

Robot Cello

Innovative Technology / Entrepreneurship / Design

Author(s):

Richard Joseph Von Tersch† (Engineering); Samantha Sudhoff† (Science); Vinay Sai Meda‡ (Science)

Abstract:

[Abstract Redacted]

Keywords: AI in Music; Robotics

Mentor(s):

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

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

Poster Presentation Abstract Number: 1663
Presentation Time: Session 4: 1:30pm-2:30pm

Investigating Early-Onset Neurodegeneration in Patients with Hereditary, Sensory, and Autonomic Neuropathy Type 1E (HSAN1E) Using 3D Cortical Organoids

Life Sciences

Author(s):

Akila Abeyaratna† (Agriculture|JMHC)

Abstract:

The DNMT1 gene encodes the enzyme DNA methyltransferase 1, which is crucial for replicating and maintaining DNA methylation patterns during cell division. A specific mutation in this protein, Y511C, causes Hereditary Sensory Autonomic Neuropathy Type 1E (HSAN1E). HSAN1E is an aggressive neurodegenerative disorder that results in sensory neuropathy, global brain atrophy, and hearing loss typically beginning between ages 20-30, and becomes fatal at age 50. The research on this condition is limited, primarily relying on mouse models. To bridge this gap, our lab has pioneered the use of 3D brain organoids, which are clusters of neurons that can mimic the complex neuronal interactions and structural organization of different regions in the human brain. For investigating early onset of dementia and cortical atrophy, we generated cortical organoids as cortex is the primary brain region affected in neuro degenerative diseases. In addition to the wild-type DNMT1 organoids, we cultured heterozygous DNMT1-Y511C organoids to mimic the condition of the patient, and homozygous DNMT1-Y511C to understand how the mutation affects the cortical development and the compensatory mechanisms that might be taking place in the heterozygous model. In this study, we found that the heterozygous and homozygous were significantly smaller than the wild type organoids and the size was tracked till day 400. To understand why such significant size difference occurred in this mutation, we will evaluate the cortical atrophy in different developmental stages by immunostaining for NeuN and MAP2 to quantify neuron content and test if cortical atrophy is a result of overall neuron loss.

Keywords: DNMT1; HSAN1E; Organoids; Neurodegeneration

Mentor(s):

Purba Mandal (Pharmacy); Yang Yang (Pharmacy)

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

Poster Presentation Abstract Number: 1664
Presentation Time: Session 4: 1:30pm-2:30pm

Role of Dnmt3bas in Epiblast Gene Expression and Epigenetic Dynamics in Stem Cell Development

Life Sciences

Author(s):

Bevan Mathew Ambrose†

Abstract:

[Abstract Redacted]

Keywords: Dnmt3bas; EpiLSCs; Epiblast; Pluripotency

Mentor(s):

Humaira Gowher (Agriculture)

Other Acknowledgement(s):

Mudasir Zahoor

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

Poster Presentation Abstract Number: 1665
Presentation Time: Session 4: 1:30pm-2:30pm

Verification of Interrupt Controller Using Universal Verification Methodology

Innovative Technology / Entrepreneurship / Design

Author(s):

Indrayudh Chowdhury† (Engineering)

Abstract:

This project focuses on verifying a Platform-Level Interrupt Controller (PLIC) using Universal Verification Methodology (UVM). Initial efforts involved developing a test plan and architecture. Following this, directed sequences were created to test the PLIC UVM test bench. Once the test bench's validity was confirmed, the focus shifted to the PLIC design, utilizing randomized test sequences to ensure comprehensive functional coverage. This verification approach highlights both the robustness of the PLIC design and the test bench's capability to assess its performance effectively. Robust verification is crucial to ensure the reliability and correctness of critical hardware components in complex systems.

Keywords: Interrupt Controller; Universal Verification Methodology; Functional Coverage; Randomized Sequences; Verification

Mentor(s):

Mark Johnson (Engineering); Maxwell Frank Michalec (Engineering)

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

Poster Presentation Abstract Number: 1666
Presentation Time: Session 4: 1:30pm-2:30pm

Understanding the Acute Hematological Impact of Intrauterine Growth Retardation in Swine

Life Sciences

Author(s):

Chiara Isabella Gibboney† (Agriculture)

Abstract:

For over twenty years, geneticists have focused their efforts on increasing fecundity in the swine breeding herd. This has effectively increased ovulation rates and litter sizes, which are both highly heritable but not uterine size, which exhibits low heritability. The lack of in-utero space decreases the conceptus survival rate, creates intrauterine growth retardation (IUGR), and increases variability among the surviving fetal population. During IUGR, nutrients are preferentially sent to the brain, starving critical organs such as the liver, which is vital to postnatal survival. This study aims to characterize the hematological effects of IUGR in postnatal piglets. We hypothesize that blood glucose and hematocrit will be reduced in IUGR piglets as a result of nutrients being redirected to the brain during in-utero development. Blood samples were collected by jugular venipuncture from piglets immediately after birth before they could ingest the sow's colostrum. Hematocrit and blood glucose were then determined on n=935 and n=950 samples, respectively, representing piglets from 82 sows. Piglets in the lower 10th percentile for birth weight were retrospectively classified as IUGR, and those above the 90th percentile were classified as large for gestational age (LGA). Preliminary statistical analysis carried out using a linear model, indicates that both hematocrit and blood glucose are significantly lower in IUGR piglets relative to LGA. Our results indicate an acute impact of IUGR on the hematological parameters of the neonatal piglet, and additional samples are being collected prior to weaning to determine if this effect persists into the postnatal period.

Keywords: Intrauterine Growth Retardation; IUGR; Hematology; Swine

Mentor(s):

Jonathan Pasternak (Agriculture); Alyssa Smith (Agriculture)

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

Poster Presentation Abstract Number: 1667
Presentation Time: Session 4: 1:30pm-2:30pm

Optimizing Translaminar Autonomous System Model Performance Utilizing Poseidon Pump Feedback Loop System

Innovative Technology / Entrepreneurship / Design

Author(s):

Emmanuel Monda Gichaba† (Engineering); Gaurav Sharma‡

Abstract:

The novel translaminar autonomous system (TAS) model allows human posterior cups (PCs) to be experimented with ex-vivo via modulating the intraocular pressure (IOP) and intracranial pressure (ICP). Chronic dysregulation between ICP and IOP may restructure the posterior eye to pathogenesis associated with ocular neurodegeneration. Currently, these pressures are regulated in the TAS model manually by increasing or decreasing the flow rate by the user to achieve desired pressures. The aim is to integrate the Poseidon pump to autoregulate the flow rates by allowing end users to automate required pressures within the system. Furthermore, this will allow large-scale experiments to be concurrently conducted. Design and incorporate a large-scale system that can run 3 pairs of eyes (6 eyes total) using 6 TAS models with 2 inflow Poseidon pumps per model. Initial integration was of 12 Poseidon pumps using 3d printed PLA material to build the pump skeleton and instrumentation needed to construct the different parts of the pump. In addition, a printed housing unit was designed to store pumps, Arduinos, fans, a USB connection hub, and Raspberry Pi. We successfully created a large-scale testing system for the TAS model. This included a 2-part housing system with the 1st part housing the pumps for the media syringes to be running concurrently with the 2nd part housing the Arduinos, fans, USB connection hub, and Raspberry Pi. We were able to build the Poseidon pumps, design the additional housing system, and integrate them within the TAS model, allowing for large-scale experimentation for studying pressure-dependent neuro-ocular degenerations.

Keywords: Translaminar Autonomous System; Feedback; Optimization; Poseidon Pump; Pressure

Mentor(s):

Tasneem Sharma (Indiana University)

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

Poster Presentation Abstract Number: 1668
Presentation Time: Session 4: 1:30pm-2:30pm

Protective Effects of Polyphenols Against Alpha-Synuclein Aggregation in a Cellular PFF Model of Parkinson's Disease

Life Sciences

Author(s):

Jacob Gold† (Pharmacy)

Abstract:

Parkinson's disease (PD) is a neurodegenerative disorder characterized by a loss of dopaminergic neurons in the substantia nigra region of the midbrain, as well as the formation of Lewy body inclusions enriched with aggregated forms of the protein alpha-synuclein (aSyn) throughout the brain. The propagation of Lewy bodies across interconnected brain regions, a process that is apparently promoted by oxidative stress, is thought to play a key role in the pathogenesis and progression of PD. Polyphenols, a group of phytochemicals present in various foods and medicines, have drawn much attention for their ability to alleviate oxidative stress. Previous research has characterized the neuroprotective role of polyphenols in toxicant PD models, focusing on amelioration of the oxidative stress component of PD. Additionally, some polyphenols have been examined for their ability to inhibit aSyn aggregation. Here, we aim to further characterize the relationship between polyphenols and aSyn pathology by utilizing a cellular model of PD that recapitulates the propagation of aSyn aggregates described above. In this model, HEK293T cells overexpressing aSyn tagged with a fluorescent protein are treated with aSyn pre-formed fibrils (PFFs) and monitored for evidence of seeded aSyn aggregation by confocal microscopy. We hypothesize that cells co-treated with PFFs and polyphenols will show a reduced aSyn aggregate burden, consistent with the idea that polyphenols can interfere with the propagation of aSyn pathology. This project provides a basis for further investigation of polyphenols as potential disease-modifying therapeutics for PD.

Keywords: Alpha-Synuclein; Parkinson's Disease; Neurodegeneration; Polyphenol; Protein Aggregation

Mentor(s):

Jean-christophe Rochet (Centers & Institutes)

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

Poster Presentation Abstract Number: 1669

Presentation Time: Session 4: 1:30pm-2:30pm

Dark-Field Absorbance Circular Dichroism of Oriented Chiral Thin Films

Physical Sciences

Author(s):

Alexander Higgins† (Science|JMHC)

Abstract:

Dark-field and confocal approaches to circular dichroism (CD) spectroscopy of uniaxial thin films further examine the relationship between symmetry and incoherence in the nonreciprocal CD response, or the component that is antisymmetric about light propagation direction. Modifying a conventional CD spectrometer for low-angle scattering detection isolates incoherent contributions to nonreciprocal CD drop-cast thin films, boasting 5-to-10-fold enhancements in CD dissymmetry parameters. Conversely, confocal detection suppresses the nonreciprocal CD response. These collective measurements offer additional insight on relevant theoretical frameworks. Namely, they provide the first compelling evidence of early predictions by Hecht and Barron, which indicate large chiral-and-interface-specific CD observables from scattered signals in uniaxially oriented assemblies. According to this theory, nonreciprocal CD is possible within the electric dipole approximation, leading to chiral-specific observables exceeding reciprocal, isotropic contributions. Dark-field absorbance CD (DCD) spectroscopy thus offers new insights into molecular and macromolecular arrangements with interface selectivity and chiral specificity.

Keywords: Surface Specificity; Interface Chemistry; Circular Dichroism; Chirality; Spectroscopy

Mentor(s):

Caitlin Elizabeth Dunlap (Science); Gwendylan Ariel Aura Turner (Science); Garth J Simpson (Science)

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

Poster Presentation Abstract Number: 1670
Presentation Time: Session 4: 1:30pm-2:30pm

Assessing Robustness in fMRI Connectome Identification: Effects of Scan Intervals and Distance Metrics

Life Sciences

Author(s):

Xinwan Hu† (HHS)

Abstract:

Functional magnetic resonance imaging (fMRI) is a non-invasive technique that measures brain activity by detecting changes in blood flow. Time series of fMRI signals is widely used to estimate functional connectomes (FCs), which are commonly represented as correlation matrices. One characteristic of FCs is "fingerprinting" that can identify individuals based on a population of FCs, often measured by identification rates (ID rates). It has been showed that tangent space projections of FCs achieved higher ID rates, while only the initial scan volumes of the time series were evaluated.

This study investigates the robustness and reliability of high ID rates when varying the starting points and scan lengths using different distance metrics (euclidean distance and correlation distance). We segmented the time series data into chunks of different sizes, both overlapping and non-overlapping. Using unrelated subjects, we compared ID rates for matching chunks (same starting time and length) and non-matching chunks (same length but different starting times).Our results showed consistently high ID rates using correlation distance for tangent space projections, whereas significant variability was observed with Euclidean distance.

These findings suggest that while tangent space projections with correlation distance provide robust identification across varying intervals, the choice of distance metric is critical. The high variability with Euclidean distance implies a need for careful selection of analytical methods in fMRI studies. This study underscores the importance of using appropriate distance metrics and considering different scan intervals to enhance the reliability and applicability of individual identification techniques in connectome research, thus advancing the precision and robustness of neuroimaging analyzes.

Keywords: fMRI Scan Length; Functional Connectome; Fingerprinting; Tangent Space Projection

Mentor(s):

Joaquin Goni Cortes (Engineering); Mintao Liu (Engineering)

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

Poster Presentation Abstract Number: 1671
Presentation Time: Session 4: 1:30pm-2:30pm

Chicken Tracking: Self-Powered Optical Frequency Identification Tags for Use in Data-Driven Agriculture

Innovative Technology / Entrepreneurship / Design

Author(s):

Philo Jeremy Kaulkin† (Polytechnic); Andrew R Fox† (Polytechnic); Baquero Sanchez Gabriel Alejandro‡

Abstract:

Agriculture has been revolutionized countless times since its inception through technologies like plows, tractors, and pesticides. Now, the power of more precise data acquisition tools has the potential to further contribute and revolutionize agricultural technology. An optical communication and computer vision-based data acquisition system for just this purpose, could collect individualized data about hundreds or thousands of livestock with little to no maintenance required by farmers. In the example use-case for this technology, cage-free chickens are fitted with a digital tag capable of optical frequency identification (OFID) communication and self-charging via a solar cell. This tag can be equipped with a variety of sensors including accelerometers, microphones, and more. By aiming a laser and photoreceptor at the surface of a solar cell on the digital tag, half-duplex communications can be achieved by inducing voltage spikes on the solar cell with the laser and by detecting the natural photoluminescence or electroluminescence of the solar cell with the photoreceptor. This half-duplex serial communication is carried out using digital pulse interval modulation (DPIM) of either the laser or the luminescence of the solar cell. To aim the DPIM transceiver, a computer vision system is employed to identify tags on the backs of livestock and direct a dichroic mirror system rotating on two axes. With this precise and highly individualized data acquisition technique, farmers can make more informed decisions about their livestock, improving their yields and product quality, and scientists can analyze behaviors of these animals in their environment.

Keywords: Computer Vision; Agriculture; Optical Communication; Artificial Intelligence; Solar Energy

Mentor(s):

Walter Daniel Leon-Salas (Polytechnic)

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

Poster Presentation Abstract Number: 1672
Presentation Time: Session 4: 1:30pm-2:30pm

Effect of Metal Ions on Tau Aggregation: A Study on Kinetics and Characterization

Life Sciences

Author(s):

Maggie Kim† (Science)

Abstract:

One of the defining pathological hallmarks of Alzheimer's disease (AD) is tau aggregation. It has been reported that these aggregates form fibers with two prominent morphologies: straight filaments and paired helical filaments. In addition, tau aggregates from post-mortem AD patients have been found to contain metal ions, suggesting that the dysregulation of metal homeostasis is linked to tau aggregation by propagating said process. Though the influence of metals on tau aggregation has been studied before, there has not been many reports of the cryo-EM structure of tau aggregates with any metals prevalent to AD. Using ThT fluorescence we monitor the kinetics of tau aggregation in the presence of different metals and further validate if there are any observable morphological differences through AFM and TEM. From our initial TEM results, we notice the fibers are reminiscent of paired helical filaments in the presence of Zn2+ and further investigate it using Cryo-EM.

Keywords: Alzheimer; Tau; AFM; TEM; Cryo-EM

Mentor(s):

Khai Quynh Tien Pham (Science); Cuong Duc Calvin Nguyen (Science)

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

Poster Presentation Abstract Number: 1673
Presentation Time: Session 4: 1:30pm-2:30pm

ENERGY ANALYSIS OF THE DEDICATED OUTDOOR AIR CONDITIONING SYSTEM COUPLED WITH A DUAL MEMBRANE MODULE HUMIDITY PUMP.

Innovative Technology / Entrepreneurship / Design

Author(s):

Clark Lay† (Engineering|JMHC); Songhao Wu‡ (Graduate)

Abstract:

In buildings such as hospitals and shopping malls air conditioning systems must use only outdoor air to ensure adequate ventilation. This is done using a dedicated outdoor air system (DOAS), which cools the outdoor air below its dew point temperature to meet specific comfort conditions. This process is energy intensive, with around 80% of the load on the cooling coil being latent load. Water vapor selective membranes provide an opportunity to greatly reduce power consumption by selectively removing water vapor from air using partial pressure gradient, thereby achieving dehumidification without phase change/condensation. In this work, we propose a Dual Membrane Module Dehumidifier (DMMD) that selectively removes water vapor prior to cooling and uses a second vapor selective membrane module to reject water vapor at sub-atmospheric pressures. Rejection at sub-atmospheric pressures reduces compressor pressure ratio and saves energy. Towards this, a thermodynamic modeling was conducted in MATLAB to investigate its annual energy saving potential over the conventional cooling and condensation process in the geographical location of Florida, USA. Performance parameters such as cooling coil size reduction, energy savings and moisture removal efficiency were compared. The analysis showed that the DMMD-DOAS was a greater improvement over a conventional DOAS as temperature and specific humidity rose. In the warmest and most humid months, evaporator capacity decreased by 54%, MRE improved by 16%, and energy savings were upwards of 13%.

Keywords: [no keywords provided]

Mentor(s):

David Warsinger (Engineering); Anand Balaraman (Engineering)

Other Acknowledgement(s):

Md Ashiqur Rahman; James Braun

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

Poster Presentation Abstract Number: 1674
Presentation Time: Session 4: 1:30pm-2:30pm

An Investigation into the Hydraulics of a Wildfire Damage to Water Distribution Systems and Finished Water Storage Tank Vent Filtration Potential

Innovative Technology / Entrepreneurship / Design

Author(s):

Marcelo Marcos† (Engineering); Payten Marley Whitfield‡ (Engineering|JMHC); Josh Michael Youngblood‡

Abstract:

Wildfires are increasingly causing drinking water to become chemically unsafe in water distribution systems, and efforts are needed to better understand and mitigate this risk. In 2020, after the CZU Lightning Complex Fire, a finished water storage tank in Boulder Creek, California became chemically contaminated with volatile organic compounds (VOCs). Follow-up investigations found that VOCs had sorbed into the plastic interior tank lining, likely originating from smoke during tank depressurization. When the tank was refilled with safe drinking water, VOCs leached from the lining and made the water unsafe downstream. The study's purpose was to better understand storage tank design, operation, and response to catastrophic hydraulic events ultimately to inform a vent filter's design. The desired vent filter was to be installed on tank vents to help prevent drinking water contamination. A literature review about wildfire damage to water distribution systems was also conducted. Insights from experts in hydraulic design and operation of water distribution systems in Indiana, Colorado, New York, and tank inspection and maintenance were obtained. Evidence shows that little information has been publicly reported about finished water storage tank hydraulic conditions from wildfire incidents. Tank types, sizes, designs, and factors that influence catastrophic tank flowrates and drainage time were evaluated. Flowrates and draining duration were considered for tank types, sizes, the number of destroyed homes, fire truck pump rates, and field experiences from utilities that experienced wildfires. Air flowrates through tank vents were also estimated. Study results provide a basis for vent filter design and future research.

Keywords: [no keywords provided]

Mentor(s):

Andrew Whelton (Engineering)

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

Poster Presentation Abstract Number: 1675
Presentation Time: Session 4: 1:30pm-2:30pm

Direct Single Phase Jet Impingement Design for Electronics Cooling

Physical Sciences

Author(s):

Ian Quan† (Engineering)

Abstract:

As semiconductor systems become more power-dense, traditional cooling methods become suboptimal, causing undesirable effects such as extreme temperature gradients and pressure drops across the cooler. For such kind of high heat flux applications, direct multi jet impingement is an attractive solution. The impinging jets offer a thinner boundary layer resulting in increases in the convective heat transfer coefficient and improves cooling performance. This presentation proposes a novel cooler manifold design with distributed inlet and outlet channels for the delivery and removal of the coolant. The new manifold design consists of a 5 x 5 and 6 x 6 array of inlet nozzles and is manufactured using advanced additive manufacturing technology and tested for thermal fluid performance experimentally. To understand the fluid flow and thermal performance of the manifold design, a numerical investigation is performed using ANSYS fluent and verified with experimental results. The expected results aim to provide a better understanding of the design of jet impingement coolers and aims to provide guidelines for future cooler designs. Future studies can incorporate denser converging nozzle grid arrays using the numerical solution model with technologies such as topology optimization to improve flow uniformity across all the nozzle outlets, improving jet uniformity across the entire cooler surface, and decreasing the temperature gradient across the cooler surface. Future cooler iterations can also be extrapolated to larger nozzle grid arrays.

Keywords: Heat Transfer; Semiconductor Cooling; Additive Manufacturing; Numerical Analysis; Jet Impingement

Mentor(s):

Tiwei Wei (Engineering); Ketankumar Jayantkuma Yogi (Engineering)

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

Poster Presentation Abstract Number: 1676
Presentation Time: Session 4: 1:30pm-2:30pm

Investigating Smoke Composition and Dispersion from Wildfire Events and Air Filter Implementation Potential on Water Storage Tanks

Innovative Technology / Entrepreneurship / Design

Author(s):

Payten Marley Whitfield† (Engineering|JMHC); Marcelo Marcos‡ (Engineering); Josh Michael Youngblood‡

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Andrew Whelton (Engineering)

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

RESEARCH TALKS

Research talks are delivered in Grissom Hall on July 25, 2024. Names as in OURConnect.

RESEARCH TALK SESSION 1 | 9:00-10:00

ROOM: GRISSOM 103

9:00 Real-Time Musical Accompaniment for Non-Improvised Music
7000 *Ryan Thomas Jordan†; Tim Nadolsky*; Edward Falcon Navarro*; Ping-Hung Nick Ko*; Caasi Nketiah Boakye*; Minsoo Oh*; Brian Mingyang Qi*; Anthony Wang*; Connor Bradley Frey**
Mentor(s): Yeon Ji Yun; Yung-Hsiang Lu; Purvish Jatin Jajal

9:20 The genetic basis of inflorescence architecture in Arabidopsis thaliana: implications for adaptation
7001 and maladaptation
Santiago Reinoso Castillo†
Mentor(s): Christopher G Oakley; Juan Diego Rojas Gutierrez

9:40 Contrastive Learning in Language Models for Software Vulnerability Detection
7002 *Michael Cheng†*
Mentor(s): Lin Tan; Nan Jiang

ROOM: GRISSOM 118

9:00 Foldable FWV Fabrication and Control Analysis
7003 *Andrew Lewis Hadikusumo†*
Mentor(s): Shijun Zhou; Nak-seung Patrick Hyun

9:20 Using Voltammetry to Probe Mass Transport in an Acoustically Levitated Droplet
7004 *Amber K Wang†*
Mentor(s): Lynn Elizabeth Krushinski; Jeffrey Edward Dick

9:40 Unveiling PFOS Neurotoxicity: Spatial Analysis of Neurotransmitters with DESI-MSI
7005 *Hurshal Pol†*
Mentor(s): Jason R Cannon; Christina R Ferreira; Josephine Maria Brown

ROOM: GRISSOM 125

9:40 Scaling Vision: The Interplay of Eyes, Body Size, and Ecological Functions in Mosquitoes
7006 *Katherine Garcia†*
Mentor(s): Ximena Bernal

ROOM: GRISSOM 126

9:00 Mini-BREAM: A Low-Cost Modular Platform for Autonomous Surface Vehicle Testing
7007 *Jhair Steven Gallego Mendez†*
Mentor(s): Nina Mahmoudian

9:20 Predictive Modeling & Experimental Observation of a Small-Scale Two-Phase Loop Thermosyphon
7008 *Fredrick G Mungai†*
Mentor(s): Justin Weibel; Debraliz Isaac-Aragones; David Warsinger

9:40 Large Property Models for Predictive Chemistry
7009 *Aakarsh Misra†*
Mentor(s): Brett Savoie; Sai Mahit Vaddadi

ROOM: GRISSOM 133

9:00 AI for Software Verification
7010 *Marilyn Rego†*
Mentor(s): Jenna L Wise DiVincenzo

9:20 Actuation strategy for an avian-inspired flapping-wing aerial vehicle (FWAV) to achieve stable
7011 flapping-gliding transition
Sota Yanagisawa†; Milan Edward Rahmani‡
Mentor(s): Abhijnan Dikshit; Pavankumar Channabasa Koratikere; Leifur Thor Leifsson

9:40 Forecasting the 2024 US Elections
7012 *Thanmaya Pattanashetty†; Joseph Michael Cromp‡*
Mentor(s): Alexandria Volkening

RESEARCH TALK SESSION 2 | 10:00-11:00

ROOM: GRISSOM 103

10:00 Metamaterial-based Structures in Underwater Noise Mitigation for Offshore Wind Energy
7013 *Yijie Zhang†; Shaocheng Wu‡*
Mentor(s): Junfei Li

10:20 Investigation of Hydrogen Evolution and local pH in Aqueous Zinc Ion Batteries
7014 *Chunge Li†*
Mentor(s): Brian Michael Tackett; Joseph Nathanael Heil

10:40 Synergetic Effect of Nanosilica Admixtures and Nontraditional Natural Pozzolans on Hydration
7015 Kinetics of Cementitious Systems
*Anel Zhussupbekova†; Raikhan Tokpatayeva**
Mentor(s): Jan Olek

ROOM: GRISSOM 118

10:00 Paper-Based Assay for Early Cervical Cancer Screening
7016 *Akansha Chauhan†*
Mentor(s): Jacqueline Linnes; Lucy Teberh Tecle

10:20 Complete Characterization of Isotope-enriched Proteins to Improve Vibrational Spectroscopy
7017 Simulations
Tristen M West†
Mentor(s): Michael Earl Reppert; Jacob Hnatusko Wat

10:40 The Worlds on Fire – Step Up to Protect Public Health and Safety
7018 *Nikki Lynn Zavodny†*
Mentor(s): Paula Danielly B Coelho

ROOM: GRISSOM 125

10:00 Pramipexole as a potential enhancer of regeneration after zebrafish spinal cord injury
7019 *Nikhil Samit Sadavarte†; Anshul Sanjeev†; Katie Manfra‡*
Mentor(s): Daniel Suter

10:20 Quantifying the veins in plants
7020 *Alyson Jones†; Kelsi Anderson†*
Mentor(s): Alexandria Volkening

ROOM: GRISSOM 126

10:00 A Study on the Temporal Robustness of Machine Learning for Poverty Mapping and Comparison of
7021 the Transfer Learning and Random Forest Approaches
Shivi Pandey†
Mentor(s): Ben Zou

10:20 ARMS: Reconfigurable Microelectronic System for Autonomous Movement and Collaboration
7022 *Junhan Shen†*
Mentor(s): Muhammad Mustafa Hussain; Mujeeb Yousuf; Dhiya eddine Belkadi; Min Sung Kim

10:40 Analysing matrix complexity for improved aptamer sensor calibration
7023 *Yashvi Choudhary†*
Mentor(s): Jeffrey Edward Dick; Vanshika Gupta

ROOM: GRISSOM 133

10:00 **7024** Real-time manufacturing machine monitoring in edge analytics using electrical current consumption: Case study of plasma etcher operation and condition prediction
Everett Mason†
Mentor(s): Eunseob Kim; Ali Shakouri

10:20 **7025** Analyzing moisture sources in the Andean Western Cordillera using water stable isotopes in precipitation during the 2023-2024 El Niño event
*Bethany Rita Kettleborough†; Valentina Saenz**
Mentor(s): Lisa Welp

10:40 **7026** Solution-Processed Synthesis and Optoelectronic Characterization of Chalcogenide Perovskite Nanomaterials: The Case of (BaxSr1-x)ZrS3
Kamran Hajibayli†
Mentor(s): Rakesh Agrawal; Daniel Christian Hayes

RESEARCH TALK SESSION 3 | 11:00-12:00

ROOM: GRISSOM 103

11:00 **7027** Using Machine Learning to Predict Thioesterase Cyclization Preference
Elliot Nick Brajkovich†
Mentor(s): Elizabeth I Parkinson; Samantha Nelson

11:20 **7028** Active Aerodynamic Tail Enhances Agile Locomotion of Legged Robots in Challenging Natural Environments
Brian G Mmari†
Mentor(s): Upinder Kaur; Jiajun An

11:40 **7029** Tau Estimation and 1 DOF Control using ORB Features
Joseph Michael McAlear†
Mentor(s): Logan Dihel; Nak-seung Patrick Hyun

ROOM: GRISSOM 118

11:00 **7030** Automated Histomorphological Assessment of Muscle Health and Healing in a Preclinical Volumetric Muscle Loss Model
Makayla Nicole Phillips†
Mentor(s): Joshua Sexton

11:20 **7031** Design of a High-Pressure Counterflow Burner for Laser Diagnostic Technique Development
Brenden Michael Bush†
Mentor(s): Benjamin Kyle Murdock; Robert P Lucht

11:40 **7032** Single Phase Static Immersive Cooling of Cylindrical Battery - Insight of Measuring Methods and Result
En-Hua Chang†; Sidney Evan Ryan‡
Mentor(s): Amy M Marconnet; Piyush Mani Tripathi

ROOM: GRISSOM 125

11:00 **7033** Advancing Wound Health Assessment Utilizing Curcuma Longa
Ishita Mukadam†
Mentor(s): Mrudula Mukadam

11:20 **7034** Categorizing stress in college-age students through EEG data and ML
Alpamys Sultanbek†; Hailey Brianna Haglid†; Justin Shakergayen‡; Katelyn Krishan Shah‡; Dalton J Aaker‡; Aiyan Sarwar Alam‡; Brian Martin Dodd‡; Brian Song‡; Charles Paul Patterson‡; Christian Alexander Howard‡; Eduard Filip Tanase‡; Yi-Huan Chen‡; Jacob Noah Fink‡; Marlee Kate Wall‡; Roma Nandan Kamat‡; Yash Mehta‡; Alfredo Gustavo Barandearan Gutierrez‡; Nikhil Xavier Friedman‡
Mentor(s): Sebastien Helie

11:40 "Metabolic Signaling and Skeletal Muscle Health: Investigating AKT Pathway Impacts on
7035 Neuromuscular Junction Plasticity"
John Ward Robbins†
Mentor(s): Natasha Jaiswal

ROOM: GRISSOM 126

11:00 Machine Learning Force Field for Ceramics at Extreme Conditions
7036 *Stephen Brice Rider†; Sabria Kionna Nesmith‡*
Mentor(s): Brian Hyun-jong Lee; Alejandro H Strachan

11:20 Impact of Slot Liner Compression and Wire Geometry on the Total Thermal Resistance in the
7037 Electric Motor's Stator-Winding Assembly
Lindsay Kathryn Sutherland†
Mentor(s): Amy M Marconnet; Shanmukhi Sripada

11:40 Simulation of Modified Coherent Ising Machines for Combinatorial Optimization
7038 *Charles Spencer Bowles†; Vidisha Singhal‡*
Mentor(s): Peter Bermel; Jie Zhu

ROOM: GRISSOM 133

11:00 Enhancing Transfection Efficiency of Hepatitis C Virus in Cell Culture
7039 *Sarah Jimenez Rojas†*
Mentor(s): Richard J Kuhn; Ryan George Peters

11:20 Thrombus Characterization in Abdominal Aortic Aneurysm and Aortic Dissection Models Using
7040 Histology and Scanning Electron Microscopy
Niharika Narra†
Mentor(s): Craig Goergen; Cortland Hannah Johns

11:40 Explainable Machine Learning for Predicting Atmospheric Blocking
7041 *William Henry Stevens†; Anh Nhu‡*
Mentor(s): Lei Wang

RESEARCH TALK SESSION 4 | 12:00-1:00

ROOM: GRISSOM 103

12:00 Investigating the Relationship Between Gut Microbiome, Biomechanics, and Scoliosis: A Holistic
7042 Approach Through Two Complementary Studies
Sarah Marie Staller†
Mentor(s): Deva Chan; Cameron Xavier Villarreal

12:20 Design and Implementation of an Inductively Coupled Plasma Neutralizer for SPT-100 Hall Thruster
7043 *Mathis Malaussena†*
Mentor(s): Alexey Shashurin; Lee E Organski

12:40 Electric Vehicle (EV) Thermal System Design Optimization
7044 *Nikolai Baranov†*
Mentor(s): Parikesit Pandu Dewanatha; Neera Jain

ROOM: GRISSOM 118

12:00 Assessing & Improving Robotic Surgeon's Intraoperative Non-Technical Skills: A Mixed-Methods
7045 Study
Dan Ha Le†
Mentor(s): Denny Yu

12:20 Effect of different microbial inoculum over bacterial colonization and biofilm formation in basil
7046 (*Ocimum basilicum*) hydroponics.
Salomon Caro Castillo†
Mentor(s): Caitlin Rose Proctor

12:40 Identification of a Novel Candidate Variant in CLPX for Spinocerebellar Ataxia in a Mixed Breed Dog
7047 *Namju Kim†*
Mentor(s): Jeanna Marie Blake; Madeline Christina Coffey; Kari J Ekenstedt

ROOM: GRISSOM 125

12:00 Singing in the Anthropocene: Evaluating Anuran Call Signal Transmission in Urban Environments
7048 *Isabella Wyatt†*
Mentor(s): Ximena Bernal; Ana Maria Ospina Larrea

12:20 Antennal Complexity in Mosquitoes: Association between Structure and Multimodal Sensory
7049 Functions
Krisha Shah†
Mentor(s): Ximena Bernal

ROOM: GRISSOM 126

12:00 Targeting GRK5 in Metastatic Cancer: Structural Insights and Therapeutic Evaluation of Novel
7050 Inhibitors
Nikki Leslie†
Mentor(s): Yueyi Chen; Brittany Nicole Heil; John Tesmer

12:20 Structural basis of nanobody inhibition of UCH37
7051 *Jaralynn Morellano†*
Mentor(s): Rishi Patel

12:40 Tool for CryoEM 2D Average Image Stitching Assisting Initial Referance Building of Helical
7052 Filaments
Damilola Showunmi†; Wei Jiang‡
Mentor(s): Xiaoqi Zhang

ROOM: GRISSOM 133

12:00 Air-entrained Structure in Underwater Noise Mitigation for Offshore Wind Energy
7053 *Shaocheng Wu†; Yijie Zhang‡*
Mentor(s): Junfei Li

12:20 Feature Extraction for Classification of Small Firearms-Like Noise and Blast Exposure Hearing Loss
7054 in Rat Models
Sahil Vijay Desai†; Jax Patrick Marrone‡; Andres Navarro‡; Emily Le Bell‡
Mentor(s): Edward L Bartlett; Meredith Christine Ziliak

12:40 Fabrication of a supercritical CO2 dryer and study of the effect of chitin in potato starch-based
7055 aerogels
Sevinch Pasilova†
Mentor(s): Andres Tovar

RESEARCH TALK SESSION 5 | 1:00-2:00

ROOM: GRISSOM 103

1:20 Dry Direct Flash NanoPrecipitation for integrated high-throughput nanoparticle powder preparation
7056 *Katy Brauer†*
Mentor(s): Kurt Ristroph

1:40 Rapid Widefield FLIM using a Single Photon Avalanche Diode Array
7057 *Ishaan Kartik Singh†*
Mentor(s): Jing Liu

ROOM: GRISSOM 118

1:00 Image Recognition of Helical EMDB Structures
7058 *Maria Munoz Perez†*
Mentor(s): Wen Jiang; Daoyi Li

1:20 Does Calcium/Calmodulin Protein Kinase II (CaMKII) Affect Sperm-Induced Actin Remodeling in
7059 Fertilized Mammalian Eggs?
Kristina Nicole Lodenquai†
Mentor(s): Janice Perry Evans; Allison Kay McCarthy

1:40 Human Papillomavirus E6 N-terminus Role for E6-p53 Interaction in E6AP-E6-p53 Complex
7060 *Sungyu Choi†*
Mentor(s): Vallabh Suresh

ROOM: GRISSOM 125

1:00 Synthetic methods to control Al siting and crystallite size in MFI zeolites for propene oligomerization
7061 *Nina A Borkowski†; Talana N Small‡*
Mentor(s): Diamarys Salome Rivera; Sarah Margaret Gustafson

1:20 Oligomerization of Light Olefins Using Aluminosilicate Catalysts
7062 *Nicholas Barmore†*
Mentor(s): Ted Taewook Kim; Jeffrey T Miller

1:40 Significance of Corn Stover Fermentable Sugars on Oxalic Acid Production by Aspergillus niger
7063 Fermentation
Mahagani Lasciers†
Mentor(s): Diana Milena Ramirez Gutierrez

ROOM: GRISSOM 126

1:00 Quantifying Rubisco Polymerization within Carboxysomes
7064 *Richard Lawrence†*
Mentor(s): Ryan Hunter Gray; Lauren Ann Metskas

1:20 Protein Structure Modeling using Deep-Learning
7065 *Anouka Saha†; David Huang‡; Tsukasa Nakamura‡; Joon Hong Park‡; Pranav Punuru‡*
Mentor(s): Anika Jain; Daisuke Kihara

ROOM: GRISSOM 133

1:00 Vibrating piezoelectric membranes for water filtration applications
7066 *Gabriel Brandt de Toledo†*
Mentor(s): Ryan B Wagner; Akshay Deolia

1:20 Sustainable Quench Oil Replacements for Austempering Salt Quenchants
7067 *Ruey-Bin Tsai†; Junyeong Ahn‡; Manila Kunwar‡*
Mentor(s): Jeffrey P Youngblood; Michael Titus; Ching-Chien Chen

1:40 Neutrophil Motility Regulation by MiR-375 Target Gene ATP2b1
7068 *Conwy Zheng†*
Mentor(s): Daniel Kim

RESEARCH TALK SESSION 6 | 2:00-3:00

ROOM: GRISSOM 103

2:00 Analyzing the Impacts of Temperature on Electric Vehicle Adoption Rates Across Multiple US States
7069 *Sai Shashank Mukkera†*
Mentor(s): Gaia Cervini; Ricardo Chahine; Nadia Gkritza

2:20 Learning Nucleation by Reversing It: A Molecular Dynamics Study of Amorphization of Organic
7070 Molecules
Kyenret Yakubu Ayuba†
Mentor(s): Tonglei Li; Doraiswami Ramkrishna

2:40 Impaired theta oscillations during working memory as a potential biomarker for autism spectrum
7071 disorders
Caroline Powell†
Mentor(s): Michael Paul Zimmerman

ROOM: GRISSOM 118

2:00 In-vitro Assessment of Patient-Specific Cerebral Aneurysm Models for Hemodynamic Analysis using
7072 Particle Image Velocimetry and 4D Flow MRI
Kara Rochelle McCrindle†
Mentor(s): Hyeondong Yang; Rudra Sethu Viji; Brett A Meyers; Pavlos Vlachos

2:20 Leveraging Real-Time Eye Tracking Metrics to Infer Cognitive States During Automated Driving
7073 *Tyler Harrison Hsieh†*
Mentor(s): Sibibalan Jeevanandam; Neera Jain

2:40 Forecasting 2024 U.S. elections
7074 *Joseph Michael Cromp†; Thanmaya Pattanashetty‡*
Mentor(s): Alexandria Volkening

ROOM: GRISSOM 125

2:00 Superconducting Diode Effect in Two-dimensional Topological Insulator Edges and Josephson
7075 Junctions
Haixuan Huang†
Mentor(s): Jukka Ilmari Vayrynen; Tatiana de Picoli Ferreira

2:20 Characterizing the role of histone variant H2A.Z in heat-responsive gene expression in Arabidopsis
7076 thaliana
Shelby Sliger†
Mentor(s): Joseph P Ogas; Jiaxin Long; Jacob Ryan Fawley

2:40 Compost Bin Monitoring Through IoT
7077 *Nicolas Rendon Arias†; Sehyeon Lim†; Nicolas Miguel Murillo Cristancho†*
Mentor(s): Walter Daniel Leon-Salas

ROOM: GRISSOM 126

2:00 Research nuclear reactor PUR-1: Anomaly detection using machine learning
7078 *Julian Mauricio Cruz Rojas†*
Mentor(s): Stylianos Chatzidakis

2:20 Knowledge Representation Trends in Midwestern Community Food Maps
7079 *William David Quintero Gallego†*
Mentor(s): Ankita Raturi; Megan Mei Yee Low

2:40 Implementing Compressed Instructions in a RISC-V Microcontroller
7080 *Abhijay Achukola†; Aniket Chatterjee†*
Mentor(s): Mark Johnson; Maxwell Frank Michalec; Cole Aaron Nelson

ROOM: GRISSOM 133

2:00 Cross-Species Analysis of Computational Laparoscopic Video Segmentation and Classification
7081 *Farren M Martinus†*
Mentor(s): Fiona Kolbinger

2:20 Flexible Mechanical Sensors
7082 *Paul A Loughlin†*
Mentor(s): Juan Camilo Osorio Pinzon

2:40 Development on Intensified Pharmaceuticals Manufacturing Processes
7083 *Urvi Mathur†*
Mentor(s): Zoltan Nagy

RESEARCH TALK SESSION 7 | 3:00-4:00

ROOM: GRISSOM 103

3:00 Investigating the effects of ciclopirox and its derivatives on urothelial and renal cell carcinomas
7084 *Abigail Hyejin Lee†*
Mentor(s): Yuxin Zhuang; Majid Kazemian

3:20 Solution-Phase Intercalation of Metal Atoms into MoS2
7085 *Yiyin Tao†*
Mentor(s): Christina W Li

3:40 Effect of artificial light at night (ALAN) and traffic noise on anuran communication
7086 *Jabez Soongeui Shin†; Adriana Bustos Torres‡*
Mentor(s): Ana Maria Ospina Larrea; Ximena Bernal

ROOM: GRISSOM 118

3:00 Mycoponics: Advanced hydroponics technology for production of mycelial leather
7087 *Simone Xin Moulton†; Adriana K Sanchez**
Mentor(s): Alexander Baena; D. Marshall Porterfield

3:20 Novel Low-Bandgap Perovskites for Solar Cells Using a Computational and Experimental Approach
7088 *Anika Bhoopalam†*
Mentor(s): S S M Tareq Hossain; Letian Dou; Arun Kumar Mannodi Kanakkithodi

3:40 Enhancing Human Psychomotor Learning Through Real-Time Cognitive Feedback
7089 *Albert Li†*
Mentor(s): Neera Jain; Jacob Grant Hunter

ROOM: GRISSOM 125

3:00 Evaluation of Ketamine's Prosocial Effects in Scn2a-deficient Mice
7090 *Rineet Ranga†; Akila Abeyaratna‡*
Mentor(s): Brody Alan Deming

3:20 Bumblebee: A self-supervised transformer model to learn top quark decay at Large Hadron Collider
7091 *Jack Patrick Rodgers†*
Mentor(s): Miaoyuan liu; Andrew James Wildridge; Ethan Michael Colbert; Yao Yao

3:40 Indiana Economic Development and Supply Chain Leakage Reduction
7092 *Daniel Camilo Puentes Rodriguez†; Kely Johanna Monroy Malagon†*
Mentor(s): Dutt Jagdish Thakkar

ROOM: GRISSOM 126

3:00 Machine Learning Approaches to Predict Protein-Protein Interactions through Electrostatic Potential
7093 Mapping
Olaoluwa Adegbohungbe†; Ryan Thomas Jordan‡
Mentor(s): Tonglei Li

3:20 SAI: Integrating Cognitive, Social, and Engineering Principles for Large-scale Planning of Public
7094 Charging Infrastructure
Meghna Swaminathan†
Mentor(s): Torsten Reimer

3:40 Multi-Agent Collaborative Sensemaking
7095 *Shreya S Venkat†*
Mentor(s): Tianyi Li

ROOM: GRISSOM 133

3:00 Investigation of Capture Efficiency in Acoustically Enhanced Filtration Systems
7096 *Kazim Hussain Jafri†*
Mentor(s): David Warsinger

3:20 Pharmacokinetic and Pharmacodynamic Assessment of Tigecycline Treatment for Nontuberculous
7097 Mycobacterium Infections
Tyler S Dierckman†
Mentor(s): Elsje Pienaar; Trevor Jaan Shoaf

3:40 Simulation-based Single Cargo Drone Stabilization Using Reinforcement Learning
7098 *Taeha Jeong†*
Mentor(s): Dengfeng Sun; Xiaolin Xu

RESEARCH TALK SESSION 8 | 4:00-5:00

ROOM: GRISSOM 103

4:00 Using Data-Driven Equation Discovery Algorithms to Show a Nonlinear Schrodinger Equation
7099 Description of Atmospheric Blocking
*Owen T Odney†; William Andrew Messman**
Mentor(s): Lei Wang; Ka ying Ho

4:20 Rainwater Stable Isotope Characterization: A First Step Towards Better Understanding Large-Scale
7100 Atmospheric Moisture Transport Over South America During a Strong El Niño
*Valentina Saenz†; Bethany Rita Kettleborough**
Mentor(s): Lisa Welp

4:40 Catchment Chamber Design for the Ballistic Impact of Mesoscale Geo-Materials
7101 *Maya Araujo†*
Mentor(s): Zherui Martinez-Guo

ROOM: GRISSOM 118

4:00 Wireless Sensor Network Deployment in Contested and Denied Undersea Environments
7102 *Mathias Erik Bock Agerman†*
Mentor(s): Christopher G. Brinton; Jonggwang Kim; Shreyas Sundaram

4:20 Data-Driven Insights into Enzyme Reaction Catalysis for Green Chemistry
7103 *Adam G Weber†*
Mentor(s): Karthik Sankaranarayanan; Olga Costa Alves Souza

4:40 Robust-object-retrieval-via-manipulation
7104 *Junyoung Kim†*
Mentor(s): Ahmed Hussain Qureshi; Hanwen Ren

ROOM: GRISSOM 125

4:00 Creating Programmable Home Radon Measurement
7105 *Kayla Y. Xu†*
Mentor(s): Richard L Kennell; Ming Qu

4:20 Evaluating Text/Image to 3D Mesh Models; A Comprehensive Overview
7106 *Sami Nasser Zagha†; Trent Michael Seaman†; Ron K Natarajan‡; Daniel EnYi Yang‡;*
Nihar Pushkar Atri‡; Dinmukhamed Mukhtar Tynysbay‡
Mentor(s): Yung-Hsiang Lu

4:40 Semi-Supervised Graph Neural Network for Pileup Mitigation
7107 *Jack Patrick Rodgers†*
Mentor(s): Miaoyuan liu; Garyfallia Paspalaki; Pan Li

ROOM: GRISSOM 126

4:00 Embedding algorithm for D-wave quantum computers
7108 *Winston Yusong Lin†*
Mentor(s): Christopher Savion Sims

ROOM: GRISSOM 133

4:00 Optimizing Wire Routing in Soft-Growing Robots for Enhanced Performance
7109 *Ethan Michael DeVries†; Mustafa Ugur**
Mentor(s): Laura Helen Blumenschein

4:20 Application of genetically encoded voltage indicators to zebrafish tissue-specific bioelectricity
7110 *Abigail Martin†*
Mentor(s): GuangJun Zhang; Ziyu Dong

4:40 Discovery of the First-in-class SHP1 Covalent Inhibitor for Cancer Immunotherapy
7111 *Levi M Johnson†*
Mentor(s): Zihan Qu

Talk Presentation Abstract Number: 7000
Presentation Time: Grissom 103 at 9:00-9:20

SURF

Real-Time Musical Accompaniment for Non-Improvised Music

Mathematical/Computation Sciences

Author(s):

Ryan Thomas Jordan† (Engineering|JMHC); Tim Nadolsky* (Science); Edward Falcon Navarro* (Science|JMHC); Ping-Hung Nick Ko* (Engineering); Caasi Nketiah Boakye* (Science); Minsoo Oh* (Science); Brian Mingyang Qi* (Science); Anthony Wang* (Science); Connor

Abstract:

Musicians often rehearse together to prepare for performances, but busy schedules and geographic distance can make group practice challenging. To address this issue, we are developing Companion, a real-time musical accompaniment system designed for non-improvised music. Companion processes a MusicXML score to generate two tempo-matched audio tracks: one for the musician's part and one for the accompaniment. Using online time warping (OTW), Companion aligns a live recording of the musician with the synthesized audio, adjusting the playback rate of the accompaniment in real-time according to the musician's progress through the score. We evaluate Companion's performance against existing score following systems and measure its synchronization accuracy by tracking the average accompaniment error between the musician and Companion. Our results demonstrate that Companion accurately tracks the musician's position and effectively synchronizes the accompaniment. Future work could enhance the system's stylistic flexibility by adjusting dynamics and articulations in response to the musician's interpretative commands.

Keywords: Musical Accompaniment; Online Time Warping; Audio Synthesis

Mentor(s):

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

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

Talk Presentation Abstract Number: 7001
Presentation Time: Grissom 103 at 9:20-9:40

SURF

The genetic basis of inflorescence architecture in Arabidopsis thaliana: implications for adaptation and maladaptation

Life Sciences

Author(s):

Santiago Reinoso Castillo†

Abstract:

Understanding the genetic basis of local adaptation is a key goal of evolutionary biology. Adaptation to one habitat requires trait values that confer high fitness (survivability and reproduction) and these values may reduce fitness in other habitats leading to fitness trade-offs across environments. Arabidopsis is a model for studying adaptation due to its well-characterized genome and short life cycle. Additionally, its wide geographical distribution ensures differences among populations creating locally adapted ecological traits. Here we aim to, 1) compare inflorescence architecture between two locally adapted populations of A. thaliana from Italy (IT) and Sweden (SW), 2) identify regions of the genome contributing to differences in inflorescence architecture and 3) test if maladaptive fecundity loci can be explained by differences in inflorescence architecture. To achieve this, a panel of Near-Isogenic Lines (NILs) with introgression segments of the SW genome tilling across the IT genetic background were used. These introgressions spanned both maladaptive loci and genes previously reported to be involved in inflorescence architecture. Results thus far indicate that IT produces 55% more flowers, 19% more cauline leaves and 28% more secondary branches than SW. This suggests that IT may achieve greater fecundity through greater branching and photosynthetic capacity of the inflorescence. Data currently being collected in the NILs will determine the genomic regions underlying these ecotypic differences. These results will provide greater understanding of how specific genomic regions controlling ecotypic differences in inflorescence architecture contribute to adaptation and maladaptation.

Keywords: Inflorescence Architecture; Local Adaptation; Genetic Trade-Offs; Genetic Mapping; Arabidopsis thaliana

Mentor(s):

Christopher G Oakley (Agriculture); Juan Diego Rojas Gutierrez (Agriculture)

Talk Presentation Abstract Number: 7002
Presentation Time: Grissom 103 at 9:40-10:00

SURF

Contrastive Learning in Language Models for Software Vulnerability Detection

Mathematical/Computation Sciences

Author(s):

Michael Cheng† (Science)

Abstract:

The exploitation of software vulnerabilities can lead to severe consequences, including data breaches, financial loss, and system failure. As such, it is essential to identify and flag these vulnerabilities during the development cycle. Methods employing large language models (LLMs), which have demonstrated promise in many text-related tasks, have recently gained popularity in the context of vulnerability detection. However, these models often struggle to distinguish between a vulnerable function and a syntactically similar benign function. t-SNE visualization of the model's internal representation of the data reveals a clear inability to disentangle such functions. This research aims to improve upon existing techniques by training LLMs with a contrastive learning approach. Using DeepSeek-Coder as our base LLM, we incorporate triplet loss to encourage the model to cluster functions from the same Common Weakness Enumeration (CWE) class more closely in the embedding space. We train our model on real-world software vulnerability data and evaluate its performance against state-of-the-art approaches. Future work includes gathering additional high-quality vulnerability data and exploring alternative architectures and training methodologies to further enhance performance.

Keywords: Machine Learning; Large Language Models; Software Security

Mentor(s):

Lin Tan (Science); Jiang (Science)

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

Talk Presentation Abstract Number: 7003
Presentation Time: Grissom 118 at 9:00-9:20

SURF

Foldable FWV Fabrication and Control Analysis

Innovative Technology / Entrepreneurship / Design

Author(s):

Andrew Lewis Hadikusumo† (Engineering)

Abstract:

The design and development of bio-inspired and efficient lift-generation flapping wing vehicles (FWVs) has been gaining much attention in the field of UAV research as an alternative to rotor and blade-driven drones such as RC planes and quadrotors. Birds’ flight agility, lift-generation efficiency, and ability to perform gliding flights have influenced and inspired researchers to develop novel flapping mechanisms and control algorithms to design and manufacture the FWVs. This research aims to specifically address the lift-generation efficiency aspect in developing a unique wing-folding mechanism (WFM) for a general class of bird-scale flapping wing vehicle (BFWV) with the goal of understanding the influence of wing folding and asymmetrical flapping on the aerodynamic forces and torque generation of BFWVs. Static aerodynamic forces and torque data of the wing-folding mechanism will be obtained from a 6-axis force transducer and a system-identification driven approach will be used to further develop the geometries of the WFM using parameter optimization to maximize its lift generation. A positive cycle-averaged lift generation is recorded using the WFM designed with the help of light-weight materials and parameter optimization. This allows the BFWV with such WFM to not only maintain but gain altitude during translational flights. Future work involves the optimization of linkage lengths and wing shape through simulation and experimental validation to maximize lift and thrust generation to allow for smooth translational free flight.

Keywords: Robotics; Bird; Design Optimization

Mentor(s):

Shijun Zhou (Engineering); Nak-seung Patrick Hyun (Engineering)

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

Talk Presentation Abstract Number: 7004
Presentation Time: Grissom 118 at 9:20-9:40

SURF

Using Voltammetry to Probe Mass Transport in an Acoustically Levitated Droplet

Physical Sciences

Author(s):

Amber K Wang† (Science)

Abstract:

Advancing nanotechnology is essential for progress in mass transport studies involving multiphase interfaces, sensor development, and understanding of electrochemical processes. Despite significant advancements in electroanalytical nanotechnology, the mass transport mechanism within an acoustically levitated droplet remains unclear. This research uses voltammetry at different depths within a levitated droplet to understand species movement in this unique environment. This study aims to determine how limiting current, a key indicator of electrochemical reactions, varies under specific conditions. An ultrasonic acoustic levitator suspends droplets of an electrolyte solution in mid-air, free from contact with any surfaces, creating a unique environment to study droplets in the air. By manually varying the electrode depth within the droplet, the research examines how these factors influence mass transport. Controlled experiments involve levitating a droplet and using a micropositioner to probe it with an electrode, studying changes in the limiting current during a redox reaction. The results showed two trends: the limiting current progressively increased/decreased as the levitated droplet evaporated over time (effectively concentrating the redox species contained within the droplet) and the limiting current changed as the probing electrode moved further within the droplet could not solely be explained by this evaporation factor. These findings provide valuable insights into the electrochemical behavior of levitated systems by comparing the limiting current at different depths. This has significant implications for developing non-contact electrochemical processes and advanced sensor technologies. The results could enhance the utilization of acoustically levitated droplets as novel reactors, driving further progress in nanotechnology and related fields.

Keywords: Mass Transport; Voltammetry; Nanotechnology; Electrochemistry; Levitated Droplet

Mentor(s):

Lynn Elizabeth Krushinski (Science); Jeffrey Edward Dick (Science)

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

Talk Presentation Abstract Number: 7005
Presentation Time: Grissom 118 at 9:40-10:00

SURF

Unveiling PFOS Neurotoxicity: Spatial Analysis of Neurotransmitters with DESI-MSI

Life Sciences

Author(s):

Hurshal Pol† (HHS|JMHC)

Abstract:

Per- and polyfluoroalkyl substances (PFAS) are a group of persistent organic pollutants contaminating drinking water and food sources. Perfluorooctanesulfonic acid (PFOS), the most prevalent PFAS chemical, accumulates in the brain resulting in motor and behavior disorders such as Parkinson's Disease and ADHD. Previous studies show neurotransmitters such as dopamine, serotonin, and glutamate are impacted by PFOS exposure, but little is known about the relationship between PFOS accumulation in the brain and the spatial distribution of neurotransmitters. We hypothesize that PFOS-specific accumulation in the brains of exposed rats will correlate with changes in neurotransmitter levels in the same regions. To test this, we will utilize Desorption Electrospray Ionizing–Mass Spectroscopy Imaging (DESI-MSI) to visualize and quantify PFOS accumulation and neurotransmitter levels in brain sections. Brain tissue from Sprague-Dawley rats dosed with 10 mg/kg PFOS or vehicle via oral gavage will be collected for DESI-MSI analysis at timepoints 1-90 days post-exposure. In a pilot experiment, we imaged coronal rat brain sections to discern the distribution of neurotransmitters and determined endogenous neurotransmitters were not detectable without chemical derivatization. Methods are being developed for future tissue treatment. Additionally, droplet tests with various concentrations of PFOS in water were performed to determine the limit of detection to ensure biologically relevant concentrations could be imaged. The detectable range included 200mg/L-67.5µg/L PFOS. This study characterizes the distribution of both PFOS and neurotransmitter distributions in the brain to elucidate mechanisms of neurotoxicity. Understanding these mechanisms can pave the path for counteracting the adverse outcomes of PFOS exposure.

Keywords: PFOS; Neurotoxicity; DESI-MSI; Neurotransmitters; Ppersistent Organic Pollutant

Mentor(s):

Jason R Cannon (Office of the Provost); Christina R Ferreira (Centers & Institutes); Josephine Maria Brown (HHS)

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

Talk Presentation Abstract Number: 7006
Presentation Time: Grissom 125 at 9:40-10:00

SROP

Scaling Vision: The Interplay of Eyes, Body Size, and Ecological Functions in Mosquitoes

Life Sciences

Author(s):

Katherine Garcia†

Abstract:

The functionality of eyes in small flying animals is constrained by their physical dimensions. Developing and maintaining large eyes requires a high energy investment and adds weight, limiting flight efficiency but allowing high sensitivity and spatial resolution. Eye scaling strategies relative to body size vary across insects and are expected to match species-specific ecological challenges. Among mosquitoes, variation in the number and size of ommatidia has been recognized among a few species, but little is known about eye-to-body size scaling patterns in connection with ecological roles in mosquitoes. In this study, we hypothesize that ecological function determines the scaling of eye structure in mosquitoes varying between species and sexes. To test this hypothesis, we investigated the allometric scaling of compound eyes across eight mosquito species that differ in their natural history. Given that mosquitoes often have salient sexual differences in foraging behavior, we also examined the scaling pattern of the eyes of males and females for each species. We use light microscopy and photography to quantify eye size and characterize the structure of the eyes. This research contributes to broadening our understanding of the visual adaptations of mosquito eyes, emphasizing how body size influences the structure of compound eyes in insects.

Keywords: Allometric Scaling; Ecological Functions; Compound Eyes; Eye Scaling; Scaling Pattern

Mentor(s):

Ximena Bernal (Science)

Other Acknowledgement(s):

Richa Singh

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

Talk Presentation Abstract Number: 7007
Presentation Time: Grissom 126 at 9:00-9:20

Colombian Research Scholars Program

Mini-BREAM: A Low-Cost Modular Platform for Autonomous Surface Vehicle Testing

Mathematical/Computation Sciences

Author(s):

Jhair Steven Gallego Mendez†

Abstract:

[Abstract Redacted]

Keywords: ROS; ASV; ILOS; PID; Dubins Curves

Mentor(s):

Nina Mahmoudian (Engineering)

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

Talk Presentation Abstract Number: 7008
Presentation Time: Grissom 126 at 9:20-9:40

SURF

Predictive Modeling and Experimental Observation of a Small-Scale Two-Phase Loop Thermosyphon

Physical Sciences

Author(s):

Fredrick G Mungai†

Abstract:

Two-phase loop thermosyphons are a promising technology with the potential to passively cool high heat flux electronics using only buoyancy forces to pump a coolant. The coolant undergoes a large density difference that causes flow circulation due to evaporation, when it adsorbs heat from a source, and condensation, when the heat is released to the environment. Modeling thermosyphons remains challenging due to the complex coupling of flow and heat transfer resulting from natural circulation of the flow. Therefore, this research seeks to develop a predictive mathematical model, with complementary experiments, to characterize the operation of small-scale loop thermosyphons. A model has been developed to predict the steady state operation of the thermosyphon. Experiments with an in-house loop thermosyphon facility that is 0.88 meters tall and constructed using 1.27 centimeter diameter tubing, are used to verify the model and identify opportunities to improve its predictive capabilities. Startup instabilities observed when subcooled liquid enters the evaporator causing dynamic pressure, flow and temperature oscillations. This motivates extending to a transient two-phase flow model, to capture the observed mechanism, enabling better understanding of the occurrence of the instabilities and methods of mitigation. This research will address the lack of predictive capabilities for two-phase flow instabilities during closed-loop natural circulation, which is one of the main barriers to the adoption of this technology in industry. Future work involves running the experimental facility for a comprehensive set of operating parameters to capture all the thermosyphon's operating regimes, providing a database for validation of the transient model.

Keywords: [no keywords provided]

Mentor(s):

Justin Weibel (Engineering); Debraliz Isaac-Aragones (Engineering); David Warsinger (Engineering)

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

Talk Presentation Abstract Number: 7009
Presentation Time: Grissom 126 at 9:40-10:00

SURF

Large Property Models for Predictive Chemistry

Mathematical/Computation Sciences

Author(s):

Aakarsh Misra†

Abstract:

Understanding a chemical's intrinsic properties and characteristics in various environments is a critical step in the chemical discovery pipelines. Obtaining such properties can be challenging due their high costs and reliance on expertise for analysis. In recent years, Deep Learning (DL) has become frequently employed in obtaining fast, accurate predictions of various chemical properties. However, current paradigms lack predictive consistency, generalizability, and are unwieldy in data scarce scenarios. Large Language Models (LLMs) trained on chemical graphs and fine-tuned on bespoke property datasets have shown some promise. But there is no consensus that the training framework behind LLMs would correspond to accurate property prediction. Since many chemical properties are derived from fundamental properties, it is possible that finetuning bespoke models from models trained on fundamental datasets would lead to accurate predictions in both low and high data contexts. Therefore, we train a Large Property Model (LPM) based on our novel Edge-Featured Graph Attention Network (EGAT) architecture and 11.7 million chemicals pulled from PubChem - each with 23 fundamental properties collected from DL-driven quantum chemistry (QC) calculations. Initial benchmarking with finetuned LLM's on predicting the solvation energy and lipophilicity of molecules has shown relatively good performance compared to other techniques. Early training of the LPM model shows reasonable performance on withheld testing sets. If our hypothesis holds true, our findings can predict properties in large-data and data-scarce contexts for applications in drug discovery, material discovery, and environmental safety.

Keywords: Chemical Property Prediction; Deep Learning; Large Property Models; Edge-Featured Graph Attention Neural Network; Large Language Models

Mentor(s):

Brett Savoie (Engineering); Sai Mahit Vaddadi (Engineering)

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

Talk Presentation Abstract Number: 7010
Presentation Time: Grissom 133 at 9:00-9:20

SURF

AI for Software Verification

Mathematical/Computation Sciences

Author(s):

Marilyn Rego† (Science)

Abstract:

Formal verification is a powerful method for enhancing software quality, but it demands significant human labor and resources. To address this challenge, this project evaluates the effectiveness of large language models (LLMs), specifically OpenAI's GPT models, in generating fully correct specifications for static verification of human-written programs. We tested this approach using the benchmark suite from VeriFast, a program verification tool for Java and C programs that efficiently handles concurrency and illegal memory accesses. The benchmarks were manually categorized to create three different types of input-output pairs to train and test the GPT models, where the input is the intended behavior specified by the user and the output is the fully specified program. Our first experiment employed prompt engineering on the GPT models. Based on the results, we created an extensive categorization of all the compilation and verification errors generated by the GPT models. In our second experiment, we used prompt chaining to address the errors. The results indicated that while prompt chaining significantly reduced compilation errors, it did not improve verification error rates compared to prompt engineering. We further explored few-shot learning to better accommodate proof repair. Through this structured approach, we aim to demonstrate the potential of LLMs in aiding the formal verification process, ultimately reducing the human effort required for verification tools like Verifast and thus improving software quality.

Keywords: Formal Verification; Large Language Models; Prompt Engineering; Separation Logic

Mentor(s):

Jenna L Wise DiVincenzo (Engineering)

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

Talk Presentation Abstract Number: 7011
Presentation Time: Grissom 133 at 9:20-9:40

SURF

Actuation strategy for an avian-inspired flapping-wing aerial vehicle (FWAV) to achieve stable flapping-gliding transition

Innovative Technology / Entrepreneurship / Design

Author(s):

Sota Yanagisawa† (Engineering); Milan Edward Rahmani‡ (Engineering)

Abstract:

Flapping-wing aerial vehicles (FWAV) inspired by birds have been researched for their potential for advanced maneuvering capability and endurance compared to traditional fixed-wing aircraft. However, the transition from flapping to gliding and its experimental validation for FWAVs has received limited attention in previous studies. Incorporating this transition into FWAV design will allow small-scale aircraft to mimic the enhanced flying qualities of birds. This study aims to develop and prototype a FWAV with a glide-lock mechanism that ensures a smooth transition from flapping to gliding flight and static stability during gliding. The glide lock mechanism was incorporated into a wrist-flexing multi-axis flapping mechanism. Hall effect sensors were used to detect and lock the position of the wings, enabling the transition from flapping to gliding. Flight testing of the FWAV was performed in various flight conditions to fully characterize the glide-lock mechanism proposed in this study. Data from the onboard microcontroller was collected to examine the flight performance, including flapping frequency and acting forces. The data was then compared with computational studies and data from previous literature. This research provides a demonstration of the mechanism as well as a comparison with previous developments and theoretical knowledge. The results of this study hope to provide a foundation for future innovation in unmanned aerial vehicle (UAV) design. Future research can focus on incorporating additional bird-like wings morphing into the glide-lock mechanism design and improving the efficiency of gliding flight configurations.

Keywords: Flapping Wing; Avian-Inspired Aircraft; Mechanism Design; Robotics; Wing Kinematics

Mentor(s):

Abhijnan Dikshit (Engineering); Pavankumar Channabasa Koratikere (Engineering); Leifur Thor Leifsson (Engineering)

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

Talk Presentation Abstract Number: 7012
Presentation Time: Grissom 133 at 9:40-10:00

SURF

Forecasting the 2024 US Elections

Mathematical/Computation Sciences

Author(s):

Thanmaya Pattanashetty† (Science); Joseph Michael Cromp‡ (Science)

Abstract:

With the upcoming elections, a common goal is to predict the outcome of the election. The process of forecasting involves uncertainty and close inspection from the public. Other organizations have created their own forecasting approaches, however many organizations are not fully transparent about their methods. Our research intends to forecast the outcome of the 2024 presidential, senatorial, and gubernatorial elections while keeping all methods and code publicly available and accessible. The mathematical model that we use is an adapted Susceptible–Infected–Susceptible (SIS) model, and this basic framework, which is quite flexible, was originally used to describe interactions between susceptible and infected individuals during disease transmission. We implement an altered version of this model where we simulate the dynamics of Democratic, Republican, and undecided voters in each state. To determine our model parameters, we use polling data gathered from the organization FiveThirtyEight. Another goal of our research is to improve the accuracy of our methods by accounting for partisan lean within the pollster organizations that produce polling data. When gathering data, pollsters' methodologies may result in partisan lean which could skew forecasts. By incorporating this potential partisan lean into our election model, the results may be more accurate. As an additional method, we also plan to investigate giving more weight larger to polls with larger sample sizes. Lastly, displaying forecast results to the public includes creating engaging visualizations that display useful knowledge about the election. Our forecasts and visualizations for this upcoming year's election will be posted on https://c-r-u-d.gitlab.io/2024/ throughout this election season.

Keywords: Differential Models; Mathematical Models; Political Science; Forecast Models

Mentor(s):

Alexandria Volkening (Science)

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

Talk Presentation Abstract Number: 7013
Presentation Time: Grissom 103 at 10:00-10:20

SURF

Metamaterial-based Structures in Underwater Noise Mitigation for Offshore Wind Energy

Innovative Technology / Entrepreneurship / Design

Author(s):

Yijie Zhang† (Engineering); Shaocheng Wu‡ (Engineering)

Abstract:

[Abstract Redacted]

Keywords: Noise Control; Underwater Acoustics; Metamaterial; Negative Poisson; Structure Design

Mentor(s):

Junfei Li (Engineering)

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

Talk Presentation Abstract Number: 7014
Presentation Time: Grissom 103 at 10:20-10:40

SURF

Investigation of Hydrogen Evolution and local pH in Aqueous Zinc Ion Batteries

Physical Sciences

Author(s):

Chunge Li† (Engineering)

Abstract:

The ongoing transition to renewable energy demands inexpensive and safe batteries for efficient energy storage. Aqueous Zinc Ion Batteries (AZIBs) present a promising solution with their high theoretical energy capacity, low potential, high material abundance and inherent safety of the aqueous electrolyte. However, the parasitic hydrogen evolution reaction (HER) that occurs during the charging process of AZIBs, where zinc metal is deposited at the anode, limits their lifetime. The HER creates a local alkaline environment for side reactions such as zinc hydroxide precipitations and uneven deposition or dendrite growth due to bubble formations. This research aims to understand the kinetics of HER that occurs concurrently with the zinc deposition in AZIBs with weakly acidic or neutral electrolytes. Here, we used the rotating ring-disk electrode (RRDE) method with an iridium oxide (IrOx) ring electrode for pH detection and a platinum ring for hydrogen collection. We captured the local pH change near the zinc working electrode and the hydrogen production during zinc deposition non-intrusively. Combined with the hydrodynamics of the RRDE system, this technique allowed for quantitative determination and comparison of the percent of current that is attributed to HER under well-defined mass transport conditions. Our findings provide insight into the mechanisms of HER coupled with zinc deposition and guidance for designing HER-suppressing modifications to enhance the cyclability of AZIBs.

Keywords: [no keywords provided]

Mentor(s):

Brian Michael Tackett (Engineering); Joseph Nathanael Heil (Engineering)

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

Talk Presentation Abstract Number: 7015
Presentation Time: Grissom 103 at 10:40-11:00

SURF

Synergetic Effect of Nanosilica Admixtures and Nontraditional Natural Pozzolans on Hydration Kinetics of Cementitious Systems

Innovative Technology / Entrepreneurship / Design

Author(s):

Anel Zhussupbekova† (Engineering); Raikhan Tokpatayeva*

Abstract:

Concrete is the most widely used construction material with cement providing its strength. However, cement production accounts for 8% of global CO2 emissions. Traditional supplementary cementitious materials (SCMs), such as fly ash or slag, reduce CO2 emissions by partially substituting cement, but their declining availability creates a supply gap that needs to be addressed. This research investigates Nontraditional Natural Pozzolans (NNPs), namely volcanic ashes and calcined clays, as viable alternatives to traditional SCMs. It seeks to determine whether NNPs can effectively replace traditional SCMs while preserving or improving mechanical and durability properties of concrete. The study examines the concrete cores from field slabs containing NNPs and explores the synergistic effect of NNPs and nano-silica admixtures through their hydration kinetics on paste samples. To evaluate mechanical properties, compressive strength tests are conducted on laboratory-prepared mortar cubes containing NNPs and nano-silica admixtures at different testing ages. Hydration kinetics are studied using differential scanning calorimetry (DSC) and isothermal calorimetry (IC) tests. Previous studies indicate that NNPs can enhance concrete's mechanical properties and durability, making them viable SCMs alternatives. However, their behavior under varying conditions - such as different temperatures, water-to-cementitious ratio, and cement chemical composition - remains uncertain. Additionally, while various admixtures, like water-reducing agents or air-entraining agents, are commonly used improve the early-age strength, the effect of nano-silica admixtures is still unknown. This study aims to provide practical data on the effect of NNPs for the concrete industry to address the supply gap and environmental concerns associated with cement production.

Keywords: Concrete; CO2 Emissions; Traditional Supplementary Materials (SCMs); Nontraditional Natural Pozzolans (NNPs); Hydration Kinetics

Mentor(s):

Jan Olek (Engineering)

Other Acknowledgement(s):

Bibigul Zhaksybay; Alberto Castillo

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

Talk Presentation Abstract Number: 7016
Presentation Time: Grissom 118 at 10:00-10:20

SURF

Paper-Based Assay for Early Cervical Cancer Screening

Innovative Technology / Entrepreneurship / Design

Author(s):

Akansha Chauhan† (Engineering|JMHC)

Abstract:

Cervical cancer is one of the most common forms of cancer among women globally and occurs disproportionately in low- and middle-income countries due to limited access to the HPV vaccines known to prevent 90% of this cancer. Screening tools for cervical cancer are often invasive, expensive, or time-intensive. This project aims to develop a rapid, protein-based lateral flow immunoassay (LFIA), similar to a COVID-19 test, for early-stage cervical cancer screening at the point-of-care. We target MCM2, a protein biomarker for early-stage cervical cancer, which we conjugated to gold nanoparticles using passive adsorption. Horseradish peroxidase with a color-changing substrate was used to enzymatically amplify the colorimetric signal at the test and control lines. The LFIA features a nitrocellulose membrane with bio-printed antibodies, sample pad, conjugate pad, and absorbent pad. We evaluated various parameters including the location and concentration of the test and control line, the optical density of the nanoparticle solution, sample volumes, and assay runtimes. Image processing software (Fiji) was used to quantify the color intensity at the test line to evaluate binding efficacy. Dynamic light scattering confirmed the average hydrodynamic diameter of the MCM2 conjugated nanoparticles to be 74 nm, validating the conjugates' stability in solution. The optimized assays were striped onto the nitrocellulose membrane using 1 mg/mL anti-MCM2 capture antibody. Future work will improve the clinical sensitivity and specificity of the LFIA. Ultimately, this assay will be interpreted by eye, allowing for rapid and low-cost screening of early-stage cervical cancer.

Keywords: Lateral Flow Assay; Cervical Cancer; Antibody-Antigen

Mentor(s):

Jacqueline Linnes (Engineering); Lucy Teberh Tecle (Office of the Provost)

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

Talk Presentation Abstract Number: 7017
Presentation Time: Grissom 118 at 10:20-10:40

SURF

Complete Characterization of Isotope-enriched Proteins to Improve Vibrational Spectroscopy Simulations

Physical Sciences

Author(s):

Tristen M West† (Science)

Abstract:

Computational simulations have played a vital role in understanding protein secondary structure. One way to predict protein secondary structure is to simulate their vibrational spectra. However, running vibrational spectroscopy simulations are often intimidating due to their complexity. The Reppert Research Group has developed a free online educational tool to simulate protein infrared (IR) spectra called AmideSpec. By automating this software and making it more quantitatively accurate, experimentalists would be able to easily run accurate simulations on proteins with limited technical knowledge. To further develop said app, two de novo proteins (NuG2b and Top7) have been labeled and their IR spectra have been collected by Fourier-transform infrared (FTIR) spectroscopy. FTIR was used to study the different amino acid's contributions to the overall protein vibrational spectrum. To isolate the labeled amino acid peaks, a reverse isotope labeling method was used. This method grows cells in C-13 media, then labels the cells by adding specific C-12 amino acids when inducing protein expression. As we study how the different amino acids contribute to each protein’s secondary structure, we can get a better understanding on how to produce more accurate simulations.

Keywords: Vibrational Spectroscopy; Rapid Screening Technique; Protein Secondary Structure; FTIR; IR

Mentor(s):

Michael Earl Reppert (Science); Jacob Hnatusko Wat (Science)

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

Talk Presentation Abstract Number: 7018
Presentation Time: Grissom 118 at 10:40-11:00

SURF

The Worlds on Fire – Step Up to Protect Public Health and Safety

Physical Sciences

Author(s):

Nikki Lynn Zavodny† (Engineering)

Abstract:

Wildfires are occurring more frequently and more intense than ever before. When this type of natural disaster occurs, components of a city's drinking water utility can become damaged. To help minimize damage and expedite recovery, water system employees should better understand the risk of water contamination and the recovery process. This research aims to understand who, before, during, and after wildfires, makes certain decisions related to drinking water systems utilities and identify major lessons learned. Staff from multiple water utilities impacted by wildfires will be contacted to collect this information. This data will then be compiled and analyzed to understand the recovery process including but not limited to how decisions are made, what resources are used, what are the major questions, and who is involved. This study is the first of its kind and will identify knowledge gaps in the recovery process. Study results will help other utilities and government agencies prepare for wildfires and know how to make decisions, who to reach out to and when, how to pay for the disaster, and how to take charge of the four phases of disaster and emergency management, which are preparedness, response, recovery, and mitigation. Future work includes collecting specific data and research on each part of the recovery such as funding, water testing, or damage assessment.

Keywords: [no keywords provided]

Mentor(s):

Paula Danielly B Coelho (Engineering)

Other Acknowledgement(s):

Andrew Whelton

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

Talk Presentation Abstract Number: 7019
Presentation Time: Grissom 125 at 10:00-10:20

Pramipexole as a potential enhancer of regeneration after zebrafish spinal cord injury

Life Sciences

Author(s):

Nikhil Samit Sadavarte† (Science|JMHC); Anshul Sanjeev† (Science); Katie Manfra‡

Abstract:

Current options for the management of spinal cord injury (SCI) are quite limited, especially concerning effective pharmaceutical treatments. Zebrafish, capable of responding to acute spinal cord injuries with complete axonal regeneration, serve as an effective model for investigating potential drug therapeutics. In this study, SCI has been performed on zebrafish larvae 5 days post-fertilization by making a precise incision at the level of the posterior end of the swim bladder. A partial screen of an FDA-approved drug library has been conducted using a visual motor response (VMR) assay to quantify swimming behavior in larvae post-SCI. From this study, pramipexole, a D2/D3/D4 dopamine receptor agonist clinically used to treat Parkinsonian symptoms and Restless Leg Syndrome, is found to enhance functional recovery after SCI. To determine the optimal concentration for maximal regenerative efforts, a series of drug dosage curves were generated using uninjured and injured zebrafish larvae. We found that 25 uM pramipexole was most effective in enhancing swimming behavior. To further evaluate and confirm the therapeutic potential of pramipexole, anti-acetylated tubulin immunostaining combined with confocal microscopy will be employed to qualitatively assess the extent of axonal bridging at the injury site. We hope that these studies will identify pramipexole as a potential therapeutic drug for the treatment of human SCI in the future.

Keywords: Regeneration; Spinal Cord Injury (SCI); Zebrafish; Pramipexole; Visual Motor Response (VMR)

Mentor(s):

Daniel Suter (Science)

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

Talk Presentation Abstract Number: 7020
Presentation Time: Grissom 125 at 10:20-10:40

Quantifying the veins in plants

Mathematical/Computation Sciences

Author(s):

Alyson Jones†; Kelsi Anderson†

Abstract:

We all know that plants absorb nutrients through their roots. However, what we often do not know is the name of the vein in which these nutrients are transported. Xylem is the structure within plants that helps both give them their form and deliver nutrients to the rest of the plant. Here we are developing tools to automate and mathematically quantify mutant patterns within this xylem tissue. We are using image-processing tools within Matlab and topological data analysis libraries within Python in order to characterize the shape of our image data. Topological data analysis is the name of a broader set of tools that we use to determine the shape of data. The main tool that we use in topological data analysis is persistent homology. In computing persistent homology, we start with a set of points and slowly increase their radius. When increasing their radius, these points will eventually touch one another and form connected components (clusters) and possibly holes or loops. These connected components and holes are significant due to persistent homology's roots within topology. Topology is the study of shapes in an abstract way. Within this field of study we focus on how many holes and pieces (connected components) a shape can have. This abstract way of looking at objects is very helpful when giving data, such as a grid of pixels or photo, a shape. Persistent homology allows us to look at images of xylem structure and mathematically determine the impact of mutations on the xylem patterns.

Keywords: Topology; Topology Data Analysis; Persistent Homology; Xylem; Image Processing

Mentor(s):

Alexandria Volkening (Science)

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

Talk Presentation Abstract Number: 7021
Presentation Time: Grissom 126 at 10:00-10:20

SROP

A Study on the Temporal Robustness of Machine Learning for Poverty Mapping and Comparison of the Transfer Learning and Random Forest Approaches

Mathematical/Computation Sciences

Author(s):

Shivi Pandey† (Liberal Arts)

Abstract:

The use of satellite imagery and machine learning for poverty mapping is a cost efficient and scalable approach to bridging the data gap in developing nations. While nightlights are widely recognized as a proxy for economic activity and poverty, they also pose significant challenges. In 2016, a novel transfer learning approach addressed some of these issues by combining daytime and nighttime imagery. Further developments such as the random forest approach have also progressed. However, an aspect of the field that lacks adequate studies is the temporal robustness of the machine learning approach. This study aims to investigate the temporal robustness of the two prevailing machine learning models for poverty mapping - transfer learning with convolutional neural networks and random forest - for five countries in Sub-Saharan Africa (Malawi, Nigeria, Uganda, Tanzania, and Ethiopia) from 2010 - 2024 with an intent to determine reliability for future predictions. This was achieved by iteratively training both models on satellite data (available every year) and survey data (available every 5 years) from 2010 - 2020, fine tuning the parameters as necessary to estimate asset wealth and consumption expenditure for the five countries. The performance of the fine tuned models were then tested for temporal robustness from 2010 - 2020, and utilized to predict a trendline from 2020 - 2030. The results are expected to provide insight on the degree to which the transfer learning and random forest models are temporally robust. Going forward, this knowledge can support developing nations in designing and tracking better targeted policies.

Keywords: Machine Learning; Transfer Learning; Random Forest; Poverty Mapping; Temporal Robustness

Mentor(s):

Ben Zou (DSB)

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

Talk Presentation Abstract Number: 7022
Presentation Time: Grissom 126 at 10:20-10:40

ARMS: Reconfigurable Microelectronic System for Autonomous Movement and Collaboration

Innovative Technology / Entrepreneurship / Design

Author(s):

Junhan Shen† (Other)

Abstract:

Microelectronic systems are vital in today's digital world. Preserving space, reducing weight, lowering energy and material consumption, and cost while enhancing functionality, performance, safety, sustainability, and reliability are crucial in microelectronic systems utilization and research. Inspired by nature, we conceptualized an Autonomous Reconfigurable Multi-dimensional System (ARMS) that addresses these attributes positively. Its innovative self-reconfiguration enables autonomous swarming and collaboration for a wide range of applications. We designed and tested three movement options (attraction using electromagnets, pulling using a stepper motor, and expansion & contraction using Nitinol Shape Memory Alloy) before securing significant movement and 100% independence. Our vibration-based solution enables complete in-box packaging (no external parts needed) and non-assisted movement. Utilizing vibrating buzzers and ESP 32, ARMS achieves 360° point-to-point movement for swarming collaborations at millimeter scale. The proposed solution offers the highest integration density for unprecedented multi-functionality and demonstrates independent movement for swarming and shape reconfiguration pathways for these advanced microelectronic systems.

Keywords: Microelectronics; Robotics; Swarming Collaboration; Microcontroller Application; Innovative Technologies

Mentor(s):

Muhammad Mustafa Hussain (Engineering); Mujeeb Yousuf (Engineering); Dhiya eddine Belkadi (Engineering); Min Sung Kim (Engineering)

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

Talk Presentation Abstract Number: 7023
Presentation Time: Grissom 126 at 10:40-11:00

Analysing matrix complexity for improved aptamer sensor calibration

Physical Sciences

Author(s):

Yashvi Choudhary† (Science)

Abstract:

Aminoglycosides are a class of antibiotic that have an effective range such that an excess results in kidney failure in patients while a lower dose causes bacterial resistance. With the advent of MRSA and other multi-drug resistant bacteria, it is becoming increasingly necessary to monitor the administered dosage of such drugs in real-time. Electrochemical aptamer-based sensors offer a new platform for real-time monitoring for such molecules with high selectivity. The sensors are equipped with DNA strands called aptamers that undergo a reversible conformational change induced by binding of the target to the aptamer which modifies the electron transfer rate from the redox tag linked to the aptamer. The electron transfer can be visualized using voltammetry in current versus potential graphs such that as the concentration of target increases, there is a corresponding increase in peak current. The correlation can be used to obtain a calibration curve, a way to determine unknown concentration of the analyte in a sample. In this field, it is common to obtain calibration curves in phosphate buffer. However, the buffer calibrations fail to consider the complexity of biological fluids. Thus, there remains a need to analyze how systematically increasing the complexity of the matrix impacts the aptamer sensor readings. Herein, we used whole blood and human blood serum as matrices to observe how the aptamer reading changes with the changing complexity of the matrix. We show that there is variation in the curves obtained in different matrices and provide a possible method to improve this disparity.

Keywords: Aptamers; Improved Calibration; Matrix Complexity; Electrochemistry

Mentor(s):

Jeffrey Edward Dick (Science); Vanshika Gupta (Science)

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

Talk Presentation Abstract Number: 7024
Presentation Time: Grissom 133 at 10:00-10:20

SURF

Real-time manufacturing machine monitoring in edge analytics using electrical current consumption: Case study of plasma etcher operation and condition prediction

Innovative Technology / Entrepreneurship / Design

Author(s):

Everett Mason†

Abstract:

The implementation of Internet of Things (IoT) and Artificial Intelligence (AI) techniques in manufacturing has become increasingly significant for improving yield and reducing expenses. Edge computing holds great potential to monitor machine productivity and predict performance anomalies in real time. With most manufacturing equipment being electrically powered, the electrical current consumption pattern can indicate the equipment's state and condition. However, conventional IoT and AI solutions that rely primarily on cloud computing encounter issues with bandwidth, latency, economics, reliability, and privacy (BLERP). This project utilized edge data analytics to convert current consumption signals into operation and condition information for modern manufacturing equipment. Four current transformers using the IO-Link protocol were deployed on a plasma etching machine for processing semiconductor devices. The monitoring model consists of three steps: 1) operation state, 2) operation type (recipe), and 3) anomaly detection. Pattern matching of time-series data and Machine Learning (ML) algorithms were developed and implemented on an edge computer. Electrical usage was calculated using the monitoring system. The collected data and operation history indicate a periodic pattern in the idle state due to subcomponent operation. Additionally, when the machine operates a recipe, the data suggests an increase in electrical current magnitude that aligns with operation start times. The study demonstrates the application of edge data analytics for monitoring the operation of manufacturing equipment through electrical current consumption. The implementation of edge computing of electrical current analysis provides real-time insights into equipment's operational state, type of operation, and potential anomalies.

Keywords: Industrial IoT; Edge Computing; Artificial Intelligence; Real-Time Monitoring; Pattern Machining

Mentor(s):

Eunseob Kim (Engineering); Ali Shakouri (Engineering)

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

Talk Presentation Abstract Number: 7025
Presentation Time: Grissom 133 at 10:20-10:40

SURF

Analyzing moisture sources in the Andean Western Cordillera using water stable isotopes in precipitation during the 2023-2024 El Niño event

Physical Sciences

Author(s):

Bethany Rita Kettleborough† (Science); Valentina Saenz* (Engineering)

Abstract:

Communities on the Western Cordillera of the Andes in Peru can receive precipitation from three potential sources: easterly transport in the upper troposphere from Atlantic moisture that has been recycled over the Amazon, westerly transport in the lower troposphere from the coastal Pacific, and northerly transport in the mid troposphere from the Amazon or eastern tropical Pacific. Rising sea surface temperatures may result in altered moisture sources and rainfall patterns, which can have profound effects on local infrastructure, agriculture, and economies. This project seeks to analyze the sources of precipitation in western Peru to aid communities in planning for future climate events. Water stable isotope contents of precipitation collected from December 2023 through April 2024 are measured to understand the influence of the 2023-2024 El Niño event in the region of Arequipa, Peru. 2-hydrogen (deuterium) and 18-oxygen water stable isotope contents were measured using a Los Gatos Research Enhanced Performance Triple Liquid Water Isotope Analyzer at Purdue University. Water stable isotope ratios can vary based on atmospheric conditions, such as temperature, relative humidity, and cloud dynamics. Reanalysis of atmospheric events during the time of precipitation may explain trends in the isotopic contents of the waters, which can be used to understand the sources of moisture over Peru. Continued work will be done to understand the influence and movement of precipitation in Peru.

Keywords: Precipitation; Water Stable Isotopes; El Niño; Andean Western Cordillera; Atmospheric Circulation

Mentor(s):

Lisa Welp (Science)

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

Talk Presentation Abstract Number: 7026
Presentation Time: Grissom 133 at 10:40-11:00

SURF

Solution-Processed Synthesis and Optoelectronic Characterization of Chalcogenide Perovskite Nanomaterials: The Case of (BaxSr1-x)ZrS3

Innovative Technology / Entrepreneurship / Design

Author(s):

Kamran Hajibayli† (Engineering)

Abstract:

The solar energy industry has been dominated by crystalline silicon technologies; however, alternative materials like perovskites, with an ABX3 crystal structure, have seen extensive research over the past decade. Recently, the focus on lead halide perovskites has increased due to their cost-effectiveness, ease of processing, and high efficiency. Nevertheless, the instability and toxicity of lead in these perovskites have spurred research into chalcogenide perovskite materials, which use S, Se, and Te as anions instead of halides. Among these, BaZrS3 is the most researched, known for its desired distorted perovskite crystal structure and potential beneficial properties similar to halide perovskites. The initial task for our project was to determine the alloying potential of BaZrS3 with SrZrS3, which crystallizes in a needle-like phase at lower temperatures. The main goal is to identify the stoichiometry range that produces the perovskite phase at lower temperatures. The procedure for the project was solution-based colloidal synthesis, performed for both materials through thermal decomposition via heat up. The primary methods for establishing the perovskite phase are via powder X-ray diffraction (pXRD) and Transmission Electron Microscopy (TEM). We aim to verify where the perovskite phase of the barium zirconium sulfide and strontium zirconium sulfide alloy is most stable. Current observations of pXRD and TEM measurements show that a barium- rich stoichiometry gives a more stable perovskite phase. In the future, the fabrication of these alloyed materials into thin films will be studied to characterize their optoelectronic properties and determine their potential for device applications.

Keywords: Chalcogenide Perovskites; Alloy; Solar Energy; Stoichiometry

Mentor(s):

Rakesh Agrawal (Engineering); Daniel Christian Hayes (Engineering)

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

Talk Presentation Abstract Number: 7027
Presentation Time: Grissom 103 at 11:00-11:20

SURF

Using Machine Learning to Predict Thioesterase Cyclization Preference

Life Sciences

Author(s):

Elliot Nick Brajkovich† (Science|JMHC)

Abstract:

Peptide natural products have long been utilized as drugs, with many having antibacterial, antifungal, and anticancer activity. Testing for these activities requires an intense investment into expression and purification, prompting bioinformatics-based approaches to prioritize promising compounds. This project aims to use machine learning to streamline the discovery of bioactive non-ribosomal peptides by predicting macrocyclization type from predicted biosynthetic gene cluster sequences. The genetic organization of non-ribosomal peptide synthetases has inspired many tools for predicting peptide structure. However, these tools have yet to reliably predict final macrocyclization by thioesterase domains despite the documented importance of macrocyclization for bioactivity.

Utilizing data from the MIBiG 3.0 repository, multiple models were trained to predict macrocyclization type from synthetase derived features, including the DNA sequence of the thioesterase domain. Best results have been achieved using a boosted decision tree model, yielding PR-AUC and ROC-AUC scores of 0.81 and 0.74, respectively. Input data was initially restricted to only 115 entries with experimentally confirmed features to preserve fidelity; however final evaluations show no significant impact on performance utilizing DNA sequences alone. This initial discovery both reduces the anticipated need for transfer learning upon deployment and increases the number of usable entries for additional model training to improve performance.

Keywords: Natural Products; Machine Learning; Peptide

Mentor(s):

Elizabeth I Parkinson (Science); Samantha Nelson (Purdue University)

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

Talk Presentation Abstract Number: 7028
Presentation Time: Grissom 103 at 11:20-11:40

SURF

Active Aerodynamic Tail Enhances Agile Locomotion of Legged Robots in Challenging Natural Environments

Innovative Technology / Entrepreneurship / Design

Author(s):

Brian G Mmari†

Abstract:

Terrestrial animals have evolved over millennia to effortlessly locomote across complex terrains, such as grasslands and forests. They exhibit a variety of gait patterns such as hopping, running, and even mid-air reorientation. A common feature among these animals is their tail which helps them in dynamic stabilization through the various gait patterns. While tails are being developed to improve the performance and adaptability of legged quadruped robots, they are modeled as passive mass which can only provide limited corrective torques to help in dynamic stabilization. In this work, we develop an Active Aerodynamic Tail (AA-Tail), with two propellers integrated at the tail end to enhance agile locomotion performances of legged robots. The proposed design weighs around 150g and enables highly precise and fast reaction capabilities, enhancing the robot's dynamic stabilization. For validation, we develop and deploy the tail on a 500g quadruped robot dog, Mini Pupper 2. The simulations and experiments demonstrate that our tail effectively enhanced the legged robot’s agility across various motion patterns simultaneously, including running, turning, leaping, slope running, standing up, sidestepping, and forward and backward locomotion. This approach proves the effectiveness of the tail as an active stabilization component essential for robots to mimic natural gait patterns in complex terrains.

Keywords: Robotics; Legged Robots; Reinforcement Learning

Mentor(s):

Upinder Kaur (Engineering); Jiajun An (Engineering)

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

Talk Presentation Abstract Number: 7029
Presentation Time: Grissom 103 at 11:40-12:00

SURF

Tau Estimation and 1 DOF Control using ORB Features

Mathematical/Computation Sciences

Author(s):

Joseph Michael McAlear† (Engineering)

Abstract:

Landing is a crucial component in robotics and control for aerial vehicles. However, it is not a trivial problem. If the robot makes contact with the target with too much velocity it could cause damage to both the machine and people. If the robot moves too slow towards the target then it would not achieve its goals in a reasonable time. In biology, bees utilize radial expansion visual cues to estimate their time to contact in order to perform landings. This phenomenon is referred to as Tau theory. Using this theory, this research developed a visual system utilizing feature detection algorithms to perform soft landings. Specifically, it uses the Oriented Fast and Rotated BRIEF (ORB) feature detector due to its efficiency and ability to find robust features in an image. To test this landing algorithm, simulations were performed using Robotic Operating System (ROS) and Gazebo. Virtual environments are utilized to mimic landing conditions, and both the estimated and ground truth Tau are collected for further examination. Both the accuracy and runtime of the algorithm are examined to ensure real-time applications. Future research will continue to optimize the algorithm and test it against an expanded set of test scenarios including different angle of approach. A different system for estimation will also be explored to improve the efficiency and accuracy of the algorithm. These improvements should help create a system that is able to be integrated with a SLAM algorithm to both map its surroundings are perform landing within it.

Keywords: ORB; Feature Detection; Tau; Time-to-Contact

Mentor(s):

Logan Dihel (Engineering); Nak-seung Patrick Hyun (Engineering)

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

Talk Presentation Abstract Number: 7030
Presentation Time: Grissom 118 at 11:00-11:20

SURF

Automated Histomorphological Assessment of Muscle Health and Healing in a Preclinical Volumetric Muscle Loss Model

Innovative Technology / Entrepreneurship / Design

Author(s):

Makayla Nicole Phillips† (Engineering|JMHC)

Abstract:

Volumetric muscle loss (VML) is a serious condition characterized by substantial and permanent skeletal muscle loss owing to numerous causes including traumatic injury and surgical removal. Given that VML results in substantial structural and functional deficits and limited treatment options exist, significant research is focused on new therapeutic strategies to promote functional muscle restoration and improve patient quality of life. Preclinical VML models and associated microscopic assessments of muscle structure and morphology (histomorphology) are critical to the evaluation and translation of next-generation therapeutic interventions for individuals with VML. Toward this end, this study aims to develop a robust and rapid histomorphological procedure for comprehensively assessing the characteristics and distributions of muscle cells in an established rodent model of VML injury. Given its user-friendly interface and diverse analytical toolkit (e.g., muscle fiber characteristics, differentiation of centrally and peripherally located muscle nuclei, microvessel identification), MuscleJ2 was utilized as the analysis software. To test the accuracy and robustness of our customized MuscleJ2-based procedure, images of laminin-stained tissue cross-sections representing experimental and control VML groups were evaluated: i) contralateral (normal) muscle, ii) VML injury without treatment, and iii) VML injury treated with novel collagen-based implant. Automated MuscleJ2 measurements, including myofiber quantity, number of centrally located nuclei, and myofiber size, were evaluated and compared to results obtained using manual assessment. Overall, the customized MuscleJ2 histomorphology procedure proved effective at differentiating VML healing outcomes for treated and control groups. Additionally, the procedure assisted in defining the novel regenerative mechanism of action observed with the collagen-based implant.

Keywords: Volumetric Muscle Loss; Histomorphological Analysis; Automated Muscle Segmentation; Engineered Polymeric Collagen Scaffold; Skeletal Muscle Healing

Mentor(s):

Joshua Sexton (Engineering)

Other Acknowledgement(s):

Rachel Alena Morrison; Sherry L Harbin

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

Talk Presentation Abstract Number: 7031
Presentation Time: Grissom 118 at 11:20-11:40

SURF

Design of a High-Pressure Counterflow Burner for Laser Diagnostic Technique Development

Physical Sciences

Author(s):

Brenden Michael Bush† (Engineering)

Abstract:

Counterflow burners are used in combustion and propulsion research because of their ability to stabilize flames that are typically unstable, enabling measurement of flame characteristics for the optimization of combustion systems. Specifically, this research aims to create a high-pressure counterflow burner with optical access that allows for testing laser diagnostics techniques that measure flame characteristics of combustion systems. The system must have a strong frame with windows that can be hydrotested to pressures up to 200 atm while not interfering with the diagnostic wavelengths involved with the experimental analysis. In addition, the contour for the co-annular nozzles must be designed to ensure boundary layer instabilities are negligible to maintain steady mass flow and produce a stable flame. A previous gas turbine rig was used for the frame with windows on all four side faces giving visibility into the combustion chamber. Four exhaust holes from a bottom flange are connected to a back-pressure valve and purge used reactants from the burner. To ensure the design can withstand the high theoretical pressures of future experiments, Finite Element Analysis (FEA) was conducted which showed negligible stress and deformation from a 200 atm test, justifying the burner's design. Lastly, the design for the co-annular nozzles underwent an iterative optimization process using boundary layer theory and Computational Fluid Dynamics (CFD) which certified stable and uniform flow will be generated. The results from FEA and CFD demonstrate the designed frame and nozzle can properly create a stable flame to be tested on.

Keywords: Counterflow Burner; Computational Fluid Dynamics; Finite Element Analysis; Boundary Layer; Combustion

Mentor(s):

Benjamin Kyle Murdock (Engineering); Robert P Lucht (Engineering)

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

Talk Presentation Abstract Number: 7032
Presentation Time: Grissom 118 at 11:40-12:00

SURF

Single Phase Static Immersive Cooling of Cylindrical Battery - Insight of Measuring Methods and Result

Physical Sciences

Author(s):

En-Hua Chang† (Engineering); Sidney Evan Ryan‡ (Engineering)

Abstract:

As the demand for utilizing lithium-ion batteries (LIB) has increased due to the entering of the informational era and the efforts of carbon neutrality, battery thermal management has become an important topic. Previous work has focused on removing heat using forced air and indirect liquid cooling. Due to the cost-effective cooling performance, single-phase static direct immersive cooling has recently gained attention. This paper aims to understand single cylindrical LIB's thermal behavior under different surroundings when implementing single-phase static immersive cooling. This paper also aimed to explore how different methods of attaching thermocouples affect the precision of the measurement. By attaching thermocouples with various orientations and attachment methods on the different regions of the LIB, the temperature measurement by thermocouples is obtained by varying two battery brands, four fluid types, two submerging percentages, and four discharge rates. The expected result is that Sony battery reaches the maximum temperature of 34 °C when under 3 C discharge rate and 90% under AmpCool-110 engineering fluid, which is 25 °C cooler relative to the same setup when cooling by 23 °C ambient air. The experiment also expected horizontal-orientated thermocouples with additional TIM between the cell's wall and the probe to provide the most accurate measurement of temperature. The present study will serve as the foundation for validating and tuning the computational model of the battery, which will be utilized to research the optimal configuration of the battery pack for cooling performance per energy density.

Keywords: Lithium Ion Battery; Immersive Cooling; Thermocouple; Battery Thermal Management

Mentor(s):

Amy M Marconnet (Engineering); Piyush Mani Tripathi (Engineering)

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

Talk Presentation Abstract Number: 7033
Presentation Time: Grissom 125 at 11:00-11:20

Advancing Wound Health Assessment Utilizing Curcuma Longa

Life Sciences

Author(s):

Ishita Mukadam†

Abstract:

[Abstract Redacted]

Keywords: Turmeric; Wound Healing; Bandage; Antibacterial; Early Detection

Mentor(s):

Mrudula Mukadam (Unknown)

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

Talk Presentation Abstract Number: 7034
Presentation Time: Grissom 125 at 11:20-11:40

Categorizing stress in college-age students through EEG data and ML

Mathematical/Computation Sciences

Author(s):

Alpamys Sultanbek† (Engineering); Hailey Brianna Haglid† (Engineering); Justin Shakergayen‡ (Polytechnic); Katelyn Krishan Shah‡ (Engineering); Dalton J Aaker‡ (Engineering); Aiyan Sarwar Alam‡ (Engineering); Brian Martin Dodd‡ (Engineering); Brian Song‡

Abstract:

Stress is on an upward trend among young adults—with the pressure to succeed increasingly affecting students (1). This growth in stress has been a major contributing factor in numerous health issues and could be linked to the growing rate of suicide among youth (2) (3). A major component and cause of stress are timed, graded and quantified exams, especially because these exams hold great importance in achieving career success. This principle has been shown in a previous 2022 study—successfully inducing stress in participants using a timed math quiz (4). Based on these findings, the present experiment investigated a method of stress diagnosis using brain activity. The 2022 study's methodology was used to induce stress in 12 college students. Various biometrics, including: skin temperature, heart rate, and brain signal, were collected while participants were performing a relaxing activity or a timed quiz. This data was then used to train an ML model to recognise stress markers in individuals. A Convolution Neural Network trained with only EEG Signal data, given a 5-second snippet of brain activity, was able to predict participant stress with an accuracy of 95%. This method of identifying stress through brain activity can be used alongside other biofeedback methods to improve the diagnostic aspects of stress therapy. For example, in a guided meditation session aiming to reduce stress, brain activity can be measured to determine when a subject has achieved a state of low stress.

Keywords: EEG; Biofeedback; Machine Learning; Stress; Neurotech

Mentor(s):

Sebastien Helie (HHS)

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

Talk Presentation Abstract Number: 7035
Presentation Time: Grissom 125 at 11:40-12:00

"Metabolic Signaling and Skeletal Muscle Health: Investigating AKT Pathway Impacts on Neuromuscular Junction Plasticity"

Life Sciences

Author(s):

John Ward Robbins† (HHS|JMHC)

Abstract:

In the Jaiswal laboratory, our research focuses on understanding how metabolic signaling pathways, specifically the AKT pathway, influence the plasticity of skeletal muscle and neuromuscular junctions (NMJs). We investigate how alterations in AKT signaling contribute to changes in skeletal muscle mass, function, and adaptive responses, particularly in conditions such as obesity and sarcopenia. Using genetic mouse models and human subjects, our study aims to unravel the molecular mechanisms underlying these physiological changes. The outcomes of our research are crucial for developing targeted therapies aimed at preserving muscle health and function in populations affected by metabolic disorders and age-related muscle degeneration. By gaining deeper insights into AKT-mediated metabolic signaling, we aim to identify potential therapeutic targets that could enhance muscle integrity and mobility, thereby improving the overall quality of life for aging individuals and those with metabolic disorders.

Keywords: Metabolic Signaling; AKT Pathway; Neuromuscular Junctions (NMJs); Age-Related Muscle Degeneration; Muscle Mass

Mentor(s):

Natasha Jaiswal (HHS)

Other Acknowledgement(s):

Pengjun Zhang

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

Talk Presentation Abstract Number: 7036
Presentation Time: Grissom 126 at 11:00-11:20

SCALE

Machine Learning Force Field for Ceramics at Extreme Conditions

Physical Sciences

Author(s):

Stephen Brice Rider† (Engineering|JMHC); Sabria Kionna Nesmith‡ (Engineering)

Abstract:

Due to the Schrödinger equation being impossible to solve analytically for multi-particle systems, various techniques have been developed to approximate the electronic properties of these systems. One such method is Density Functional Theory (DFT), which relies on the idea that the electron density that minimizes the system's energy corresponds to the solution to the Schrödinger equation. However, the computational efficiency of even DFT prohibits simulations of systems with atoms in O(1000). To overcome such a challenge, machine-learning models have been trained to predict the atomistic forces with orders of magnitude improved computational efficiency. This research aims to expand the applications of force fields to ceramics at extreme conditions using an automated, open-access pipeline utilizing nanoHUB infrastructure. The pipeline consists of a tool that uses Quantum Espresso, a coded implementation of DFT, to acquire the inputs to a machine-learned force field created with Spectral Neighbor Analysis Potential (SNAP). From there, molecular dynamics via the Large-scale Atomic/Molecular Massively Parallel Simulator (LAMMPS) is used to improve the model iteratively. The result is a tool that uses machine learning to deliver quantum-accurate interatomic potentials to the user for any ceramic and semiconductor. This tool was designed to investigate known ceramics to better inform the design of military protective gear, but it can be used to generate interatomic potentials for general applications of any material class.

Keywords: Neural Network; Ceramics; Cyberinfrastructure; DFT; Force Field

Mentor(s):

Brian Hyun-jong Lee (Engineering); Alejandro H Strachan (Engineering)

Other Acknowledgement(s):

Rushik Desai

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

Talk Presentation Abstract Number: 7037
Presentation Time: Grissom 126 at 11:20-11:40

SCALE

Impact of Slot Liner Compression and Wire Geometry on the Total Thermal Resistance in the Electric Motor's Stator-Winding Assembly

Innovative Technology / Entrepreneurship / Design

Author(s):

Lindsay Kathryn Sutherland† (Engineering|JMHC)

Abstract:

The rise in electric motors, driven by the electric vehicle and renewable energy industries, demands effective thermal management solutions for their safe and reliable performance. Minimizing the thermal resistance of the stator-winding assemblies of motors is crucial for efficient heat dissipation. Slot liners are electrically insulating sheets that separate current-carrying copper wires from the motor's metallic stator to prevent shorting. This study experimentally examines the impact of slot liner compression and wire geometry on the winding-slot liner-stator thermal resistance by utilizing commercial slot liners like Nomex® and TufQuin®. Stator-winding assemblies are constructed by stacking a copper piece with wire-shaped ridges, a slot liner, a stator, and a reference material. The copper side is heated, and the reference material side is cooled, inducing a temperature gradient. Different experiments are performed with varying compression strains in the slot liner and wire geometries. The resulting two-dimensional, steady-state temperature maps are captured using infrared (IR) microscopy. These maps are then analyzed in MATLAB to calculate the total thermal resistance across the stator-winding assembly. Results indicate that the total thermal resistance of the assembly decreases with increased slot liner compression and decreased inter-wire spacing. This research provides insight into how compression and geometric factors can affect total thermal resistance. By changing the packaging of wires to decrease inter-wire spacing and using flexible slot liners, the total thermal resistance in the stator-winding assembly can be reduced, enhancing the thermal management of electric motors.

Keywords: Electric Motors; Slot Liner; Thermal Resistance; IR Microscopy; Wire Packaging

Mentor(s):

Amy M Marconnet (Engineering); Shanmukhi Sripada (Engineering)

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

Talk Presentation Abstract Number: 7038
Presentation Time: Grissom 126 at 11:40-12:00

SCALE

Simulation of Modified Coherent Ising Machines for Combinatorial Optimization

Mathematical/Computation Sciences

Author(s):

Charles Spencer Bowles† (Engineering|JMHC); Vidisha Singhal‡ (Engineering)

Abstract:

There exists a class of hard problems known as combinatorial optimization problems within the cores of logistics, finance, drug discovery, machine learning, and several other fields. These problems involve selecting the best configuration from a finite set of options. The broad consensus amongst computer scientists is that their unique properties prohibit conventional computers from finding solutions at useful problem sizes. Therefore, improved hardware architectures are needed to address these challenges. Recently, researchers are exploring a class of computational systems known as Coherent Ising Machines (CIMs) for their inherent ability to accelerate these problems. CIMs are optical computers that represent the elements of combinatorial optimization problems as pulses in a feedback system, naturally progressing to optimal solutions. Due to their analog nature, CIMs suffer from the phenomenon amplitude inhomogeneity, whereby nonbinary spins misrepresent a problem's underlying parameters, decreasing quality of results. We seek to alleviate this issue by investigating and combining previously proposed modifications to traditional CIMs. Modifications include new combinations of both network dynamics and spin couplings achievable in optical and electronic platforms. We provide an extensible benchmarking system capable of efficiently simulating broad classes of CIMs and assessing their performances and times-to-solutions on the standard BigMaq and G-set datasets. We report promising results for the use of multiple improvements on a traditional CIM. Uniform benchmarking helps provide insight to the relative efficacies of various promising CIM architectures prior to their physical construction, and we encourage further use of this benchmarking system through a publicly-available Python API.

Keywords: Optimization; Unconventional Computing; Photonics; Simulation

Mentor(s):

Peter Bermel (Engineering); Jie Zhu (Engineering)

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

Talk Presentation Abstract Number: 7039
Presentation Time: Grissom 133 at 11:00-11:20

SURF

Enhancing Transfection Efficiency of Hepatitis C Virus in Cell Culture

Life Sciences

Author(s):

Sarah Jimenez Rojas†

Abstract:

Hepatitis C Virus (HCV) is a bloodborne pathogen causing chronic liver disease, cirrhosis, and hepatocellular carcinoma, with over 50 million people infected worldwide and 1 million new infections each year. Direct acting antivirals cure up to 95% of chronic HCV infections; however, reinfection can occur after successful treatment, and cases continue to rise across the United States, leading to the urgent need for an HCV vaccine. Rational vaccine design is limited by a lack of structural information. Notably, there is no resolved structure of HCV due to the heterogeneity, lipophilicity, and low yields of cell-cultured virus. To overcome this, an alternative purification approach is to use affinity-tag particles generated by transfection of in vitro transcribed viral RNA. In this research, the transfection of HCV with a polyhistidine and One-Strep-Tag will be optimized in hepatic cell line Huh 7.5. The transfection efficiency of different treatments, such as transfection technique (lipofectamine 3000, PEI-MAX, and electroporation), ratios of DNA to transfection reagent (1:1, 1:2, 1:3, 1:4, 1:5), and harvesting time aim to be evaluated. An immunofluorescence assay, utilizing an E2 antibody, and a focus-forming assay will be used to test transfection efficiency and infectious titer, respectively. All this with the purpose of designing a comprehensive protocol for transfection and quantification, critical aspects to future purification and characterization of viral structure through cryo-EM and other techniques to inform vaccine design.

Keywords: Hepatitis C Virus (HCV); Structural Virology; Transfection; Cell-Cultured Virus; Rational Vaccine Design

Mentor(s):

Richard J Kuhn (Science); Ryan George Peters (Science)

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

Talk Presentation Abstract Number: 7040
Presentation Time: Grissom 133 at 11:20-11:40

SURF

Thrombus Characterization in Abdominal Aortic Aneurysm and Aortic Dissection Models Using Histology and Scanning Electron Microscopy

Innovative Technology / Entrepreneurship / Design

Author(s):

Niharika Narra† (Engineering|JMHC)

Abstract:

Aortic dissections (ADs) and abdominal aortic aneurysms (AAAs) are common aortic pathologies. AD is characterized as a tear in the intima, forming a false lumen. AAA is the localized-dilation and weakening of the aortic wall, resulting in complex flow patterns. While distinct, both frequently develop thrombus within the lumen (AAA) or within the wall (AD). Due to the hemodynamic differences, we hypothesize that thrombus structure and composition will vary between these two conditions. To examine this, we utilized murine models: 1) topical elastase-?-Aminopropionitrile for AAA and 2) angiotensin II-infused apolipoprotein E-deficient mice for AD. Using serial ultrasound measurements, we detected vessel expansion and monitored 1) diameter changes and 2) thrombus deposition. Using histology, we quantified the degree and composition of intramural (IMT) and intraluminal thrombus (ILT) in ADs and AAAs respectively. Color segmentation of Movat's pentachrome slides revealed a significantly higher percent area of fibrin ($p<0.001$) in ILT, while red blood cells (RBCs) were significantly higher ($p<0.001$) in IMT. Histology and scanning electron microscopy images showed fibrin layers in the ILT structure, while the IMT formed a compact network of fibrin and RBCs. Higher amount of fibrin appears to correlate with a greater degree of organization in the ILT, which may be caused by the active blood flow in AAAs. This pattern is mostly absent in the low wall shear stress environment of the false lumen of ADs. These findings are an initial effort to correlate thrombi formation with vessel growth rate and rupture risk to improve patient outcomes.

Keywords: Aortic Aneurysm; Aortic Dissection; Thrombus; Scanning Electron Microscopy; Histology

Mentor(s):

Craig Goergen (Engineering); Cortland Hannah Johns (Engineering)

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

Talk Presentation Abstract Number: 7041
Presentation Time: Grissom 133 at 11:40-12:00

SURF

Explainable Machine Learning for Predicting Atmospheric Blocking

Physical Sciences

Author(s):

William Henry Stevens† (Science); Anh Nhu‡

Abstract:

Atmospheric blocking events, characterized by persistent high-pressure systems that block prevailing westerly wind patterns, can significantly impact weather patterns and lead to extreme conditions like heat waves, cold spells and droughts. However, there has yet to be any significant study identifying the precursor patterns that indicate the imminence of blocking long before it occurs. This project explores a multidisciplinary approach to identifying and understanding these precursor patterns through integrating a scientific understanding of physics and atmospheric science with the patterns identified by a Convolutional Neural Network (CNN) and Explainable Artificial Intelligence (XAI). The network is trained on simulation data from the Two-Layer Quasi-Geostrophic (QG) Model, investigating various atmospheric variables such as potential vorticity and jetstream flow, and has shown to predict the occurrence of future atmospheric blocking with 95%, 90%, and 85% accuracy at 1, 5, and 10 lead days prior to the event, respectively. The patterns used by the neural network to predict the onset of blocking were identified through employment of an XAI technique called Layer-Wise Relevance Propagation (LRP), which produces a relevancy heat-map highlighting the pixel features deemed most important to the network's predictions. These features are consistent with a physics-based understanding of precursor blocking behavior. This work confirms the existence of precursor patterns for atmospheric blocking, identifies their behavior, and proposes a reliable mechanism for using them to predict future blocking occurrences. The promising results motivate future research endeavors utilizing machine learning and physical understanding to predict atmospheric blocking long before its effects impact the world.

Keywords: Machine Learning; Atmospheric Science; Atmospheric Blocking; Explainable AI; Heatwaves

Mentor(s):

Lei Wang (Science)

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

Talk Presentation Abstract Number: 7042
Presentation Time: Grissom 103 at 12:00-12:20

SURF

Investigating the Relationship Between Gut Microbiome, Biomechanics, and Scoliosis: A Holistic Approach Through Two Complementary Studies

Life Sciences

Author(s):

Sarah Marie Staller† (Engineering|JMHC)

Abstract:

Research indicates that relationships exist between the gut microbiome, musculoskeletal biomechanics, and scoliosis. Gut microbiome alteration can impact hormone production, bone density, and nutrient absorption. Scoliotic curvature can cause asymmetrical spinal loading. These factors have been implicated in scoliosis progression. However, the specific interplay of mechanics and biological properties in spinal health remains unclear. Two separate yet complementary studies were considered to elucidate these relationships. The first study examined the impact of scoliosis severity on spinal loads and muscle activities. To accomplish this, a preexisting thoracolumbar musculoskeletal model was further developed to include coronal alignment. Patient X-rays were used to generate patient-specific models grouped by scoliosis severity: mild, moderate, and severe. Significant differences were detected among groups in maximum muscle activities, compressive forces, and anterior-posterior shear forces in orthostatic simulations, indicating that scoliosis severity influences biomechanics. The second study evaluated the impacts of gut microbiome disruption and subsequent intervention on spinal health in a healthy mice model. Mice were split into five groups: control, cessation, prebiotic, exercise, and prebiotic + exercise. Vertebrae and intervertebral discs will be characterized by morphometry, mechanics, histology, and biochemical content. It is hypothesized that differences among groups will be observed, and affected properties will provide insight into the gut-spine axis. Future work involves expanding the investigative approach to consider the influence of gut microbiome modulation within a scoliotic murine population. A holistic understanding of the association between gut health, biomechanics, and scoliosis can illuminate the mechanisms driving this disorder and guide the development of new treatments.

Keywords: AnyBody Technology; Microcomputed Tomography; Coronal Alignment; Bone Mechanics; Musculoskeletal System

Mentor(s):

Deva Chan (Engineering); Cameron Xavier Villarreal (Office of the Provost)

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

Talk Presentation Abstract Number: 7043
Presentation Time: Grissom 103 at 12:20-12:40

SURF

Design and Implementation of an Inductively Coupled Plasma Neutralizer for SPT-100 Hall Thruster

Physical Sciences

Author(s):

Mathis Malaussena† (Engineering)

Abstract:

Hall effect thrusters are used for satellite propulsion and are a major area of research as their improvements could enable a broader range of space missions. A crucial element of their system is the neutralizer, which neutralizes the accelerated ion beam generated by the thruster. The commonly used hollow cathode neutralizer, while being the most efficient alternative, has a limited lifespan as it is easily contaminated by residual gaseous products present in vacuum chambers, imposing impractical stringent requirements for laboratory vacuum pumping systems. To overcome these limitations, this research aims to design and implement a neutralizer which uses an electrodeless inductively coupled plasma (ICP) discharge. ICP neutralizers enable stable, repeatable, and extended operation by eliminating the use of electrodes susceptible to contamination. The initial phase of research consists of prototyping the neutralizer, executed in a vacuum chamber with varying parameters, including gas flow rate, chamber pressure, coil, ICP chamber dimensions, and RF power and frequency. The results from this phase are based on photographic observations of the plasma generated, from which an array of parameter ranges for optimal operation were determined. The second phase consists of the implementation and optimization of the prototype within the system. Electrical parameters of the ICP neutralizer and SPT-100 Hall-effect thruster will be taken while running both systems in tandem. Development of an ICP neutralizer enables utilization of Hall-effect thrusters with various types of propellants and advancement of dual-mode propulsion concepts sharing the same propellant between the chemical and electric propulsion systems on a spacecraft.

Keywords: Hall Effect Thruster; Inductively Coupled Plasma; Gas Discharge Physics; Electric Propulsion; RF Current

Mentor(s):

Alexey Shashurin (Purdue University); Lee E Organski (Engineering)

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

Talk Presentation Abstract Number: 7044
Presentation Time: Grissom 103 at 12:40-1:00

SURF

Electric Vehicle (EV) Thermal System Design Optimization

Innovative Technology / Entrepreneurship / Design

Author(s):

Nikolai Baranov† (Engineering)

Abstract:

[Abstract Redacted]

Keywords: Electric Vehicle; Thermal Management System; Graph-Based Model; Design Optimization; Human-Machine Interaction

Mentor(s):

Parikesit Pandu Dewanatha (Engineering); Neera Jain (Engineering)

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

Talk Presentation Abstract Number: 7045
Presentation Time: Grissom 118 at 12:00-12:20

SURF

Assessing and Improving Robotic Surgeon’s Intraoperative Non-Technical Skills: A Mixed-Methods Study

Innovative Technology / Entrepreneurship / Design

Author(s):

Dan Ha Le†

Abstract:

Non-technical skills (NTS) are interpersonal and cognitive skills necessary to ensure patients’ safety in surgeries. However, about 43% of surgical errors are attributed to a dearth of these skills. Consequently, the goals of this research are to (1) assess the effectiveness of personalized coaching at improving surgeons’ NTS, and (2) determine factors challenging surgeon’s NTS in the operating room (OR). Our team of experts used NOTSS (Non-Technical Skills for Surgeons) assessment tool to rate nine robotic surgeons’ NTS, each across three surgeries (n=27). Each surgeon then received two personalized NTS coaching sessions, one between each surgery. All coaching sessions were conducted virtually and recorded. Using Cohen’s d statistics, the effect size of the coaching intervention shows fairly strong improvement in surgeons situation awareness (d = 0.67) and leadership (0.65) after coaching. Thematic analyses of the coaching session transcripts revealed that robot integration, team coordination, and sociotechnical issues were core contributing factors challenging surgeons NTS. Through these, we recommend considerations for surgeons to optimize interactions with other team members. This study has implications for NTS assessment, coaching, and robot integration. Effectively assessing surgeons’ NTS is critical in understanding the factors that challenge surgeons and ultimately affect patient safety.

Keywords: [no keywords provided]

Mentor(s):

Denny Yu (Engineering)

Other Acknowledgement(s):

Marian Nwanne Obuseh

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

Talk Presentation Abstract Number: 7046
Presentation Time: Grissom 118 at 12:20-12:40

SURF

Effect of different microbial inoculum over bacterial colonization and biofilm formation in basil (Ocimum basilicum) hydroponics.

Life Sciences

Author(s):

Salomon Caro Castillo†

Abstract:

As the human population grows and natural resources become scarce, improving crop production is imperative. Traditional agriculture relies on chemical fertilizers and faces vulnerabilities due to climate change. Alternative methods, like hydroponics, and the role of microbial communities in plant development offer promising possibilities. However, microbiomes in hydroponic systems are prone to instability due to nutrient solution circulation. This study aims to determine how inoculation strategies influence biological stability and plant growth in a hydroponic system using Kratky jars. Conditions evaluated include basil grown with nanopure water, a monoculture of plant growth-promoting bacteria (PGPB) Pseudomonas putida, and inoculation with biofilm from another basil hydroponic system. Flow cytometry and DNA quantification were used to track microbial community changes, with planned sequencing for community composition analysis. Biofilm thickness was assessed using microscopy to detail bacterial colonization. Results showed that neither the bacterial monoculture nor the inoculated biofilm significantly affected plant height and span. However, root mass was larger in plants inoculated with the monoculture and biofilm compared to those grown in nanopure water, suggesting that Pseudomonas putida and the biofilm may enhance root growth and plant health. The decrease in cell concentration after monoculture inoculation indicates that these effects may be independent of biological stability, implying a strong initial inoculation impact regardless of microbial productivity. These findings enhance the understanding of microbial colonization in hydroponic systems and their effects on plant growth, which is crucial for managing bacterial proliferation and promoting sustainable crop production.

Keywords: Microbial Communities; Hydroponics; Flow Cytometry; DNA quantification; Plant Growth-Promoting Bacteria (PGPB)

Mentor(s):

Caitlin Rose Proctor (Engineering)

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

Talk Presentation Abstract Number: 7047
Presentation Time: Grissom 118 at 12:40-1:00

SURF

Identification of a Novel Candidate Variant in CLPX for Spinocerebellar Ataxia in a Mixed Breed Dog

Life Sciences

Author(s):

Namju Kim†

Abstract:

Spinocerebellar ataxia (SCA) is a progressive neurodegenerative disorder primarily affecting the cerebellum, resulting in the loss of motor control and voluntary muscle coordination. While previously described in Jack and Parson Russell Terriers due to autosomal recessive mutations in the genes CAPN1 and KCNJ10, and in other dog breeds in SCN8A, SLC12A6, and SPTBN2 (Alpine Dachsbracke, Belgian Malinois, and Beagle, respectively), an atypical case of SCA was recently documented in a mixed breed dog. Health records and necropsy findings identified paraparesis, SCA, anemia, and retinal degeneration in this individual. Because SCAs are inherited conditions, whole-genome sequence (WGS) was generated for the affected dog, with the aim of identifying the underlying genetic mutation driving the phenotype. The known canine mutations above were not present in this affected mixed-breed dog. Principal Component Analysis of genomic data confirmed this dog's mixed-breed identity. The affected dog's WGS was then screened for private variants compared to WGS from >700 unaffected dogs. This established variant elimination pipeline revealed a private homozygous exonic 4-base-pair mutation in CLPX. CLPX is a novel candidate gene for SCA in any species that encodes a subunit of a molecular chaperone involved in mitochondrial protein degradation in a pathway related to SCA. In-silico tools predict a frameshift and a premature stop codon within 17 amino acids, truncating 6.64% of the protein. Our study is the first to explore the association of CLPX mutation with SCA. This connection is potentially significant for human health due to the high evolutionary conservation of CLPX across species.

Keywords: Neurodegenerative Disease; Genetics; Canine; Mitochondria; clpx

Mentor(s):

Jeanna Marie Blake (Veterinary Medicine); Madeline Christina Coffey (Office of the Provost); Kari J Ekenstedt (Veterinary Medicine)

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

Talk Presentation Abstract Number: 7048
Presentation Time: Grissom 125 at 12:00-12:20

Bernal REU

Singing in the Anthropocene: Evaluating Anuran Call Signal Transmission in Urban Environments

Life Sciences

Author(s):

Isabella Wyatt†

Abstract:

For communication to take place, signals should be transmitted from the sender to the receiver. Several environmental factors, such as relative openness, vegetation type, and temperature, among others, affect how far an acoustic signal travels. Urbanization alters both the physical and acoustic structure of signaling environments, potentially affecting the transmission of acoustic signals and therefore, their active space. However, our understanding of how urbanization affects transmission of acoustic signals is limited. Here, we investigate signal transmission in rural vs noise-polluted urban environments in frogs, a group of high conservation concern that relies on acoustic signaling for reproduction. In particular, we performed transmission experiments by broadcasting calls of four native species (Dryopytes versicolor, Acris blanchardi, Lithobates catesbeiana, L. clamitans) at urban and rural breeding sites in the Greater Lafayette area. To examine acoustic degradation of the calls and differential changes in signal:noise ratio, we recorded these playbacks at five distances (1, 2, 4, 8, and 16 m) in the presence and absence of pre-recorded traffic noise. Excess attenuation was determined by measuring call intensity at those distances. Signal degradation and excess attenuation analyses evaluating frogs calling at urban and rural breeding areas provide valuable insights into the effects of urbanization on anuran call transmission. Overall, our study aids in broadening our understanding of the challenges confronted by organisms living in rapidly changing environments, providing insights into previously unconsidered factors that may play a role in declining amphibian populations.

Keywords: Bioacoustics; Signal Transmission; Urbanization; Anthropogenic Noise; Frogs

Mentor(s):

Ximena Bernal (Science); Ana Maria Ospina Larrea (Science)

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

Talk Presentation Abstract Number: 7049
Presentation Time: Grissom 125 at 12:20-12:40

Bernal REU

Antennal Complexity in Mosquitoes: Association between Structure and Multimodal Sensory Functions

Life Sciences

Author(s):

Krisha Shah†

Abstract:

[Abstract Redacted]

Keywords: Sensory Compensation; Flagellar Ears

Mentor(s):

Ximena Bernal (Science)

Other Acknowledgement(s):

Richa Singh

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

Talk Presentation Abstract Number: 7050
Presentation Time: Grissom 126 at 12:00-12:20

Structural and Computational Biology and Biophysics REU

Targeting GRK5 in Metastatic Cancer: Structural Insights and Therapeutic Evaluation of Novel Inhibitors

Life Sciences

Author(s):

Nikki Leslie†

Abstract:

G-protein-coupled receptors (GPCRs) are the largest family of cell surface signaling receptors and are known to activate diverse signal transduction pathways. GPCR kinases (GRKs) regulate GPCR signaling through selective phosphorylation which promotes their desensitization and internalization, thus maintaining cellular homeostasis. Furthermore, GRKs in pathopsychological conditions can promote tumorigenesis and metastasis, with processes such as the transactivation of receptor tyrosine kinases (RTKs). The GRK family (GRK1-7) is classified based on structural and sequence similarity into three kinase subfamilies: visual (GRK1/7), GRK2-like (GRK2/3), and GRK4-like (GRK4/5/6). GRK5 is upregulated in metastatic cancers and is a promising cancer therapeutic target. We hypothesize that our novel GRK5 inhibitors will enable superior selectivity for GRK5 to enhance therapeutic outcomes. Sunitinib, an FDA-approved multitargeted RTK inhibitor, is used to treat patients with renal cell carcinoma and gastrointestinal stromal cancer. Previously, we have developed a class of highly selective inhibitors targeting GRK5 derived from Sunitinib and elucidated the structures of GRK5 bound to some of these compounds. Current progress focuses on testing them in Pancreatic Ductal Adenocarcinoma (PDAC) cell growth and migration in vitro assays. In parallel, we developed a new class of macrocyclic compounds derived from previously published GRK6 inhibitors. We collected X-ray diffraction data and resolved the structures of GRK5 bound to these new compounds, which will allow us to understand drug-target interactions and optimize compound potency and selectivity. Future work will be to test the macrocyclic compounds in cell growth and migration in vitro assays using PDAC cancer cell lines.

Keywords: GRK; Cancer; Drug Development; GPCR; X-Ray Crystallography

Mentor(s):

Yueyi Chen (Pharmacy); Brittany Nicole Heil (Science); John Tesmer (Science)

Other Acknowledgement(s):

Arun K Ghosh; Brittany Lee Allen-Petersen; Nicholas Noinaj

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

Talk Presentation Abstract Number: 7051
Presentation Time: Grissom 126 at 12:20-12:40

Structural and Computational Biology and Biophysics REU

Structural basis of nanobody inhibition of UCH37

Life Sciences

Author(s):

Jaralynn Morellano†

Abstract:

The Ubiquitin C-terminal Hydrolase UCH37/UCHL5 is a deubiquitinating enzyme (DUB) associated with the 26S proteasome. It plays a key role in protein degradation by cleaving branchpoints for Lys48 linkages within polyubiquitinated substrates prior to degradation. Biochemical studies have shown there is a noncanonical ubiquitin binding site (S1' site) for this linkage specificity that lies on the opposite face of the canonical binding site (S1 site). The canonical and noncanonical nanobodies are developed by yeast display to bind to the S1 and S1' site, allowing for the inhibition of multivalent ubiquitin binding. Studies surrounding Lys48 branchpoints are particularly of interest in cancer due to its integral role in protein degradation. UCH37 can cleave Lys48 branchpoints to save proteins from degradation. The proteasome subunit Rpn13 brings UCH37 out of its autoinhibited state and fully activates cleavage activity. Our experiments aim to determine the structural basis of multivalent nanobody association with UCH37. We formed a UCH37 C88A Rpn13 DEUBAD ncNb complex through a combination of column affinity purification and size exclusion chromatography. Currently, crystal screens are being incubated and observed for crystal growth. As an alternative we have also turned to protein cryogenic electron microscopy. This structure will allow us to observe how different nanobodies of similar sequences differentiate between the distinct ubiquitin binding sites of UCH37.

Keywords: Deubiquitinating Enzyme (DUB); UCH37/UCHL5; Nanobodies; Inhibition; Multivalent Ubiquitin Binding

Mentor(s):

Rishi Patel (Science)

Other Acknowledgement(s):

Chittaranjan Das; Nicholas Noinaj; Shalini Iyer; Nipuni Maleesha Pannala

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

Talk Presentation Abstract Number: 7052
Presentation Time: Grissom 126 at 12:40-1:00

Structural and Computational Biology and Biophysics REU

Tool for CryoEM 2D Average Image Stitching Assisting Initial Referance Building of Helical Filaments

Life Sciences

Author(s):

Damilola Showunmi†; Wei Jiang‡

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Xiaoqi Zhang (Science)

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

Talk Presentation Abstract Number: 7053
Presentation Time: Grissom 133 at 12:00-12:20

SURF

Air-entrained Structure in Underwater Noise Mitigation for Offshore Wind Energy

Innovative Technology / Entrepreneurship / Design

Author(s):

Shaocheng Wu† (Engineering); Yijie Zhang‡ (Engineering)

Abstract:

[Abstract Redacted]

Keywords: Noise Control; Metamaterials; Structure Design; Wind Energy

Mentor(s):

Junfei Li (Engineering)

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

Talk Presentation Abstract Number: 7054
Presentation Time: Grissom 133 at 12:20-12:40

SURF

Feature Extraction for Classification of Small Firearms-Like Noise and Blast Exposure Hearing Loss in Rat Models

Life Sciences

Author(s):

Sahil Vijay Desai† (Engineering|JMHC); Jax Patrick Marrone‡ (Engineering); Andres Navarro‡ (Science); Emily Le Bell‡ (Science)

Abstract:

Auditory evoked potentials (AEPs) are a current standard of care for diagnosing hearing loss (HL). For these assessments, patients are presented with diagnostic auditory stimuli, and their neural responses are recorded to identify neurologic or otologic abnormalities. One challenge of this approach is misinterpreting similarities within types of HL. A patient with noise-induced hearing loss (NIHL) could present with a loss in hearing sensitivity; however, the cause of this damage could be from various stimuli, such as small firearms-like noise (SAF) or high-pressure explosion noise (blast). With each stimulus requiring distinct therapeutic profiles, clinicians can struggle with current diagnostics to determine proper treatment strategies and restore hearing functionality. This study attempts to distinguish types of NIHL by identifying biomarkers to classify each exposure. Rat subjects were divided into three groups and exposed to either blast, SAF, or sham noise. Groups were monitored for 56 days after the initial exposure, and traditional and non-traditional diagnostic stimuli were used to measure auditory responses during this period. Results have shown that AEPs in SAF exposures have significantly decreased transmissions from the auditory nerve and inferior colliculus compared to sham exposures. Further data is being analyzed for the blast group, and our combined results are being used to train a machine learning algorithm to correlate given AEPs to their respective NIHL type and the number of days since their exposure. Future work includes enhancing the robustness of our model by correlating anatomical changes in cochlear and brain tissue with our physiological data.

Keywords: Noise-Induced Hearing Loss; Small Firearms-Like Noise; Auditory Evoked Potentials; Blast Noise Exposure; Machine Learning

Mentor(s):

Edward L Bartlett (Science); Meredith Christine Ziliak (Science)

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

Talk Presentation Abstract Number: 7055
Presentation Time: Grissom 133 at 12:40-1:00

SURF

Fabrication of a supercritical CO2 dryer and study of the effect of chitin in potato starch-based aerogels

Physical Sciences

Author(s):

Sevinch Pasilova†

Abstract:

Aerogels are ultralight, highly porous materials (usually 90 to 99.8% air by volume) derived from gels where the liquid component is replaced with air. The most effective method to maximize the aerogel porosity is using supercritical drying, which involves replacing the liquid in the gel with a supercritical fluid, such as carbon dioxide. This method is commonly applied in forming silica, carbon, metal oxide, and chalcogenide aerogels. Recently, we have demonstrated the potential of supercritical drying to form potato thermoplastic starch (TPS) aerogels, resulting in a brittle structure. This work aims to enhance the mechanical properties of the TPS aerogel by introducing chitin in the TPS formulation. Chitin is a bio-based polymer extracted from crustacean exoskeletons and is known for improving mechanical strength, thermal stability, and moisture resistance in composite materials. To this end, we have built a supercritical dryer to produce our TPS aerogels derived from potato starch. We conducted experiments with varying chitin ratios in TPS aerogels alongside a sample without chitin. The aerogels' mechanical strength, thermal stability, moisture resistance, and porosity significantly improved with chitin (up to 3 wt%). Future research will focus on refining drying parameters and exploring new biopolymer sources.

Keywords: Thermoplastic Starch; Aerogel; Supercritical Drying; Potato Starch; Chitin

Mentor(s):

Andres Tovar (Purdue University)

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

Talk Presentation Abstract Number: 7056
Presentation Time: Grissom 103 at 1:20-1:40

SURF

Dry Direct Flash NanoPrecipitation for integrated high-throughput nanoparticle powder preparation

Physical Sciences

Author(s):

Katy Brauer† (Engineering)

Abstract:

Flash Nanoprecipitation (FNP) is a scalable nanoparticle preparation technique that utilizes the amphiphilic nature of stabilizing polymers to encapsulate a particle core composed of a hydrophobic substance. FNP has a range of applications across various fields including agriculture, electronics, and pharmaceuticals. Using FNP in the formulation of nanoparticle delivery vehicles for hydrophobic therapeutics has resulted in improved bioavailability when compared to traditional crystalline dosages due to the amorphous character of the particle core and the high specific surface area of the particle itself. The turbulent flow from miscible solvent and antisolvent streams produces an instantaneous homogeneous mixing environment in which particle formation occurs at a rate much faster than nanoparticle self-assembly (1.5-5ms compared to 20-100ms). These conditions make particle production precise and reproducible, and high flow rates provide an ease of scalability that other preparation methods lack. Current processes employ a secondary antisolvent dilution step after particles have been formed to prevent the dissolution of stabilizing polymers from the particle core, and some also include an additional filtration procedure to increase solute concentration. The solution is then sent to a spray dryer, which uses heated gas flow to evaporate the liquid phase, leaving the stabilized particles isolated. This project intends to show that the particle solution can be sent directly from the mixer into a spray dryer without intermediate dilution or filtration operations. The time scale of exiting the mixing chamber to drying the solvent occurs fast enough to avoid particle degradation, therefore lowering operating cost and processing time.

Keywords: [no keywords provided]

Mentor(s):

Kurt Ristroph (Engineering)

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

Talk Presentation Abstract Number: 7057
Presentation Time: Grissom 103 at 1:40-2:00

SURF

Rapid Widefield FLIM using a Single Photon Avalanche Diode Array

Physical Sciences

Author(s):

Ishaan Kartik Singh† (Science|JMHC)

Abstract:

Fluorescent lifetime imaging microscopy (FLIM) has been shown to have great biological relevance and potential, particularly in imaging metabolic activity of cells and Forster resonance energy transfer (FRET) studies. However, it has historically required a large number of datapoints and an accordingly slow framerate - no more than 1 Hz has been demonstrated up to this point. Faster imaging speeds is a priority in FLIM research, as it would enhance biomedical applications of FLIM, such as finding tumor microenvironments via hypoxic region detection, and open up the possibility of multiplexed FLIM, namely within super-resolution microscopy. Using the recently developed ultra-precise single photon avalanche diode (SPAD) array, which offers picosecond precision and virtually 0 noise, we demonstrate a practical implementation of SPAD arrays for rapid widefield FLIM at up to an 11 Hz framerate via fitting and 1 kHz via rapid lifetime determination (RLD). Simulations were performed to determine the set of imaging parameters that balance framerate and precision given the limits imposed by the SPAD architecture. FLIM images of quantum dots were then taken with a SPAD array at those parameters to determine that 2 Hz and 11 Hz imaging speeds recover bi-exponential fits, and 1 kHz imaging speeds recover mono-exponential fits with RLD. These findings also indicate the techniques that must be better explored to fully utilize the SPAD array's capabilities, particularly Laguerre deconvolution and bi-exponential RLD.

Keywords: FLIM; SPAD; Bioimaging; Fluorescence; Single Photons

Mentor(s):

Jing Liu (Science)

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

Talk Presentation Abstract Number: 7058
Presentation Time: Grissom 118 at 1:00-1:20

SURF

Image Recognition of Helical EMDB Structures

Life Sciences

Author(s):

Maria Munoz Perez†

Abstract:

Cellular proteins frequently form helical filaments, playing fundamental roles in both regulated biological processes and pathological conditions, such as Alzheimer's disease and other neurodegenerative disorders. Extensive research with cryo-electron microscopy (cryo-EM) and other techniques has greatly advanced our understanding of these helical structures. However, identifying the structure of experimental images remains challenging. A tool that can recognize whether a protein's structure has been previously identified and provide relevant data from the database would be invaluable. This research aims to develop and train a neural network for efficient image recognition of helical structures from the Electron Microscopy Data Bank (EMDB). Preprocessing the data is needed, as numerous incorrect and missing entries were identified on the database. To address this, we used helical indexing with the cylindrical projection of a 3D map (HI3D) and implemented a correlation-based validation method to clean essential helical parameters. Additionally, an automatic method for validating new database entries will be developed. The neural network, currently trained on a subset of the cleaned dataset, demonstrated effective feature extraction. Scaling up the entire helical database and data augmentation is expected to enhance generalizability for real cryo-EM images. A classifier will be designed on this pre-trained network to accurately identify structures from the database. Preliminary results suggest that this project is a promising tool for the recognition and validation of helical EMDB structures, with potential applications in improved database management and accurate protein structure identification.

Keywords: Helical Structures; EMDB; Image Recognition; Neural Network

Mentor(s):

Wen Jiang (Science); Daoyi Li (Science)

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

Talk Presentation Abstract Number: 7059
Presentation Time: Grissom 118 at 1:20-1:40

SURF

Does Calcium/Calmodulin Protein Kinase II (CaMKII) Affect Sperm-Induced Actin Remodeling in Fertilized Mammalian Eggs?

Life Sciences

Author(s):

Kristina Nicole Lodenquai† (Science)

Abstract:

Calcium/Calmodulin-dependent Protein Kinase II (CaMKII)—a calmodulin-binding protein—is found in mammalian oocytes. CaMKII is an integral player responsible for meiosis resumption and the progression of embryonic interphase. However, research differs on CaMKII's role in key egg activation events like cortical granule exocytosis (when vesicles in the cytoplasm are released to form a membrane around the egg), the membrane block to polyspermy (the cell membrane's ability to prevent fertilization by multiple sperm), and embryonic development. While previous evidence establishes that CaMKII is essential for critical cytoskeletal components—such as the organization of the meiotic spindle and proper actin dynamics—the specific effects of this protein on sperm-induced actin remodeling remain unexplored. This research aims to bridge the gap between what is known about CaMKII's functions and its effects on the fertilization cone—an actin rich patch at the point of sperm entry. The initial phase of this research involved optimizing KN-93 (a calmodulin CaMKII inhibitor) to determine its ideal concentration to prevent the formation of second polar bodies (indicators of meiosis resumption). Oocytes treated with varying concentrations of KN-93 underwent in vitro fertilization (IVF). Using fluorescence microscopy, the intensity of actin and microtubules were measured. Additionally, microtubule organization was qualitatively measured, and actin filament length and density at the fertilization cone were measured in the cell cortex. This research provides valuable insights into CaMKII's impact on essential oocyte characteristics through immunofluorescence analysis. Future work will involve live cell imaging to observe the dynamics of sperm-induced actin remodeling in real-time.

Keywords: Fertilization Cone; CaMKII; CaMKII Inhibitor; Actin; Microtubules

Mentor(s):

Janice Perry Evans (Science); Allison Kay McCarthy (Science)

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

Talk Presentation Abstract Number: 7060
Presentation Time: Grissom 118 at 1:40-2:00

SURF

Human Papillomavirus E6 N-terminus Role for E6-p53 Interaction in E6AP-E6-p53 Complex

Life Sciences

Author(s):

Sungyu Choi† (Engineering)

Abstract:

High-risk strains of human papillomavirus (HPV), notably HPV 16 and HPV 18, are leading causes of invasive cervical cancer (71.2%) and can also cause oropharyngeal, anal, head, and neck cancers. Modern research focuses on hindering HPV 16/18-related tumorigenesis by targeting the highly conserved E7 and E6 oncoproteins. This study emphasizes the E6 oncoprotein, which degrades the tumor suppressor protein p53 by forming a complex with E6AP (ubiquitin protein ligase E3A, UBE3A) via an E6AP LxxLL motif, leading to p53 ubiquitination, degradation, and uncontrolled cell proliferation. Peptides containing the E6AP LxxLL motif alone are sufficient for inducing p53 binding to E6. X-ray diffraction and cryogenic electron microscopy (cryo-EM) structures of this p53 degradation complex suggest interactions between the E6 N-terminus and p53. Simulations have revealed that the E6 N-terminus transitions from a folded, non-accessible state to an unstructured, solvent-exposed state when E6 binds to LxxLL peptides. Based on these results, it is hypothesized that this “unsheathed” N-terminal domain acts as a hook to latch onto p53 for recruitment. To test this hypothesis, various lengths of the E6 N-terminal residues were synthesized using solid-phase synthesis, purified, and labeled with dye for fluorescence polarization (FP) assays to analyze their interaction with p53. Binding affinities, represented by equilibrium dissociation constants from FP assays, will be identified for this potential interaction site within the E6-p53 complex. Successful FP data analysis would provide valuable insights into inhibiting HPV-induced cancers by targeting the E6-p53 interaction, offering a promising avenue for drug development and screening methods.

Keywords: E6 N-Terminal; p53; HPV; Fluorescence Polarization; Peptide Synthesis

Mentor(s):

Vallabh Suresh (Pharmacy)

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

Talk Presentation Abstract Number: 7061
Presentation Time: Grissom 125 at 1:00-1:20

CISTAR

Synthetic methods to control Al siting and crystallite size in MFI zeolites for propene oligomerization

Physical Sciences

Author(s):

Nina A Borkowski†; Talana N Small‡

Abstract:

The majority of current energy production methods rely on non-renewable sources, making it crucial to develop a clean, easily replicable energy alternative. This work focuses on propene oligomerization, which is a key intermediate step in the conversion of shale gas resources to higher molecular weight products for transportation fuel resources. The process involves flowing propene through zeolite catalysts, which are known for their highly porous, crystalline structure, and shape selectivity.

H-MFI zeolites are used for propene oligomerization because of their thermal stability, resistance to coke deactivation, and commercial availability. This research focuses on synthesizing zeolites by adjusting synthesis parameters to control crystal size and aluminum distribution within the zeolite framework, which has been proposed to affect rates and selectivity. The parameters altered include organic structure-directing agents (SDAs), water content, and silicalite seed amounts. The choice of SDA affects aluminum distribution in the framework, while water and silicalite seed content influence crystal size.

In this work, three different organic SDAs are used: 1,4-diazabicyclo[2.2.2]octane (DABCO), dipropylamine (DPA), and tetrapropylammonium (TPA). Recipes with DABCO and TPA had varying water contents, while MFI-DPA varied silicate seed amounts. Preliminary data from x-ray diffraction, nitrogen physisorption, elemental analysis, dynamic light scattering, and temperature-programmed desorption experiments shows that the synthesized samples have H-MFI framework with varying molar ratios and effective crystal diameters. This research aims to optimize the synthesis of H-MFI zeolites for more efficient catalytic conversion of shale gas resources, contributing to the development of sustainable energy sources.

Keywords: Zeolite; Synthesis; Proton Siting; Crystal Size; Oligomerization

Mentor(s):

Diamarys Salome Rivera (Engineering); Sarah Margaret Gustafson (Engineering)

Other Acknowledgement(s):

Rajamani P Gounder

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

Talk Presentation Abstract Number: 7062
Presentation Time: Grissom 125 at 1:20-1:40

CISTAR

Oligomerization of Light Olefins Using Aluminosilicate Catalysts

Physical Sciences

Author(s):

Nicholas Barmore†

Abstract:

For over 70 years chemical engineers have been researching and developing light olefin oligomerization, primarily for use as higher molecular weight fuels. Zeolites are one such catalyst that can be used for this process. They are silicon aluminum crystals with Bronsted acid sites on each aluminum ion. Although it can form 6 bonds, Al forms only 4 in zeolites, all to oxygen, which are subsequently bonded to silicon. This undercoordination allows these Al sites to act as Bronsted acids through a charge imbalance between it and the silicon ion. Silica alumina is another catalyst but is comprised of silicon aluminum oxides. For comparison, silica alumina has ~10,000 times less catalytic activity. While Al-O-Al, or aluminum oxide, bonds are non-reactive, we hypothesize that there are a few Al-O(H)-Si bonds, the same as those in zeolites, that act as Bronsted acids within silica alumina, which explains its slight activity. The scope of this project aims to synthesize these sites on the surface of non-reactive silica. These will then be compared to commercially available zeolites for things like conversion, selectivity, rates, and stability. Preliminary results show that a highly reactive catalyst can be prepared, as well as evidence for Bronsted acid sites such as cracking and skeletal isomerization as products of the oligomerization reaction. Determination of the number and characterization of the type of active sites will be determined to quantify the differences in these catalysts with those of zeolites.

Keywords: Aluminosilicate; Catalyst; Oligomerization; Zeolites

Mentor(s):

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

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

Talk Presentation Abstract Number: 7063
Presentation Time: Grissom 125 at 1:40-2:00

CISTAR

Significance of Corn Stover Fermentable Sugars on Oxalic Acid Production by Aspergillus niger Fermentation

Life Sciences

Author(s):

Mahagani Lasciers†

Abstract:

Organic acids are highly valuable resources in food products, pharmaceutical industries, and recently, building materials. Thus, developing sustainable, large-scale production methods is essential. Currently, the production of organic acids such as oxalic acid relies on petrochemical industries. However, advancements in lignocellulose biomass transformation, such as corn stover liquefaction, offer a more economical and abundant low-cost resource for organic acid production. Enzymatic liquefaction of corn stover can produce pumpable slurries, which, when fermented with Aspergillus niger, yield high levels of various organic compounds, including oxalic acid. This research focuses on evaluating the main fermentable sugars, glucose, xylose, and arabinose, that make up corn stover slurries, to assess their role in oxalic acid production. Separate fermentations were performed for the individual sugars and the corn stover slurry over six days, with samples collected on days zero and six to monitor changes in the sugar profile and organic acid production. Oxalic acid production was favored at a pH range of 5 to 6, with pH control maintained twice daily until fungal growth ceased. Oxalic acid production for slurry material ranged between 15 and 19 g/L, and the compound was proved to be produced with the individual sugars, glucose, xylose, and arabinose. This confirms that all fermentable sugars within the corn stover slurry are capable of producing oxalic acid, meaning that the biomass can be fully utilized. This not only allows for increased environmental sustainability but also contributes to the scale-up of alternative organic acid production.

Keywords: Fermentation; Biomass Slurries; Organic Acid; Aspergillus niger

Mentor(s):

Diana Milena Ramirez Gutierrez (Engineering)

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

Talk Presentation Abstract Number: 7064
Presentation Time: Grissom 126 at 1:00-1:20

Structural and Computational Biology and Biophysics REU

Quantifying Rubisco Polymerization within Carboxysomes

Life Sciences

Author(s):

Richard Lawrence†

Abstract:

Rubisco has been found to spontaneously polymerize into higher-ordered structures such as chains and lattices within ?-carboxysomes. Whereas previously, best methods involved visually qualifying which rubiscos participate in these polymers, the purpose of this study was to consistently quantify any participating rubisco molecule. This was carried out by using matlab scripts to perform particle picking and biophysical analysis on reconstructed electron tomograms to find which rubiscos are participating in intermolecular interactions. Custom programs were written to test the accuracy of the results and to visualize their various properties. A particularly exciting breakthrough was when a histogram of the distances between chains confirmed our theory that the chain lattices follow a six-fold symmetry. Another result was that the matlab script, responsible for identifying interacting pairs, produced a graph of the binding affinity of rubisco which was validated by previous results. And a final result is that the rubiscos participating in these higher-ordered structures can now be visualized in the tomograms themselves, making quantification even more effective. This research explores the interactions and polymerization of proteins through liquid-liquid phase separation. This type of biological and biophysical process is a quickly growing field of study which has deep implications in how biological structures can spontaneously form. Current methods involve studying these polymerizations in vitro, but soon it will translate to in situ studies, and it is essential to be able to quantitatively identify polymers within the more noisy environments that a proper in situ study requires.

Keywords: Carboxysomes; Rubisco; Polymerization; Computational Biophysics; cryoET

Mentor(s):

Ryan Hunter Gray (Science); Lauren Ann Metskas (Science)

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

Talk Presentation Abstract Number: 7065
Presentation Time: Grissom 126 at 1:20-1:40

Structural and Computational Biology and Biophysics REU

Protein Structure Modeling using Deep-Learning

Life Sciences

Author(s):

Anouka Saha†; David Huang‡ (Science); Tsukasa Nakamura‡; Joon Hong Park‡ (Science); Pranav Punuru‡ (Science)

Abstract:

The Critical Assessment of protein Structure Predictions (CASP)-Critical Assessment of PRediction of Interactions (CAPRI) competition aims to advance methods of predicting protein structure from sequence information. The current year's CASP (CASP16) focuses on predicting protein monomer and multimer structures, ligand interactions with proteins, nucleic acid complexes and protein-nucleic acid complexes.

As part of the Kihara lab's efforts in predicting biomolecular structures from the given sequences, I use AlphaFold3, a deep-learning software used to predict structures from sequences, corroborating my results with templates of similar sequences and literature searches, which give us known information about said protein target. There are various phases of targets for CASP; phase 0 where the stoichiometry of a protein is unknown, phase 1 where the stoichiometry is known, and phase 2 where we have to choose models that the group stipulates as accurate from thousands of user submitted model structures.

Keywords: Proteins; Protein Modeling; Deep-Learning; Structural Biology

Mentor(s):

Anika Jain (Science); Daisuke Kihara (Science)

Other Acknowledgement(s):

Yuki Kagaya; Genki Terashi; Emilia Tugolukova; Jacob C Verburgt; Nicholas Noinaj

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

Talk Presentation Abstract Number: 7066
Presentation Time: Grissom 133 at 1:00-1:20

SURF

Vibrating piezoelectric membranes for water filtration applications

Physical Sciences

Author(s):

Gabriel Brandt de Toledo† (Engineering)

Abstract:

In air and water filtration applications, membranes are employed to filter fluids that have been polluted by particulates. Among such filtration membranes, vibrating membranes have greater capture efficiencies, better anti-fouling qualities, and longer lifespan than static membranes. Membrane vibration is induced via the converse piezoelectric effect, a material property in which an applied voltage causes mechanical strain in the membrane. Experiments by Akshay Deolia using a polyvinylidene fluoride (PVDF) membrane in water have shown displacement amplitudes significantly greater than the piezoelectric tensor of PVDF and applied voltage suggested. Displacement was also smaller in air than in water, a denser and more viscous fluid. A COMSOL Multiphysics 6.2 model of the PVDF membrane in both water and air was employed, with acoustic-structure interactions, solid mechanics, electrostatics, and their respective couplings being considered. System damping was modeled as dielectric losses and mechanical boundary layer impedance. Eigenfrequency analysis and frequency domain studies were conducted to reproduce the observed membrane displacement amplitudes. Results are interpreted in terms of both membrane displacement amplitudes and fluid total acoustic pressure at both membrane and fluid resonant frequencies. A better understanding of where system eigenfrequencies are located, membrane eigenmodes, damping mechanisms, and displacement amplitudes was achieved. In addition, hypotheses for both the greater membrane displacement amplitude seen in water and the mechanism under which membrane flexural resonances are excited are proposed.

Keywords: [no keywords provided]

Mentor(s):

Ryan B Wagner (Engineering); Akshay Deolia (Engineering)

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

Talk Presentation Abstract Number: 7067
Presentation Time: Grissom 133 at 1:20-1:40

SURF

Sustainable Quench Oil Replacements for Austempering Salt Quenchants

Physical Sciences

Author(s):

Ruey-Bin Tsai†; Junyeong Ahn‡ (Engineering); Manila Kunwar‡ (Engineering)

Abstract:

Quenching is the process of rapidly cooling a material in a medium with a lower temperature. Controlling quenching conditions, such as quench speed, medium viscosity, and material orientation, is crucial for metals processing, as deviations can lead to drastically different microstructures and properties. While conventional metal quench oils, such as mineral oils and other petroleum derivatives, are effective, they are often expensive and unsustainable. Therefore, identifying sustainable quench alternatives, such as vegetable oils, and understanding their quench properties is essential. This study focuses on measuring the cooling characteristics of over 70 commercially available oils following the ASTM D6200 standard. These characteristics are utilized in a Gaussian process machine learning model, along with other quench-related properties such as boiling point, degradation point, heat capacity, and viscosity, to predict cooling curves. The aging of the oils during quenching is also investigated through accelerated aging and rheometry. The constructed machine learning model predicts cooling curve characteristics with high accuracy. Pearson correlation plots reveal strong connections between the cooling rate of the quenched metal and the boiling point and viscosity of the quenchant. Additionally, accelerated aging of high-oleic soybean oil demonstrates an exponential relationship between aging time and oil viscosity. Although further quench tests and refinements of the machine learning model are necessary, this work provides a basis for understanding the quench-related properties of commercial oils and identifying sustainable quench oil alternatives.

Keywords: Quenchants; Vegetable Oils; Machine Learning; Thermal Aging

Mentor(s):

Jeffrey P Youngblood (Engineering); Michael Titus (Engineering); Ching-Chien Chen (Engineering)

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

Talk Presentation Abstract Number: 7068
Presentation Time: Grissom 133 at 1:40-2:00

SURF

Neutrophil Motility Regulation by MiR-375 Target Gene ATP2b1

Life Sciences

Author(s):

Conwy Zheng† (Engineering)

Abstract:

Neutrophils are the most abundant white blood cells that form the first line of defense against infections through mechanisms like ROS, Phagocytosis, NETosis and recruitment of other immune cells. However, excessive recruitment of neutrophils or overstaying at a site of infection can have negative impacts like inflammation or additional tissue damage. Therefore, proper regulation of neutrophil activity is important to maintain a healthy immune system. This project focuses on the plasma membrane calcium ATPase gene ATP2b1, one of many target genes of MiR-375, as a regulator of neutrophil motility in both zebrafish and human leukemia (HL-60) cells. Discovery of potential regulator genes of neutrophil migration was achieved through RNA sequencing of MiR-375 overexpressing zebrafish, where ATP2b1 was verified to have a significant effect on neutrophil motility using our CRISPR/Cas9 system of Tissue-Specific-Knockout (TSKO). Human relevance was further determined through developing ATP2b1 knockdown cell lines through lentiviral transduction of shRNA expressing plasmids. In both systems, ATP2b1 knockdown cells showed significant decrease in their recruitment and migration when compared to control. Furthermore, this phenotype was rescued when full-length ATP2b1 was reintroduced into both TSKO zebrafish and knockdown HL-60 cells, giving strength to our hypothesis that proper calcium channeling via ATP2b1 is crucial for proper neutrophil activity. Currently, the project is gearing towards exploring whether ATP2b1 regulates other neutrophils functions while also looking into other target genes of MiR-375 as potential regulators of neutrophil motility.

Keywords: Neutrophil; microRNA; Zebrafish; CRISPR/Cas9

Mentor(s):

Daniel Kim (Science)

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

Talk Presentation Abstract Number: 7069
Presentation Time: Grissom 103 at 2:00-2:20

SURF

Analyzing the Impacts of Temperature on Electric Vehicle Adoption Rates Across Multiple US States

Mathematical/Computation Sciences

Author(s):

Sai Shashank Mukkera† (Science)

Abstract:

Despite the advancements in electric vehicle (EV) technology, less than 10% of vehicles in the US are EVs, indicating that the country remains an early adopter of this technology. Although EVs offer numerous advantages, their penetration remains low, particularly in regions with extreme temperatures. While numerous studies have examined the impacts of policy and sociodemographic factors on EV adoption, the influence of temperature has not been thoroughly explored. This study examines the influence of temperature on the adoption of EVs across various climatic regions in the United States. Our previous research focused on California and New York revealed that temperature is among the most important predictor of battery electric vehicle (BEV) and plug-in hybrid electric vehicle (PHEV) population change rate and penetration. Building on these findings, we extend our analysis to five additional states, such as North Carolina and Minnesota, to capture a broader range of climate variations. We gather detailed ZIP code-level data on land surface and air temperatures, sociodemographic characteristics, charging infrastructure availability, and land use patterns. Utilizing logistic curves, we build a parametric model to understand the impacts of temperature on the rate of EV adoption. Our work is the first to analyze how temperature influences the parameters of the logistic curve, providing insights into the rate of adoption in different climatic regions. We expect our results to reaffirm that temperature is a critical predictor of BEV and PHEV adoption rates. Through these advancements, we aim to provide a more detailed understanding of the factors influencing EV adoption and support the development of targeted strategies for promoting sustainable transportation across diverse climatic regions in the United States.

Keywords: Electric Vehicles; Machine Learning; Temperature Variation; Sustainable Transportation; Climate Impact

Mentor(s):

Gaia Cervini (Engineering); Ricardo Chahine (Engineering); Nadia Gkritza (Engineering)

Other Acknowledgement(s):

Lavan Teja Burra

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

Talk Presentation Abstract Number: 7070
Presentation Time: Grissom 103 at 2:20-2:40

SURF

Learning Nucleation by Reversing It: A Molecular Dynamics Study of Amorphization of Organic Molecules

Mathematical/Computation Sciences

Author(s):

Kyenret Yakubu Ayuba† (Engineering|JMHC)

Abstract:

Nucleation, a critical first step in crystallization, remains one of the most challenging phenomena to understand due to its stochastic nature. Nucleation has wide-ranging implications and is crucial for various applications, including materials science and pharmaceutical, nutraceutical, agrochemical, fine chemical, and specialty chemical manufacturing. This project aims to gain fundamental insights into the nucleation mechanism by simulating the amorphization process of molecular clusters. Specifically, molecular dynamics (MD) simulations are being performed using the Large-scale Atomic/Molecular Massively Parallel Simulator (LAMMPS) software package to compute the amorphization kinetics of initially crystal-like clusters. Each MD simulation provides dynamic data about the state of a system at multiple timesteps, capturing the movement and interactions of atoms as a cluster structure transitions toward a randomly packed state. For each atom in the system, the output file details its type, unique identifier, and scaled (fractional) coordinates at each timestep within the simulation box. The resulting trajectories from the MD simulations are being visualized using Visual Molecular Dynamics (VMD). Principal component analysis (PCA) will then be conducted on the simulation trajectories to reduce their dimensionality and help identify key configurations, including energy minima, that are associated with the amorphization process. Simulating the amorphization process offers insights into how a system departs from its crystalline state, revealing factors that dictate the initial occurrence of nucleation. The ultimate goal is to develop a machine learning model trained on the simulated trajectories to learn symmetry information that is created through nucleation.

Keywords: Nucleation; Molecular Dynamics (MD) Simulation; LAMMPS; Organic Molecules; Molecular Clusters

Mentor(s):

Tonglei Li (Pharmacy); Doraiswami Ramkrishna (Engineering)

Talk Presentation Abstract Number: 7071
Presentation Time: Grissom 103 at 2:40-3:00

SURF

Impaired theta oscillations during working memory as a potential biomarker for autism spectrum disorders

Life Sciences

Author(s):

Caroline Powell† (Science)

Abstract:

Fragile X Syndrome (FX), the most common genetic form of autism spectrum disorder (ASD), is a neurodevelopmental condition that causes mild to severe learning impairments, deficits in social communication, and mood instability. Additionally, cases of FX have been shown to have impaired working memory, however, the underlying mechanism causing this impairment remains unknown. We focused on whether low-frequency theta (4-8 Hz) oscillations, a frequency band diminished in FX, is a primary mechanism for working memory in the context of behavior. To determine this, we utilized a go/no-go visual discrimination task, a task commonly used to measure inhibitory control in ASD. Water restricted, head-fixed Fmr1 knockout mice, and naive wild-type mice (as a control), were trained on the task. When they showed proper discrimination, we took in-vivo electrophysiological recordings to measure the local field potentials (LFPs) and single-unit responses for the different stimuli-reward pairings. Our results will better examine how the theta oscillations are utilized during memory encoding and recall. Furthermore, the results from this study will better clarify the learning deficits present in ASDs, such as sensory processing issues and weak executive control, and could provide a new avenue for potential future therapy.

Keywords: Fragile X Syndrome; Theta Oscillations; Visual Cortex; Go/No-Go Task

Mentor(s):

Michael Paul Zimmerman (Engineering)

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

Talk Presentation Abstract Number: 7072
Presentation Time: Grissom 118 at 2:00-2:20

SURF

In-vitro Assessment of Patient-Specific Cerebral Aneurysm Models for Hemodynamic Analysis using Particle Image Velocimetry and 4D Flow MRI

Life Sciences

Author(s):

Kara Rochelle McCrindle† (Engineering)

Abstract:

A significant challenge for clinicians dealing with unruptured intracranial aneurysms is assessing the risk of rupture against the risk of operation. Many factors can influence aneurysm formation, growth, and rupture, but accurate risk assessment is complex, with specific mechanisms still unknown. Hence, there is a need for in vitro cerebral aneurysm phantoms that mimic patient-specific geometry and conditions. Small sample sizes and a lack of diverse and comprehensive measurements have limited previous studies on aneurysm hemodynamics. Our research aims to fabricate box models for seven internal carotid artery (ICA) aneurysms at two time points to address these limitations. The dataset includes four stable aneurysms and three growing aneurysms. The fourteen models are created by 3D printing patient-specific geometries using acrylonitrile butadiene styrene (ABS) filament, constructing acrylic boxes, and casting vascular replicas with polydimethylsiloxane (PDMS). Particle image velocimetry (PIV) and 4D flow magnetic resonance imaging (MRI) are used to obtain flow data to analyze the wall shear stress (WSS) in both stable and growing aneurysms. Once the flow profiles are obtained for all models, linear regression and student t-test will be used to assess significant differences both temporal and across groups. This data can help study the mechanisms of aneurysm growth and improve clinical rupture risk evaluations. Additionally, the dataset can aid MRI data harmonization and PIV/MRI velocity reconstruction for future aneurysm research.

Keywords: Cerebral Aneurysm; Patient-Specific Modeling; Particle Image Velocimetry; 4D Magnetic Resonance Imaging; Hemodynamics

Mentor(s):

Hyeondong Yang (Engineering); Rudra Sethu Viji (Engineering); Brett A Meyers (Centers & Institutes); Pavlos Vlachos (Centers & Institutes)

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

Talk Presentation Abstract Number: 7073
Presentation Time: Grissom 118 at 2:20-2:40

SURF

Leveraging Real-Time Eye Tracking Metrics to Infer Cognitive States During Automated Driving

Mathematical/Computation Sciences

Author(s):

Tyler Harrison Hsieh† (Engineering|JMHC)

Abstract:

Understanding how humans interact with automated systems such as autonomous cars is key to reduce disuse and misuse of such systems. Our research aims to study cognitive factors critical to human decision making, namely, Trust, Risk-Perception, and Mental Workload, when interacting with conditionally automated vehicles. There is little to no literature examining real-time changes in users' cognitive factors in response to different operating conditions during automated driving. Further, psychophysiological measures used to infer these states provide real-time continuous measurements, but are hard to interpret and suffer from involuntary physiological processes. We address this challenge by including eye-gaze based metrics to our measurements such as area of interest fixation identification and individual pupil diameter. Eye-tracking glasses and April Tags integrated into the driving simulation provide eye-gaze and pupillometry data that can be viewed in real time by researchers. A graphical user interface (GUI) will provide visualization through an interactive design, to clearly convey contextual information which can be used to infer some cognitive factors. This tool serves to aid researchers in validating hypotheses and providing additional insight into participant behavior in real-time. Further, unlike psychophysiological measurements, eye-gaze fixations measured in real-time suffer minimal noise due to physiological processes, and may not require inter-participant normalization. This lends itself well to autonomous vehicle usage in industry, since unobtrusive eye-tracking cameras operate in similar capacities to eye-tracking glasses and already have been implemented for basic human response detection such as drowsiness detection.

Keywords: Human-Machine Interaction; Autonomous Driving; Control-Oriented Modeling; Eye Tracking

Mentor(s):

Sibibalan Jeevanandam (Engineering); Neera Jain (Engineering)

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

Talk Presentation Abstract Number: 7074
Presentation Time: Grissom 118 at 2:40-3:00

SURF

Forecasting 2024 U.S. elections

Mathematical/Computation Sciences

Author(s):

Joseph Michael Cromp† (Science); Thanmaya Pattanashetty‡ (Science)

Abstract:

Forecasting elections is an exciting, yet complicated, endeavor that is often scrutinized by the public. Additionally, the methods of popular forecasters are not always fully transparent, making it difficult to understand their methods. Our research aims to accurately forecast the 2024 U.S. presidential, senatorial, and gubernatorial elections and share our results with the public. We use a Susceptible-Infected-Susceptible model to track interactions between Democratic, Republican, and undecided voters. Using polling data, we produce ten thousand possible election-night scenarios that make up our forecasts. In past election cycles, this method performed as well as major forecasters such as Sabato’s Crystal Ball and FiveThirtyEight. To improve our future forecasts, we are also analyzing information about the polls that we use such as their sample size and associated polling organization. Using the results of our analysis, we will tweak our methods to improve our forecasts’ accuracy. The final focus of our project is to visualize uncertainty by posting our forecasts and interactive tools on our website (https://c-r-u-d.gitlab.io/2024/) in the months leading up to Election Day 2024.

Keywords: Mathematical Modeling; Forecasting Elections

Mentor(s):

Alexandria Volkening (Science)

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

Talk Presentation Abstract Number: 7075
Presentation Time: Grissom 125 at 2:00-2:20

Superconducting Diode Effect in Two-dimensional Topological Insulator Edges and Josephson Junctions

Physical Sciences

Author(s):

Haixuan Huang† (Science)

Abstract:

The superconducting diode effect -- the dependence of critical current on its direction -- can arise from the simultaneous breaking of inversion and time-reversal symmetry in a superconductor and has gained interest for its potential applications in superconducting electronics. In this presentation, we discuss the effect in a two-dimensional topological insulator (2D TI) in both a uniform geometry as well as in a long Josephson junction. We show that in the presence of Zeeman fields, a circulating edge current enables a large non-reciprocity of the critical current. We find a maximum diode efficiency 1 for the uniform 2D TI and (\sqrt{2}-1)^2 \approx 0.17 for the long Josephson junction.

Keywords: Superconducting Diode Effect; Topological Insulator; Josephson Junction

Mentor(s):

Jukka Ilmari Vayrynen (Science); Tatiana de Picoli Ferreira (Science)

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

Talk Presentation Abstract Number: 7076
Presentation Time: Grissom 125 at 2:20-2:40

Characterizing the role of histone variant H2A.Z in heat-responsive gene expression in Arabidopsis thaliana

Life Sciences

Author(s):

Shelby Sliger† (Agriculture|JMHC)

Abstract:

[Abstract Redacted]

Keywords: Epigenetics; Plants; Chromatin; H2A.Z; H3K27me3

Mentor(s):

Joseph P Ogas (Agriculture); Jiaxin Long (Agriculture); Jacob Ryan Fawley (Agriculture)

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

Talk Presentation Abstract Number: 7077
Presentation Time: Grissom 125 at 2:40-3:00

Compost Bin Monitoring Through IoT

Innovative Technology / Entrepreneurship / Design

Author(s):

Nicolas Rendon Arias†; Sehyeon Lim†; Nicolas Miguel Murillo Cristancho†

Abstract:

This project takes advantage of recent advances in IoT (Internet of Things) and off-the-shelf sensors to enhance agricultural land management and composting practices. By integrating real-time data collection, analysis, and automation, the project aims to improve sustainable agricultural practices, optimize resource utilization, and reduce waste. Key parameters such as temperature and composting conditions (CO2, ammonia, and pH) are continuously monitored using LoRaWAN radio technology and electronic sensors, enabling precise decision-making and enhanced compost quality.

The implementation of the LoRaWAN network is a key aspect of the development process of our system as it allows sensor monitoring over long distances. Our system also includes a web-based dashboard that is easy to use, facilitating access to users of different backgrounds. The project contributes to a greener future where sustainable land management and waste reduction are prioritized.

Furthermore, this project underscores the significant social impact. By deploying these modern technologies in rural areas of Peru, we want to improve the quality of life for local communities, providing them with the tools to adopt sustainable practices, enhance their productivity, and measure their practices in a precise way that can help them make decisions for their land management.

Keywords: Sustainability; Composting Prototype; Internet of Things; Agricultural Sensors; Wireless Communication

Mentor(s):

Walter Daniel Leon-Salas (Polytechnic)

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

Talk Presentation Abstract Number: 7078
Presentation Time: Grissom 126 at 2:00-2:20

Colombian Research Scholars Program

Research nuclear reactor PUR-1: Anomaly detection using machine learning

Innovative Technology / Entrepreneurship / Design

Author(s):

Julian Mauricio Cruz Rojas†

Abstract:

Anomaly detection is a critical issue in nuclear applications, with the potential to save millions of dollars and countless working hours. The development of a reliable and intelligent anomaly detection tool would allow nuclear reactor operators to prevent possible reactor shutdowns and health hazards. AI technologies are strong candidates for this task, however, due to the inherent difficulty of obtaining abnormal data coming from a nuclear reactor, the effectiveness of these technologies on real data remains uncertain. In this work, data measured from the research nuclear reactor PUR-1, along with synthetically created abnormal data, was used to study the performance of a set of data-driven supervised learning machine learning models in anomaly detection tasks. Among the used algorithms (SVM, Logistic Regression, Decision Trees, Random Forest, Naive Bayes), Random Forest obtained the best F1-Score when trained on abnormal data generated by two methods: the addition of Gaussian noise, and the alteration of a signal to exhibit unexpected exponential behavior. Finally, models were tested in out-of-domain data. It was observed that the addition of Gaussian noise failed to produce clear differences between normal and abnormal data for instances from steady-state operations above 88 % power output, leading models to predict all data as normal. Conversely, with abnormal data from exponential alteration, all models achieved an F1-Score above 0.99 when tested on out-of-domain data, demonstrating strong detection capabilities in this scenario. The results of this study serve as a proof-of-concept for the use of machine learning techniques in anomaly detection for nuclear reactors.

Keywords: Machine Learning; Anomaly Detection; Nuclear Reactor; Supervised Learning

Mentor(s):

Stylianos Chatzidakis (Engineering)

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

Talk Presentation Abstract Number: 7079
Presentation Time: Grissom 126 at 2:20-2:40

Colombian Research Scholars Program

Knowledge Representation Trends in Midwestern Community Food Maps

Innovative Technology / Entrepreneurship / Design

Author(s):

William David Quintero Gallego†

Abstract:

Regional food systems include farms, food processors, and a range of food infrastructure critical to community resilience. Understanding the complexities of food systems is crucial for addressing issues such as food security, sustainability, and accessibility. Community food maps are created to provide people with targeted food information: for instance, where to find low-cost or affordable food, when to find seasonal and locally produced food, or how to participate in novel or interesting food experiences. While many mapping methodologies to enable co-production of local food maps and mapping technologies have improved to enable dynamic content management, we argue that community food maps vary widely in quality, relevance, and accuracy, especially accessibility for food insecure map users. Despite the growing number of community food maps, there is a gap in the literature concerning how and why food maps are created, including the mapping content, key features, and the data and technologies used. To address this gap, we conducted a content analysis of 39 community food maps in 5 Midwestern States (Illinois, Indiana, Michigan, Kentucky, and Ohio). The dataset of community food maps was curated via a systematic Google Search, using the keyword "[State Name] food map" with a set of inclusion and exclusion criteria. The maps have been analyzed using a coding protocol to elicit key features in the map and data sources. Our goal is to provide insights into the reasons for developing these maps and what can be learned from these projects to create better maps in the future.

Keywords: Food Systems; Content Analysis; Knowledge Representation; GIS; Maps

Mentor(s):

Ankita Raturi (Engineering); Megan Mei Yee Low (Engineering)

Other Acknowledgement(s):

Juan D Velasquez De Bedout

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

Talk Presentation Abstract Number: 7080
Presentation Time: Grissom 126 at 2:40-3:00

VIP

Implementing Compressed Instructions in a RISC-V Microcontroller

Mathematical/Computation Sciences

Author(s):

Abhijay Achukola† (Engineering); Aniket Chatterjee† (Engineering)

Abstract:

In microcontroller architecture, the ability to store more programs or more instructions allows for more functionality and more complex programs to better operate on microcontrollers. We implemented the C, or compressed instruction, extension in the RISC-V core, including some instructions that do not have 32-bit equivalents, such as push and pop instructions as well as table jump instructions which fall under the Zcmp and Zcmt subsets of the C extension. The new instructions added provide valuable utility to developers as the push and pop instructions allow saving register values before and after a function call and table jump instructions allow for things such as the creation of a vectored interrupt table for better interrupt handling in the microcontroller. While other compressed instructions were simply implemented by converting them to their 32-bit equivalents, these instructions had to be tackled differently as multiple 32-bit instructions were needed to implement one 16-bit instruction. This was done by using a ROM to store a database of 32-bit instructions that each of these new 16-bit instructions decode into and using a state machine to send the correct 32-bit instructions while stalling the fetching of the next instruction until the 16-bit instruction has been fully processed. To implement and verify that that the C extension works with the existing core, SystemVerilog was used as the HDL and Verilator was used for simulation. Custom RISC-V assembly test cases were also written to test and verify the new compressed instructions implemented operate as intended.

Keywords: RISC-V; Instruction Sets; CPU Architecture

Mentor(s):

Mark Johnson (Engineering); Maxwell Frank Michalec (Engineering); Cole Aaron Nelson (Engineering)

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

Talk Presentation Abstract Number: 7081
Presentation Time: Grissom 133 at 2:00-2:20

SURF

Cross-Species Analysis of Computational Laparoscopic Video Segmentation and Classification

Innovative Technology / Entrepreneurship / Design

Author(s):

Farren M Martinus† (Engineering)

Abstract:

Deep learning models have the potential to augment laparoscopic surgery by overlaying segmented images onto the surgical field or providing real-time performance evaluations. Most existing research in the field of laparoscopic image analysis uses retrospective human data. With regard to prospective model evaluation and clinical translation, it is currently unknown to what extent computational models for laparoscopic image analysis trained on human data are transferable to data from large animal surgeries and vice versa. In this project, we are investigating the cross-species validation of laparoscopic image analysis models. Specifically, two laparoscopic image analysis models will be tested for their cross-species validity: a Convolutional Long Short-Term Memory (ConvLSTM) model for surgical tool detection and segmentation, and a Transformer-based segmentation model for organs and anatomical structures. For the surgical tool tracking model, public human (Cholec80) and porcine (Endoscopic Vision Challenge 2017) datasets are utilized. The anatomical segmentation and classification model will be tested using human and porcine datasets from the Dresden Surgical Anatomy Dataset (DSAD) and the Endoscopic Vision Challenge 2018, respectively. Effectiveness will be measured qualitatively through visual analysis of segmented video feeds and quantitatively using accuracy, precision, F1 score, recall, intersection over union (IOU), and mean average precision (mAP). In conclusion, we envision this work will provide an understanding of the relevance of animal testing for human applications and improve veterinary practices with AI tools developed on more abundant human data.

Keywords: Deep Learning; Laparoscopy; Cross-Species

Mentor(s):

Fiona Kolbinger (Engineering)

Other Acknowledgement(s):

Muhammad ibtsaam Qadir

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

Talk Presentation Abstract Number: 7082
Presentation Time: Grissom 133 at 2:20-2:40

SURF

Flexible Mechanical Sensors

Innovative Technology / Entrepreneurship / Design

Author(s):

Paul A Loughlin† (Engineering)

Abstract:

Programmable soft metamaterials introduce new opportunities to leverage geometrical nonlinearities, enabling adaptability, shape morphing, and mechanical computing. These metamaterials offer an alternative approach for controlling soft robotics, mechanical information processing, signal filtering, and tactile sensing, driven by the mechanical response of the structure rather than a traditional computer. Metasheets composed of repeating dome units have garnered interest due to their capabilities, such as exhibiting different energy minima, inversion path dependency, multiple global stable shapes, and shape-changing properties. In this work, we explore a class of multistable metastructures composed of repeating dome units that enable strain amplification and sensing. We achieve this by combining soft materials, Thermoplastic Polyurethane (TPU), with conductive Polylactic Acid (PLA) filaments, which facilitate strain field amplification and measurement using stress produced by dome inversion. We utilize Fused Deposition Modeling (FDM) 3D printing to embed the sensor into the structure, ensuring reliable and consistent measurements. Various sensor geometries and locations are used to address two main hurdles encountered during the manufacturing process. First, we mechanically couple the TPU and PLA, which do not meld together, to produce a uniform membrane. Second, we relocated the sensors from the top of the sheet to the underside to improve printing quality. Additionally, we examine the proximity of the sensor to the dome units to prevent sensor failure due to high stresses, ensuring more reliable and consistent measurements. By solving these issues, full-scale testing can be conducted with a sheet of domes with embedded sensors, allowing for strain measurements across the entire metasheet surface and potentially distinguishing between different external forces.

Keywords: Mechanical Sensing; Flexible Sensors; Bistability

Mentor(s):

Juan Camilo Osorio Pinzon (Engineering)

Other Acknowledgement(s):

Jhonatan Steven Rincon Angarita; Andres Arrieta Diaz

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

Talk Presentation Abstract Number: 7083
Presentation Time: Grissom 133 at 2:40-3:00

SURF

Development on Intensified Pharmaceuticals Manufacturing Processes

Author(s):

Urvi Mathur† (Engineering)

Abstract:

Process Intensification is the development of apparatus and methods that can lead to significant improvements in the manufacturing processes by reducing the equipment, waste, and cost footprint. During the pandemic, the challenge of affordable and sustainable healthcare was amplified and continues to persist even after. Hence, there is a dire need for Process Intensification in the pharmaceutical industry. The research consists of API case studies: the modular continuous synthesis and isolation of Lomustine and the optimization of Retosiban crystallization amongst impurities. Lomustine is an orphan oncology drug. The goal is to intensify the process by designing a modular continuous and small-scale manufacturing rig for Lomustine, reducing its footprint while increasing throughput. The goal for Retosiban is to reduce the waste footprint of its manufacturing process and optimize by digital twin development. The research framework relies on the corroboration of wet experiments with the digital design of the processes. To collect and analyze the results, Process Analytical Technology (PAT) such as Ultra Performance Liquid Chromatography (UPLC) will be used. Solubility curves developed from digital design twin will be fitted to the data collected from wet experimentations. With the help of parameter estimation, the digital model can be advanced to have a realistic approach that will further allow optimization. This research represents the framework for process intensification of API. Limited studies focus on the integration of the digital design twin with the experimentation results that optimizes continuous-flow-processes for API. Hence, this study can be utilized for optimization of such API.

Keywords: Process Intensification; Pharmaceuticals; Crystallization; Digital Design Twin; Process Analytical Technology

Mentor(s):

Zoltan Nagy (Engineering)

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

Talk Presentation Abstract Number: 7084
Presentation Time: Grissom 103 at 3:00-3:20

SURF

Investigating the effects of ciclopirox and its derivatives on urothelial and renal cell carcinomas

Life Sciences

Author(s):

Abigail Hyejin Lee† (Science|JMHC)

Abstract:

As drug discovery is known to be a labor, time, and cost-intensive process, computational drug repurposing provides a promising approach for identifying new applications of existing therapeutics. From a large-scale *in silico* drug screening, our lab has identified ciclopirox (CPX), an FDA-approved antifungal agent, as a top candidate for treating urothelial and renal carcinomas. CPX has previously demonstrated anti-tumor activity against other cancers through an iron chelation mechanism, however, its clinical application has been hampered by a limited half-life *in vivo* and low aqueous solubility. To mitigate these shortcomings, we developed the novel modified CPX-1 (mCPX-1) prodrug, which has structural modifications to improve both solubility and resistance to iron-mediated inactivation. Thus, this study investigates how mCPX-1 impacts cancer cell proliferation and provides resistance to iron-mediated inactivation *in vitro* as compared to conventional CPX and existing CPX prodrugs. Canine urothelial and human renal cancer cell cultures were first treated with CPX and selected prodrugs in the presence or absence of iron. Relative cell proliferation was then quantified with a Cell Counting Kit (CCK8) assay. Additionally, the impact of CPX on the activation of pathways associated with proliferation, such as the Wnt/β-catenin and Myc pathway, was determined using western blot. Results suggest that mCPX-1 exhibits the most potent anti-tumor activity and greatest resistance to iron-mediated inactivation in both urothelial and renal cancer cells. These findings provide insights on the activity, stability, and mechanism of CPX, and may support future exploration of mCPX-1 for *in vivo* animal models and ultimately human clinical trials.

Keywords: Drug Repurposing; Ciclopirox; Urothelial carcinoma; Renal Carcinoma; Cell Proliferation

Mentor(s):

Yuxin Zhuang (Agriculture); Majid Kazemian (Science)

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

Talk Presentation Abstract Number: 7085
Presentation Time: Grissom 103 at 3:20-3:40

SURF

Solution-Phase Intercalation of Metal Atoms into MoS2

Physical Sciences

Author(s):

Yiyin Tao† (Science)

Abstract:

Two-dimensional layered materials are known for their flexible bandgap and great structural tunability. They are great candidates for semiconductors, optical materials, and catalysts. Intercalation is a method of tuning the structure of the layered material. Transition metal ions intercalation are driven by charge transfer and their redox activity, enabling the phase engineer on host material. However, Due to the different reduction potentials, charges, and sizes of metal precursors, side reactions such as secondary nucleation, metal oxides, and etched host materials also occur. In previous studies, systematic intercalation conditions have been done on WS2, in which we found the reaction and side products can be controlled by charge density and reduction potential. In this paper, we performed a systematic study on LixMoS2 to study the trends in intercalation and following structural changes. Reaction was driven by charge density and reduction potential; metal precursors with low charge density result in secondary nucleation and metal precursors with high charge densities etch the sheets potentially. After intercalation, we observed that the structure of MoS2 shifts from 2H semiconducting phase to 1T metallic phase which can be used as a catalyst. HER measurements showed that intercalated MoS2 nanosheets are catalytic active.

Keywords: Two-Dimensional Material; Initercalation; Metal

Mentor(s):

Christina W Li (Science)

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

Talk Presentation Abstract Number: 7086
Presentation Time: Grissom 103 at 3:40-4:00

SURF

Effect of artificial light at night (ALAN) and traffic noise on anuran communication

Life Sciences

Author(s):

Jabez Soongeui Shin† (Science); Adriana Bustos Torres‡ (Science)

Abstract:

Urbanization is a major cause of landscape transformation worldwide and exposes organisms to novel sensory pollutants. Artificial light at night (ALAN) and traffic noise are persistent threats to animals that rely on acoustic communication at night, interfering with the detection and perception of sexual signals. Ultimately, ALAN and traffic noise can negatively affect the mating behavior and reproduction across taxa. Studies have investigated these sensory pollutants independently, but their combined effects are unclear even though they often occur simultaneously. Here, we studied the independent and combined effects of ALAN and traffic noise on anurans, a nocturnal group that relies on acoustic signals for reproduction. We examined how these sensory pollutants affect the activity patterns in mixed-species aggregations and individual male calling behavior. To do so, we broadcast ALAN, traffic noise, or both combined at choruses and individual males while recording their calls before-, during, and post-exposure. Both sensory pollutants independently alter the number of individuals calling per species, resulting in fewer species calling in choruses. When combined, ALAN and traffic noise seem to have a stronger effect. Male Gray treefrogs seem to alter their call properties in the presence of ALAN and traffic noise independently and combined. While both pollutants affect calling behavior, ALAN may have a longer-lasting impact on frog choruses and individuals. Our work generally reveals changes in calling behavior and chorus structure elicited by ALAN and traffic noise. These effects of combined sensory pollutants need further investigation to understand and predict their impacts on biodiversity.

Keywords: Sensory Pollutants; Mating Behavior and Reproduction; Mixed-Species Aggregations; Choruses; Anurans

Mentor(s):

Ana Maria Ospina Larrea (Science); Ximena Bernal (Science)

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

Talk Presentation Abstract Number: 7087
Presentation Time: Grissom 118 at 3:00-3:20

SURF

Mycoponics: Advanced hydroponics technology for production of mycelial leather

Innovative Technology / Entrepreneurship / Design

Author(s):

Simone Xin Moulton† (Engineering|JMHC); Adriana K Sanchez* (Polytechnic)

Abstract:

The environmental and ethical concerns of the bovine and synthetic leather industries have highlighted a need for sustainable alternatives in leather textile production. Fungal leather (i.e. Mycoleather) has emerged as a promising solution due to its material similarity to traditional leather, biodegradability, low carbon footprint, and versatile methods of production. This study aims to investigate the impact of substrate type, growth system design, and product post-treatment on the manufacturability of mycoleather. This will be achieved by recreating the results of industry-leading mycoleather production processes and developing novel growth system technologies able to fulfill the market requirements. Fungal sheets are grown using two methods: solid granular substrates and Mycoponics™. The first method involves inoculating a solid substrate (e.g. sawdust) with liquid mycelium culture, to create a mycelium mat, which is overlaid with a porous material (e.g. cotton) for embedment and enhancing material durability and flexibility. Mycoponics™, a liquid-based cultivation technique, on the other hand, delivers liquid nutrients through bioengineered porous ceramic elements, eliminating the need for granular solid substrates. Post-harvest, the mycelial mats involve physical and chemical treatment to improve strength, flexibility, and water resistance. Properties and product quality are measured by mechanical, optical, thermal and physicochemical properties. Measured values are then compared to industry standard values for cowhide leather (e.g tensile strength: > 8.0 MPa, elongation 10-80%, tear stress: > 20 N). These results will contribute to the understanding of fungus-based bioregenerative engineering and provide foundation for expansion and diversification of production processes in sustainable materials manufacturing.

Keywords: Mycoponics™; Sustainability; Leather; Bioregenerative; Fungus

Mentor(s):

Alexander Baena (Engineering); D. Marshall Porterfield (Agriculture)

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

Talk Presentation Abstract Number: 7088
Presentation Time: Grissom 118 at 3:20-3:40

SURF

Novel Low-Bandgap Perovskites for Solar Cells Using a Computational and Experimental Approach

Physical Sciences

Author(s):

Anika Bhoopalam† (Engineering|JMHC)

Abstract:

The development of new materials for low-cost and efficient solar cells has gained traction in the past few decades. One of these promising classes of materials is called perovskites. In addition to research efforts into new materials, recent efforts include exploring new structures such as tandem solar cells, which contain solar absorbers of various bandgaps to capture more of the solar spectrum. The goal of this project is to develop new low-bandgap (below 1.1 eV) perovskite solar absorber materials with the overarching goal of incorporation into tandem solar cells. To achieve this goal, computational and experimental methods are employed. The computational methods include analysis of machine learning (ML) model results as well as the use of density functional theory (DFT). The ML model was trained on a combination of experimental and computational perovskite results in a specific chemical space. The compounds predicted to be stable and display a low-bandgap were chosen for further analysis with DFT. DFT is a first-principles computational method that can accurately calculate material properties. The candidates from the ML model were analyzed with DFT. DFT gave detailed information about the band structure and stability of chosen compounds. Compounds that were predicted to have desirable thermodynamic and electrical properties were tested experimentally using thin film studies. From the film studies, the real-life bandgap and stability could be determined. In the end, promising low-bandgap compounds were identified and in the future, they could be fabricated into solar cells to see their performance in a real device.

Keywords: Perovskite; Thin Film; DFT

Mentor(s):

S S M Tareq Hossain (Engineering); Letian Dou (Engineering); Arun Kumar Mannodi Kanakkithodi (Engineering)

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

Talk Presentation Abstract Number: 7089
Presentation Time: Grissom 118 at 3:40-4:00

SURF

Enhancing Human Psychomotor Learning Through Real-Time Cognitive Feedback

Innovative Technology / Entrepreneurship / Design

Author(s):

Albert Li†

Abstract:

Simultaneous demand for synchronized cognitive and motor activity makes learning to operate multirotor systems, such as drones, tedious and challenging for humans. To address this, the objective of this research is to optimize the learning process for novice drone pilots by developing a physical brain-computer interface that dynamically increases the difficulty of a simulated drone landing task based on participants' cognitive workload in real time. This system utilizes functional near-infrared spectroscopy (fNIRS), a noninvasive neuroimaging technique that measures cognitive load through cortical hemodynamic activity. As participants become more proficient at the task, our system gradually removes computer-assisted controls corresponding to the user's decrease in cognitive workload. This process incrementally increases the difficulty of the task, with the end goal of achieving full manual control by the user and successful performance of the simulated landing task within an hour-long training session.

Future pilot studies will be conducted to evaluate the effectiveness of cognitive load measurements as a psychophysiological method to enhance motor learning for novice drone pilots. The performance of novice participants using our system will be compared against those learning to perform the task completely manually. Ultimately, we aim to translate this technology to real drones, enhancing training protocols and operational efficiency for novice pilots in real-world scenarios.

Keywords: Brain-Computer Interface; Functional Near-Infrared Spectroscopy; Cognitive Learning Theory

Mentor(s):

Neera Jain (Engineering); Jacob Grant Hunter (Engineering)

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

Talk Presentation Abstract Number: 7090
Presentation Time: Grissom 125 at 3:00-3:20

Evaluation of Ketamine's Prosocial Effects in Scn2a-deficient Mice

Life Sciences

Author(s):

Rineet Ranga† (HHS); Akila Abeyaratna‡ (Agriculture|JMHC)

Abstract:

Autism spectrum disorder (ASD) is a neurodevelopmental disorder affecting 1 in 36 children, characterized by deficits in social communication and interaction. SCN2A, a gene encoding a sodium ion channel (Nav1.2), has been identified as one of the leading monogenic causes of ASD. Our lab has characterized a novel mouse model of SCN2A deficiency, which recapitulates many of the phenotypes seen in ASD patients, such as social deficits. Ketamine, an N-methyl-d-aspartate (NMDA) receptor antagonist, has recently been evaluated as a therapeutic in autistic children, showing significant improvement in social communication and social withdrawal. Ketamine also increases serotonin release in major brain regions affected in ASD, like the prefrontal cortex. Using the Three-chamber assay, we aim to determine if acute injections of ketamine produce prosocial effects in Scn2a-deficient mice. To better understand through which receptors ketamine could be eliciting its prosocial effects, 7-Cholrokynuric acid, an NMDA receptor antagonist, as well as CP-94, 253, and Psilocybin, 5HT1B and 5HT2A receptor agonists were evaluated.

Keywords: Ketamine; Social Deficits; Autism Spectrum Disorder; Psilocybin; SCN2A

Mentor(s):

Brody Alan Deming (Pharmacy)

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

Talk Presentation Abstract Number: 7091
Presentation Time: Grissom 125 at 3:20-3:40

Bumblebee: A self-supervised transformer model to learn top quark decay at the Large Hadron Collider

Mathematical/Computation Sciences

Author(s):

Jack Patrick Rodgers† (Science|JMHC)

Abstract:

As deep learning methods and particularly Large Language Models have shown huge promise in a variety of applications, we attempt to apply a BERT (Bidirectional Encoder Representations from Transformers) model developed by Google utilizing the infamous multiheaded attention mechanism to a high energy physics problem. Specifically, we focus on the process of top quark-anti top decay reconstruction and demonstrate that the model can learn the decay chain and kinematics with high accuracy via self-supervised learning. The learned decay information can be adapted to downstream tasks such as mass and spin correlation variables reconstruction that are crucial for studying top quark entanglement and search for top/anti-top bound states in high energy collisions. Using decay kinematics that would be reconstructed by the detector at CMS, we tokenize, mask, and take it as input into the model to find the “next” tokens, which we treat as the generated or truth kinematics. As a result, the model learns to effectively “translate” the kinematics measured by the detector at CMS to the true kinematics of the ttbar decay with a preliminary result of 30% improvement in the target region of 340-350 GeV and a 0.95 AUROC score in discrimination from the bound state toponium. In further studies, we hope to increase the scale of this tool and explore its practical applicability in the detector at CMS for reconstruction, as the model can easily be applied to any decay process which gives it huge potential for future studies in the high energy domain.

Keywords: Deep Learning; Transformer; Physics

Mentor(s):

Miaoyuan liu (Science); Andrew James Wildridge (Science); Ethan Michael Colbert (Science); Yao Yao (of Science)

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

Talk Presentation Abstract Number: 7092
Presentation Time: Grissom 125 at 3:40-4:00

Indiana Economic Development and Supply Chain Leakage Reduction

Social Sciences / Humanities / Education

Author(s):

Daniel Camilo Puentes Rodriguez†; Kely Johanna Monroy Malagon†

Abstract:

The Dauch Center and the Purdue Center for Regional Development (PCRD) are spearheading a project to create a comprehensive online marketplace aimed at fostering commercial relationships within the state of Indiana. This website will provide companies with access to essential information to help them establish connections with local suppliers. By utilizing this platform, businesses looking to set up operations in Indiana can easily identify and engage with companies that meet their supply chain needs.

The team has gathered extensive data from various databases. Purdue University students have played a crucial role in this endeavor, conducting thorough research to compile the necessary information. This extensive data collection has paved the way for the creation of dynamic dashboards using Power BI.

The development process involved four key steps: analyzing the collected information, designing visualizations to present relevant data, implementing these designs in Power BI, and thoroughly testing the dashboards to ensure their functionality. The implementation phase required creating numerous data connections.

The resulting dashboard divides the state of Indiana into 11 regions, further segmented into counties. Users can filter information by region, company type, products, services, and other criteria, making it easier to locate potential business partners. This tool is expected to significantly enhance the ability of companies to establish and strengthen commercial relationships within Indiana.

Keywords: Supply Chain; Data Connections; Commercial Relationships; Local Suppliers; Regional Development

Mentor(s):

Dutt Jagdish Thakkar (DSB)

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

Talk Presentation Abstract Number: 7093
Presentation Time: Grissom 126 at 3:00-3:20

DUIRI

Machine Learning Approaches to Predict Protein-Protein Interactions through Electrostatic Potential Mapping

Life Sciences

Author(s):

Olaoluwa Adegbohungbe† (Science|JMHC); Ryan Thomas Jordan‡ (Engineering|JMHC)

Abstract:

[Abstract Redacted]

Keywords: Protein-Protein Interactions; Machine Learning; Electrostatic Potential

Mentor(s):

Tonglei Li (Pharmacy)

Other Acknowledgement(s):

Koushiki Basu

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

Talk Presentation Abstract Number: 7094
Presentation Time: Grissom 126 at 3:20-3:40

DUIRI

SAI: Integrating Cognitive, Social, and Engineering Principles for Large-scale Planning of Public Charging Infrastructure

Mathematical/Computation Sciences

Author(s):

Meghna Swaminathan† (Science)

Abstract:

Infrastructural planning of electric vehicle (EV) charging stations is crucial for enhancing user experience and supporting the sustainable growth of EV adoption. A key challenge is the scarcity of charging stations on highways and in urban areas, leading to significant inconvenience for EV users. This research seeks to identify critical variables in users' decision-making process when selecting charging stations.

Our approach involves conducting surveys among diverse populations to gather data on EV charging behaviors and preferences. Participants engage in think-aloud protocols, vocalizing their thought processes while choosing charging stations. This involves creating 50 maps of randomly chosen cities, each with a random start and end point, and two randomly chosen charging stations with different features. The maps provide essential information such as car type, charger type, battery percentage remaining, and the distance and time between points. Participants use this data to decide which charging station they

would use on their way to the destination.

The survey results will be used to understand which variables matter in users' decision-making regarding charging station selection for future experimental studies. We expect this research to yield validated cognitive models of charging station choice behavior, an integrated framework for multi-objective planning, and actionable recommendations for policymakers and stakeholders. These outcomes will support the efficient, equitable, and sustainable expansion of EV charging infrastructure, ultimately enhancing the driving experience for EV users and promoting long-term community well-being.

Keywords: [no keywords provided]

Mentor(s):

Torsten Reimer (Purdue University)

Other Acknowledgement(s):

Juan Pablo Loaiza Ramirez

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

Talk Presentation Abstract Number: 7095
Presentation Time: Grissom 126 at 3:40-4:00

DUIRI

Multi-Agent Collaborative Sensemaking

Mathematical/Computation Sciences

Author(s):

Shreya S Venkat† (Science)

Abstract:

[Abstract Redacted]

Keywords: Human-AI Collaboration; Autogen; Sensemaking; Collaboration Mechanisms

Mentor(s):

Tianyi Li (Polytechnic)

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

Talk Presentation Abstract Number: 7096
Presentation Time: Grissom 133 at 3:00-3:20

SURF

Investigation of Capture Efficiency in Acoustically Enhanced Filtration Systems

Physical Sciences

Author(s):

Kazim Hussain Jafri† (Engineering)

Abstract:

Innovative indoor air filtration systems are required to reduce indoor air pollution. Current high efficiency filtration systems have limitations on capturing particles within the most penetrating size ranges and impose enormous pressure drops. Additionally, the se methods have high energy requirements due to their low operating efficiencies; therefore, new filtration methods need to be investigated. Pretreatment of aerosols using acoustic standing waves have previously been shown to increase rates of gravitational deposition, impaction, interception and other aerosol capture phenomenon through particle agglomeration. The improvements of these capture mechanisms have led to increased capture efficiency of low power air filtration system s. Here, the authors investigate the efficiency enhancements to fiber-based filtration systems through acoustic standing waves placed within immediate proximity of the filter. Polystyrene latex particle spheres ranging from 0.2 to 2 ?m were aerosolized and sprayed into a bench-scale setup . An acoustic radiating plate and ultrasonic transducer were placed immediately preceding a MERV filter. Particle concentrations were measured upstream and downstream of the filter . The authors hypothesize results from this experiment will indicate that filter efficiency increases when acoustic standing waves are introduced. This paper demonstrates the increase in capture efficiency of MERV filters due to acoustically enhanced streaming forces and fluid particle interaction with close proximity to fiber media in energy efficient air filtration systems.

Keywords: [no keywords provided]

Mentor(s):

David Warsinger (Engineering)

Other Acknowledgement(s):

Sudharshan Anandan

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

Talk Presentation Abstract Number: 7097
Presentation Time: Grissom 133 at 3:20-3:40

SURF

Pharmacokinetic and Pharmacodynamic Assessment of Tigecycline Treatment for Nontuberculous Mycobacterium Infections

Mathematical/Computation Sciences

Author(s):

Tyler S Dierckman† (Engineering|JMHC)

Abstract:

Nontuberculous Mycobacteria (NTM) are found throughout the environment, but in immunocompromised individuals, they can cause severe infections requiring antibiotic treatment for a year or more. Treatment regimens for many NTM strains are not well standardized and rely on expert opinion rather than empirical data. Our research integrates pharmacokinetic (PK) modeling with established pharmacodynamic (PD) metrics to predict the efficacies of antibiotics in humans against a variety of NTM strains. Tigecycline is one such antibiotic which has shown promise against NTM strains such as M. abscessus in vitro. Prior studies are reviewed to obtain experimentally determined PK parameters including clearance rate constants and volumes of distribution. These parameters, along with dosing, administration route, and mechanism of action, inform the mathematical implementation of the PK model which is solved in MATLAB. The PK model is implemented with random variability to simulate many possible tigecycline concentration time courses that inform efficacy through direct comparison to established therapeutic targets. The percentage of time courses that reach or surpass a therapeutic target is known as the probability of target attainment (PTA). PTAs are calculated and analyzed against corresponding metrics that represent the concentrations of tigecycline necessary to kill different NTMs to determine tigecycline's efficacy against the spectrum of NTM species. Future work includes combining PK models to evaluate the effectiveness of multi-antibiotic treatment strategies to more accurately represent real treatment situations. More complex and detailed PK-PD models may also be implemented, paving the way for comprehensive human clinical studies of proposed antibiotics against NTMs.

Keywords: Nontuberculous Mycobacteria; Pharmacokinetics; Tigecycline

Mentor(s):

Elsje Pienaar (Engineering); Trevor Jaan Shoaf (Engineering)

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

Talk Presentation Abstract Number: 7098
Presentation Time: Grissom 133 at 3:40-4:00

SURF

Simulation-based Single Cargo Drone Stabilization Using Reinforcement Learning

Mathematical/Computation Sciences

Author(s):

Taeha Jeong†

Abstract:

The demand for Unmanned Aerial Vehicles (UAV), commonly known as drones, is exponentially growing worldwide. These machines find utility across diverse sectors, including inspection, monitoring, exploration, product delivery, and military operations. While drones can offer immense potential to benefit humanity, there are challenges that require attention. One significant issue is stabilizing drones in the presence of wind turbulence. As these are unmanned vehicles, the presence of automatic stabilization system is required of them. Previous research has focused on modeling and simulation realistic turbulence data and optimizing travel plans under windy conditions. Building upon the work, this study focused on further improving the existing model by attaching a cargo to the drone. Software tools such as PX4 Autopilot, Gazebo, Robot Operating System (ROS), and Python were used to retrieve, incorporate real-world wind data, and to model a cargo carrying drone. This study extends the previous drone stabilization model to accommodate the additional weight connected to it, impacting the aerodynamics and decision-making processes. Python and other software tools to were used to develop and evaluate a reinforcement model based on drone output and to load the trained model onto the drone for refinement and assessments. Future research will involve modeling different cargo shapes and weights to simulate more realistic environments.

Keywords: UAV; AI; Simulation; Stabilization; Cargo

Mentor(s):

Dengfeng Sun (Engineering); Xiaolin Xu (Engineering)

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

Talk Presentation Abstract Number: 7099
Presentation Time: Grissom 103 at 4:00-4:20

SURF

Using Data-Driven Equation Discovery Algorithms to Show a Nonlinear Schrodinger Equation Description of Atmospheric Blocking

Physical Sciences

Author(s):

Owen T Odney† (Science); William Andrew Messman* (Science|JMHC)

Abstract:

In the atmospheric science community, the phenomenon of atmospheric blocking has defied a consensus on its origins for decades. It is vital to be able to predict and model blocking, as it intensifies normal weather patterns into extreme, drawn-out weather events that create considerable personal and economic danger to communities around the world. Several models attempt to provide an explanation for this phenomenon, including a multiple-scale perturbation approximation of a barotropic vorticity model, yielding a first-order linear Rossby wave solution with a slow-varying amplitude described by a Nonlinear Schrodinger (NLS) equation. This experiment aims to provide evidence for this model as an explanation of atmospheric blocking. To do so, an NLS equation is derived and made into predictive simulation following previous work, and a perfect NLS equation solution dataset is generated. Then, utilizing the nonlinear dynamics equation discovery tool PySINDy and its WeakPDE library, the experiment attempts to confirm the PySINDy algorithm can successfully detect the specific NLS equation from the solution dataset. From there, the PySINDy algorithm can be applied to different atmospheric simulations to find the corresponding NLS equations, and these equations can be compared to block-identifying algorithms to see if strong patterns can be found between the blocks and the NLS equations. Future experiments would attempt to detect the NLS equation from real atmospheric data to prove it can accurately explain atmospheric blocking.

Keywords: Atmospheric Blocking

Mentor(s):

Lei Wang (Science); Ka ying Ho (Science)

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

Talk Presentation Abstract Number: 7100
Presentation Time: Grissom 103 at 4:20-4:40

SURF

Rainwater Stable Isotope Characterization: A First Step Towards Better Understanding Large-Scale Atmospheric Moisture Transport Over South America During a Strong El Niño

Physical Sciences

Author(s):

Valentina Saenz† (Engineering); Bethany Rita Kettleborough* (Science)

Abstract:

Although recognized for centuries, the El Niño Phenomenon now represents more extreme climate events and far-reaching consequences. The Central Andean Western Cordillera, arid and occasionally subject to intense rainfall events, experiences more destructive flooding and landslides as a result. The millions of people in the region not only have very little water for their daily needs but also face the risk of losing everything, including their lives, when El Niño strikes. An enhanced understanding of rainfall patterns can empower communities to implement more efficient strategies for water management and damage mitigation. Stable isotopes are used to trace hydrological processes like rainfall; however, their interpretation in the region is challenging due to its sensitivity to large-scale atmospheric circulation patterns. This research aims to contribute to the improved interpretation of isotopic behavior in the region by expanding the available dataset with characterized rainwater samples collected daily from December 2023 to March 2024 (rainy season) in Arequipa, situated in the Central Andean Western Cordillera of Peru. An LGR water isotope analyzer will be used to measure stable isotope ratios of oxygen-18 to oxygen-16 and deuterium to hydrogen-1 (d18O and dD, respectively). Deuterium excess will be calculated to quantify how much a sample deviates from the Global Meteoric Water Line (GMWL), which may indicate additional evaporation or suggest water vapor recycling. Given that various sources of moisture have distinct isotopic signatures, this data will be useful to track how moisture sources and travel paths change and identify fluctuations within El Niño events.

Keywords: El Niño Phenomenon; Central Andean Western Cordillera; Stable Isotopes of Rainfall; Atmospheric Moisture Transport

Mentor(s):

Lisa Welp (Science)

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

Talk Presentation Abstract Number: 7101
Presentation Time: Grissom 103 at 4:40-5:00

SURF

Catchment Chamber Design for the Ballistic Impact of Mesoscale Geo-Materials

Physical Sciences

Author(s):

Maya Araujo† (Engineering|JMHC)

Abstract:

Quartz particles moving at high velocities undergo complex stress states during impact while causing damage, which is pivotal to understand for aircraft engine blade design. During impact, quartz particles undergo fracturing and amorphization, making it very difficult to collect the particles after impact and learn about the impact's effect. To facilitate a greater understanding for quartz particles after collisions, this research aims to design a particle catchment chamber for quartz after impacting a target substrate for post-mortem analysis. The initial portion of this research determined the specifications for a quartz collection chamber and its design. The shape of the collection chamber depends upon the restitution coefficients of quartz and the probabilities of particle fracture at different impact velocities. Considering the high fracture rates and low restitution coefficients for quartz, the most effective chamber types are short in length and minimize sharp corners. A single-stage light-gas particle gun was used to fire quartz particles at an aluminum substrate. Prototype catchment chambers will be tested for their ability to contain post-impact quartz particles. These tests will determine any necessary modifications to the catchment chambers. This research evaluates the properties of a suitable collection chamber for quartz particles after impact. Further work involves determining the dynamic fracture behavior of quartz during ballistic impact.

Keywords: [no keywords provided]

Mentor(s):

Zherui Martinez-Guo (Engineering)

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

Talk Presentation Abstract Number: 7102
Presentation Time: Grissom 118 at 4:00-4:20

SURF

Wireless Sensor Network Deployment in Contested and Denied Undersea Environments

Mathematical/Computation Sciences

Author(s):

Mathias Erik Bock Agerman†

Abstract:

Underwater Intelligence, Surveillance and Reconnaissance (ISR) systems are projected to play an important role in monitoring contested undersea environments, such as maritime choke points. Wireless sensor networks are integral to such systems, tasked with collecting and transmitting data from the environment. Due to the presence of adversaries who may attempt to disrupt communication between sensors and the unique challenges posed by undersea communication channels, there is a need for novel algorithms tailored to the underwater setting. Therefore, this project aims to formulate and solve an optimization problem with the objective of maximizing sensor coverage over a given probability density, indicating where events are more or less likely to occur, while adhering to connectivity constraints. The proposed constrained optimization problem is non-convex and nonlinear, meaning that it is challenging to find a global optimum. However, a gradient descent algorithm was constructed to find locally optimal deployments. Furthermore, simulations using different probability densities were conducted to test the algorithm and display the resulting sensor deployments. The simulations show that the deployed network effectively covers high priority regions while maintaining connectivity. Due to the relative novelty of underwater ISR systems and the lack of existing research thereof, the main conclusions will revolve around the appropriateness of the model with a focus on future research prospects.

Keywords: Wireless Sensor Networks; Underwater Communication; Non-Convex Optimization; Connectivity Constraints; Coverage Optimization

Mentor(s):

Christopher G. Brinton (Engineering); JONGGWANG KIM (Engineering); Shreyas Sundaram (Engineering)

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

Talk Presentation Abstract Number: 7103
Presentation Time: Grissom 118 at 4:20-4:40

SURF

Data-Driven Insights into Enzyme Reaction Catalysis for Green Chemistry

Life Sciences

Author(s):

Adam G Weber† (Engineering)

Abstract:

Biocatalysis, the use of enzymes to catalyze reactions, provides a more specific, sustainable, and efficient method of chemical synthesis to manufacturers. There are approximately twenty thousand enzymatic reactions in our reaction databases and millions of enzymes sequences annotated to these transformations. To produce a desired target compound, human scientists rely on their experience and intuition to select the appropriate enzyme reaction chemistry and its corresponding enzyme sequence candidates. It is difficult for a small group of scientists to have an encyclopedic knowledge of enzyme reaction chemistry. Thus, tools are needed that can identify and suggest biocatalytic synthesis routes for target molecules in an unbiased fashion after considering the entire dataset of ~20,000 enzymatic transformations. This research focuses on the development of such a tool, called RDEnzyme. RDEnzyme utilizes AI/data science to suggest single step retrosynthetic pathways. It does this by identifying potentially evolvable reactions from the large corpus of known enzymatic reactions RHEA. The tool currently provides users with a ranked list of fifty proposed reactions along with scores to measure the reaction’s complexity change and evolvability. Here, we employ this tool to plan synthetic routes towards medicinal compounds, some of which are in FDA's critical shortage list. The result plans set the stage for the development of biocatalytic routes that will lead to more efficient and sustainable manufacturing to alleviate current shortages.

Keywords: Enzyme; Biocatalysis; Retrosynthesis; Data Science; Biological Engineering

Mentor(s):

Karthik Sankaranarayanan (Engineering); Olga Costa Alves Souza (Office of the Provost)

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

Talk Presentation Abstract Number: 7104
Presentation Time: Grissom 118 at 4:40-5:00

SURF

Robust-object-retrieval-via-manipulation

Mathematical/Computation Sciences

Author(s):

Junyoung Kim† (Engineering)

Abstract:

Object retrieval in cluttered confined spaces is a crucial task in robotics, applicable in fields like surgery, inventory management, maintenance, and cleaning. The task presents significant challenges due to the existence of obstacles and the limited workspace in confined settings. In this work, we aim to find and optimize object retrieval plans via obstacle rearrangement while minimizing the moving distance for the robot end effector. Our approach generates different grasp positions on the target object, figures out the corresponding collision objects, and then leverages the customized Monte Carlo Tree Search (MCTS) to rearrange the obstacles before retrieving the target object. The MCTS rearrangement planner generates robot action sequences to relocate obstacles in the areas that do not block the robot's motion to the target object. This goal-focused MCTS strategy balances exploration and exploitation, which as a result finds short robot action sequences efficiently. We plan to compare our method with the SOTA baselines in the simulation environment before deploying it to the real robot to perform real-world object retrieval tasks.

Keywords: Robotics; Object Retrieval; Task and Motion Planning; Artificial Intelligence

Mentor(s):

Ahmed Hussain Qureshi (Science); Hanwen Ren (Science)

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

Talk Presentation Abstract Number: 7105
Presentation Time: Grissom 125 at 4:00-4:20

Creating Programmable Home Radon Measurement

Physical Sciences

Author(s):

Kayla Y. Xu†

Abstract:

Radon naturally occurs in the soil and can seep into homes through cracks and leaks. The alpha particles formed by the decay of radon gas that when inhaled can damage bronchial epithelial cells in the lung that could cause cancer. Radon is the second leading cause of lung cancer behind smoking. The EPA recommends that homes be fixed if the radon level is greater than 4 pCi/L. In Indiana, it is estimated that one in three homes has elevated radon levels. Furthermore, the radon levels at different locations of a home tend to differ significantly. Their values also change a lot throughout the year. Homeowners usually just do a one-time measurement of the radon level at one location which does not capture the overall radon profile of the entire home. Commercial radon detectors are expensive, and the data collected is not accessible or interoperable without programming interface. The present study aims to create an accessible and easy-to-use device to measure radon levels in one’s home and analyze for trends spatially and temporally. To achieve this, the homemade device has to be calibrated and converted from counts of radioactive events to concentrations of radon decay products by analyzing the energy released from decay products. One of the decay products is Rn222, which can be easily measured. Since most homes are affected by ventilation and other outside factors, an equilibrium ratio can be applied to discern the original concentration of radon gas. The results can be used to analyze trends in radon exposure in homes across longer periods of times or create radon exposure maps of homes.

Keywords: Radon; Radiation; Air Quality Monitoring; IoT

Mentor(s):

Richard L Kennell (Centers & Institutes); Ming Qu (Engineering)

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

Talk Presentation Abstract Number: 7106
Presentation Time: Grissom 125 at 4:20-4:40

Evaluating Text/Image to 3D Mesh Models; A Comprehensive Overview

Mathematical/Computation Sciences

Author(s):

Sami Nasser Zagha† (Science); Trent Michael Seaman† (Engineering); Ron K Natarajan‡ (Science); Daniel EnYi Yang‡ (Exploratory Studies); Nihar Pushkar Atri‡ (Science); Dinmukhamed Mukhtar Tynysbay‡ (Science)

Abstract:

[Abstract Redacted]

Keywords: Deep Learning; Generative AI; 3D Models

Mentor(s):

Yung-Hsiang Lu (Engineering)

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

Talk Presentation Abstract Number: 7107
Presentation Time: Grissom 125 at 4:40-5:00

Semi-Supervised Graph Neural Network for Pileup Mitigation

Mathematical/Computation Sciences

Author(s):

Jack Patrick Rodgers† (Science|JMHC)

Abstract:

In the Large Hadron Collider (LHC) at CERN, protons collide more than a million times per second. Pileup, which are interactions in the same or nearby proton bunch crossings in the accelerator, can be thought of as noise which affects many reconstructed physics variables such as the jet mass and jet transverse momentum. This noise results in worse resolution and as a consequence lower physics analysis sensitivity. Furthermore, pileup is expected to increase by a factor of 4 or 5 to be ~200 for the future LHC run that starts until 2029. Currently, an algorithm called PUPPI (Pileup Per Particle Identification) exists to mitigate pileup. A previous proof of concept study that uses a semi-supervised graph neural network for particle level pileup mitigation was tested using CMS fast simulation samples. The idea is to connect the training samples (labeled) and testing samples (unlabeled) as nodes in a graph using tracking and physics information. In addition, a dedicated masking technique was applied to reduce bias. The model was retrained using CMS full simulation which introduced more complexity in geometry and consequently graph neighbor construction. This increase in the complexity of geometry necessitated a more complex masking technique of particle labels. To use hyperparameter tuning in conjunction with these masking parameters, we introduce a bayesian optimization framework that aims to minimize a statistical performance metric of the physics performance observables for validation datasets. The current results from the Semi-Supervised Graph Neural Network outperform the baseline pileup mitigation algorithm PUPPI.

Keywords: Deep Learning; Graph Neural Network; Physics

Mentor(s):

Miaoyuan liu (Science); Garyfallia Paspalaki (Purdue University); Pan Li (Purdue University)

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

Talk Presentation Abstract Number: 7108
Presentation Time: Grissom 126 at 4:00-4:20

DUIRI

Embedding algorithm for D-wave quantum computers

Physical Sciences

Author(s):

Winston Yusong Lin† (Science)

Abstract:

[Abstract Redacted]

Keywords: Quantum Computing; Physics; Graph Theory; Computational Methods

Mentor(s):

Christopher Savion Sims (Engineering)

Other Acknowledgement(s):

Andy Jung

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

Talk Presentation Abstract Number: 7109
Presentation Time: Grissom 133 at 4:00-4:20

SURF

Optimizing Wire Routing in Soft-Growing Robots for Enhanced Performance

Physical Sciences

Author(s):

Ethan Michael DeVries† (Engineering); Mustafa Ugur* (Graduate)

Abstract:

Soft-growing robots excel in navigating complex environments, exhibiting dexterity, passive deformation, and dramatic extension in length. They are ideal for data collection in hazardous environments via cameras and other sensors. However, providing reliable power and data connections throughout the robot is challenging without limiting growth or steering. This research presents a potential solution, helical wire routing, and investigates the impact of this method on soft-growing robot performance. Two tests were conducted: an eversion test, for growth, and a quasi-static bending test, for steering. Variables examined include helix pitch, wire flexibility, number of wires, and wire spacing. Results verify that a straight wire causes a small bending radius in eversion, leading to skewed growth and increased resistance, potentially damaging the wire. In a helical routing, a small pitch (6in) slows growth due to cyclic speed fluctuations, while a large pitch (36in) slows due to wire bending resistance. For quasi-static bending, a straight wire performs best when aligned with the line of no compression but generally adds stiffness. A large pitch helical routing minimizes wire-induced stiffness and allows for compression areas between pitches. A medium pitch (12-18in) is the best pitch that balances growth and steering improvement. These findings are crucial for optimizing wire routing in soft-growing robots, ensuring consistent power and data supply with minimal performance impact, and enhancing functionality and environmental sensing.

Keywords: [no keywords provided]

Mentor(s):

Laura Helen Blumenschein (Engineering)

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

Talk Presentation Abstract Number: 7110
Presentation Time: Grissom 133 at 4:20-4:40

SURF

Application of genetically encoded voltage indicators to zebrafish tissue-specific bioelectricity

Life Sciences

Author(s):

Abigail Martin† (Science|JMHC)

Abstract:

Bioelectricity, which is characterized by electrical signaling across cell membranes through the distribution of charged molecules, has been thoroughly investigated in neuronal and muscular systems. Recently, its involvement in embryonic development has been recognized. Determining the role of bioelectricity in embryonic development can help decipher the regulatory mechanisms for developmental patterning, regeneration, and cancers. Many genetically encoded voltage indicators, or GEVIs, have been reported in many publications to study the bioelectricity in neuronal systems of several model organisms. However, it is not known which GEVIs are suitable for studying zebrafish embryonic development, especially in a tissue-specific manner.

To first test which GEVIs work in zebrafish, we cloned a few recently developed GEVIs and made Tol2 constructs under the UAS promoter. By injecting the constructs into neuronal promoter-driven Gal4 fish lines, it was determined whether the signals could be visualized. Secondly, to achieve the tissue-specific membrane voltage signals, corresponding promoter-driven Gal4 fish lines were characterized. Finally, to understand tissue-specific bioelectricity during embryonic development, membrane voltage was visualized in different tissues using corresponding promoters. Upon finishing our experiments, functional GEVIs in zebrafish can be determined. Tissue-specific bioelectricity can be informative to reveal the roles of bioelectricity during embryonic development.

Keywords: Bioelectricity; Zebrafish; GEVI

Mentor(s):

GuangJun Zhang (Veterinary Medicine); Ziyu Dong (Science)

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

Talk Presentation Abstract Number: 7111
Presentation Time: Grissom 133 at 4:40-5:00

Discovery of the First-in-class SHP1 Covalent Inhibitor for Cancer Immunotherapy

Life Sciences

Author(s):

Levi M Johnson† (Science)

Abstract:

Cancer immunotherapy is a cancer treatment method that harnesses the immune system's defensive capabilities against tumors. Recent advancements including immune checkpoint blockade and adoptive cell therapies have found success, however challenges such as limited efficacy, side effects, and poor tissue penetration limit advancement. Addressing these issues is required to develop safer and more effective treatment strategies.

SHP1 is a protein tyrosine phosphatase (PTP) expressed in hematopoietic cells that has been found to negatively regulate immune responses. Inhibiting SHP1 in the body causes enhanced anti-tumor activity in T cells and natural killer cells, suggesting SHP1 as a promising therapeutic target. However, PTPs are considered "undruggable" by many due to their highly conserved binding domains. This "undruggable" nature has hindered small molecule inhibitor development until now.

Our research led to the molecule M029, which exhibits over 25-fold selectivity for SHP1 versus SHP2 and greater than 60 fold selectivity against other PTPs. M029 demonstrates stability and low toxicity, with oral bioavailability and efficacy shown in vitro and in vivo. In mouse models, M029 delayed tumor progression by enhancing T cell and NK cell activation and infiltration, effects reversed by anti-CD8+ or anti-NK1.1 treatments, confirming its immune-mediated mechanism. Safety assessments revealed no adverse effects at high doses.

This study introduces M029 as a potent SHP1 inhibitor with potential for cancer immunotherapy, marking a significant advancement in targeting SHP1 and other challenging protein tyrosine phosphatases. M029's development informs future strategies against these targets, contributing to broader drug discovery efforts in immunotherapy.

Keywords: Drug Discovery; Cancer Immunotherapy; Medicinal Chemistry

Mentor(s):

Zihan Qu (Science)

Other Acknowledgement(s):

Brenson A Jassim

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

VIRTUAL PRESENTATIONS

Presentations available on Summer Symposium website July 25 – August 1, 2024.
Presentations sorted by program (if any) and then last name of first author. Names as in OURConnect.

Anvil REU

9000 *Nihar Kodkani†; Selina Lin‡*
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9001 *Selina Lin†; Nihar Kodkani‡*
Mentor(s): Nannan Shan; Jungha Woo

9002 *Austin Riley Lovell†; Philip Wisniewski†*
Mentor(s): Sarah Rodenbeck; Ashish Ashish

9003 *Anjali Rajesh†*
Mentor(s): Guangzhen Jin; Rajesh Kalyanam

9004 *Alex Sieni†*
Mentor(s): Amiya K Maji; Robert A Campbell

9005 *Richie Tan†*
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9006 *Jeffrey Winters†*
Mentor(s): Amiya K Maji; Robert A Campbell

9007 *Philip Wisniewski†; Austin Riley Lovell†*
Mentor(s): Sarah Rodenbeck; Ashish Ashish

ASPIRE REU

9008 *Abdellah Amrhar†*
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9009 *Elsia Rodriguez-Linares†*
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9010 *Robert D Serrano†*
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VIP

9011 *Aishwarya Saikrupa Anand†; Aryan M Kadakia†; Benjamin Liming Zou‡*
Mentor(s): Cole Aaron Nelson

9012 *Colin James Chambers†*
Mentor(s): Timothy Francis Hein

9013 *Kevin Ming Chang†; Sabrina Chang‡; Aditya Krishnan Sivathanu‡*
Mentor(s): James G Ogg; Aaron C Ault

9014 *David Talabadze†*
Mentor(s): Shreya Ghosh

9015 *tri Than†; Brady Owen Philhower†; Rauf Emre Erkiletlioglu†; Gilbert Chang†*
Mentor(s): Jacob Chappell; Cole Aaron Nelson; Boyuan Chen

9016 *Justin Yasuumi†; Yi-Hsuan Cheng†*
Mentor(s): Mark Johnson; Cole Aaron Nelson

Non-Program

9017 *Michael Jeffery Dick†; William Milne‡*
Mentor(s): Mark Johnson

9018 *Shamari Garrett†*
Mentor(s): Hossein Mousazadeh

9019 *Rishita Korapati†*
Mentor(s): Matthew Lanham

9020 *Hannah Krouse†; Rebekah Chaffee†; Logan Locker†; Heidi Vazquez Garcia†; Georgeia Edwards‡; Sam Heidlebaugh‡; Lourdes Sanchez‡*
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9024 *Myeongin Wang†*
Mentor(s): Matthew Lanham

9025 *Wei Yuan†*
Mentor(s): Matthew Lanham

9026 *Ethan Andrew Zhang†*
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† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement
Additional faculty/staff acknowledgements listed in the online abstract booklet.

Virtual Presentation Abstract Number: 9000
Presentation Time: July 25-August 1

Anvil REU

Molecular Chemistry Gateway: Developing Open OnDemand Applications for Purdue's Anvil Cluster

Mathematical/Computation Sciences

Author(s):

Nihar Kodkani† (Science); Selina Lin‡ (Science|JMHC)

Abstract:

Computational chemists utilize packages like GROMACS for molecular dynamics simulations and VASP for performing quantum-mechanics simulations. Running these calculations and simulations is a processor-intensive task, thus benefiting significantly from high-performance computing (HPC) clusters. Although these molecular simulation packages are available on the Anvil super computing cluster from the command line, having an interactive web gateway will help inexperienced users. This project aims to integrate GROMACS and VASP as interactive applications within the Open OnDemand (OOD) portal. We focused first on implementing GROMACS, as it is a widely used package in chemistry and biological domains. Before implementing, we researched parameters for the various simulations. After extensive consultations with computational chemists and GROMACS users, a standard set of parameters was determined. To make job submission easier for new users, the application provided an optional Python script to automatically generate .mdp files (simulation configuration files) given user-provided parameters. The GROMACS OOD application contains an option to generate simulation movies. This was created using a combination of VMD and FFMPEG (visualization and video software). We additionally implemented the VASP application, another popular application in the quantum chemistry community. The initial development process was similar to GROMACS, but the parameters varied depending on the type of simulations. In addition, the application had pre-generated configuration files like GROMACS. Implementing the gateway makes it much easier for Anvil users to apply Gromacs and VASP for their research, allowing computational chemists and researchers to focus on their research without needing to navigate the complexities of Linux commands.

Keywords: Molecular Dynamics; Computational Chemistry; Anvil; HPC; Gromacs

Mentor(s):

Nannan Shan (Information Technology); Jungha Woo (Information Technology)

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

Virtual Presentation Abstract Number: 9001
Presentation Time: July 25-August 1

Anvil REU

Facilitating Research through Developing Application Gateways on Anvil

Mathematical/Computation Sciences

Author(s):

Selina Lin† (Science|JMHC); Nihar Kodkani‡ (Science)

Abstract:

Researchers use GROMACS and the Vienna Ab initio Simulation Package (VASP) to simulate molecular environments. The simulations are processor-intensive, and high-performance computing (HPC) clusters significantly speed up the process. Although both software packages are available on Anvil via the command line, a graphical user interface (GUI) would benefit users unfamiliar with Linux commands. This project aims to integrate GROMACS and VASP as interactive applications within the Open OnDemand portal on Anvil. The process first involves identifying critical parameters for the molecular simulations. Building an Open OnDemand application requires YAML files for front-end development and job submission to the cluster. Error checking for text inputs and file uploads ensures that users’ simulations have a greater chance of running smoothly. Each application utilizes a batch script to run the user’s specified simulation. These backend scripts are developed to support different software requirements for CPU and GPU resources. The GROMACS application additionally provides post-analysis data graphs from xvg files, making it easier for researchers to interpret the results. The VASP application can automatically create input files to simplify the job submission process, allowing users to submit their jobs with only the structure file prepared. Creating web-based gateways for the GROMACS and VASP software on Anvil makes it significantly easier for users to run simulations without complex Linux commands. This project sets an example for developing web portals for molecular software packages that other HPC centers can adopt.

Keywords: Anvil; Gromacs; Vasp; Open OnDemand; Molecular Dynamics Package

Mentor(s):

Nannan Shan (Information Technology); Jungha Woo (Information Technology)

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

Virtual Presentation Abstract Number: 9002
Presentation Time: July 25-August 1

Anvil REU

AI-Powered Operational Data Analytics: Predicting Job Queue Times on ANVIL

Mathematical/Computation Sciences

Author(s):

Austin Riley Lovell† (Science); Philip Wisniewski† (Science|JMHC)

Abstract:

Estimating when the scheduler will run a job submitted to a high-performance computing system is an important task that can improve the user experience and help optimize resource allocation within the system. Due to the complex nature of jobs submitted to HPC systems and their variable run times, queue time prediction is challenging. Models attempting to solve this problem have been developed in the past; however, they often wildly mispredict queue times and could be more reliable. In this work, there is an attempt to create queue time estimation models based on modern deep learning architecture. The approach incorporates feature engineering using interval trees based on job submit, start, and end time to find connections between queued jobs and the parameters of currently running and previously queued jobs to improve prediction accuracy. Synthetic data creation using the SMOTE method and feature normalization through log and min-max scaling are utilized before feeding historic jobs from the Slurm Workload Manager on Anvil into a feed-forward neural network for training. The results are benchmarked against KARNAK 2.0, a pre-existing decision tree-based prediction method, and a traditional XGBoost regression model by comparing prediction validity within various minute thresholds. It is expected that the deep learning-based model will outperform these existing methods. The model will be deployed through a command line tool on Anvil. Given a specific queued job or a hypothetical job with certain requested resources, users can receive a queue time estimate and optimize their job submissions based on this information.

Keywords: Machine Learning; Neural Network; AI; HPC; High Performance Computing

Mentor(s):

Sarah Rodenbeck (Information Technology); Ashish Ashish (Information Technology)

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

Virtual Presentation Abstract Number: 9003
Presentation Time: July 25-August 1

Anvil REU

Open OnDemand Dashboard for Purdue's Anvil HPC Cluster

Mathematical/Computation Sciences

Author(s):

Anjali Rajesh†

Abstract:

This project aims to develop a comprehensive and interactive dashboard for the Anvil high performance computing cluster at Purdue University by providing detailed insights into user allocations, resource usage, and job performance metrics, ultimately focusing on enhancing job efficiency. This research project prioritizes making improvements on the current Anvil web-based dashboard built with the Open OnDemand platform. The current dashboard does not reveal any information to researchers pertinent to whether their jobs are efficiently utilizing their allocation. In the improved dashboard, information regarding service unit credits, disk usage, CPU efficiency, memory efficiency, and other metrics, is derived by parsing data from the open-source job scheduler Slurm, using scripts written in Ruby. Furthermore, the dashboard also integrates utilities such as sacct and reportseff. Sacct is used for displaying job accounting data from the Slurm database; reportseff is an open-source Python script from Princeton University which provides detailed job efficiency information for both CPU and memory utilization. The queried data is presented in a user-friendly manner using various Javascript graphing and table libraries, including Chart.js, Highcharts, and Datatables, using Ruby on Rails as the web framework to maintain the backbone of the dashboard. The objective of the dashboard is to provide a clean, well-structured, and extensible interface for researchers to visualize useful information about their utilization of Anvil without accessing the terminal. Individuals working on Anvil may view detailed statistics regarding job performance metrics via the dashboard, and can identify and debug any jobs that are noticeably inefficient.

Keywords: Anvil; Open OnDemand; HPC; Dashboard; Slurm

Mentor(s):

Guangzhen Jin (Information Technology); Rajesh Kalyanam (Information Technology)

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

Virtual Presentation Abstract Number: 9004
Presentation Time: July 25-August 1

Anvil REU

Automating HPC Software Deployment

Mathematical/Computation Sciences

Author(s):

Alex Sieni†

Abstract:

On HPC systems, many researchers require the installation of various large, complex scientific applications. This process is generally cumbersome due to the large number of dependencies and the steep learning curve for building software from source. The proposed solution aims to automate that process through a user-friendly interface, providing real-time build information while achieving enough modularity for use at various institutions. Resources utilized encompass Go, Charm.sh library implementations (TUI: terminal user interface), Spack, Jenkins, PostgreSQL, and Kubernetes.

The user interface is accessible via SSH into a frontend node or via log-in on a web-based cluster portal. After inputting the necessary parameters, a Jenkins CI/CD pipeline builds the Spack applications, configures a Spack environment, and confirms functionality through testing. A full Spack spec is returned, and environment modules are placed within the user's directory to be loaded for later use.

Currently, a proof-of-concept for this workflow is complete. The next steps include hosting the TUI, pipeline, and database on Kubernetes and providing the option to pass a Spack YAML file for quicker Spack and application configuration. Through the proposed solution, automating software deployment will increase accessibility to powerful scientific software, automate testing and error reporting, and allow for greater research output.

Keywords: HPC Applications; CICD; Spack; Build Automation

Mentor(s):

Amiya K Maji (Information Technology); Robert A Campbell (Information Technology)

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

Virtual Presentation Abstract Number: 9005
Presentation Time: July 25-August 1

Anvil REU

Open OnDemand Dashboard Development for the Anvil Supercomputer

Mathematical/Computation Sciences

Author(s):

Richie Tan† (Science)

Abstract:

Supercomputers like Anvil, the NSF-funded supercomputer built by Purdue University, provide powerful, cost-efficient computing resources for researchers nation-wide. This REU project focuses on bridging the gap between the Linux terminal and the web-based Open OnDemand user experiences on Anvil by combining responsive, informative, and user-friendly dashboard design with detailed job management and performance metrics, enabling productive, streamlined research for researchers with varying amounts of computing experience. The updated dashboard homepage developed in this project introduced widgets displaying users' service unit credit and disk usages, important Anvil announcements, and partition statuses and resource load to provide researchers a quick, centralized overview of key information. By querying Slurm, an open-source job scheduling and accounting software used on Anvil, the dashboard transforms difficult-to-parse data from Anvil into easy-to-understand tables and charts without the user ever interacting with the terminal and Linux commands. The improved dashboard concisely formats key information about a researcher's jobs while offering the option to view more detailed data, allowing researchers to quickly analyze their jobs without being overwhelmed by irrelevant information. Further information regarding each job's memory, CPU, GPU, and time utilizations will provide researchers more comprehensive insights to their jobs on Anvil. The new Anvil dashboard will lower the barrier of entry to high performance computing for researchers without sacrificing important functionality and metrics traditionally provided by Anvil's terminal interface.

Keywords: HPC; Open OnDemand; Anvil; Ruby on Rails; Slurm

Mentor(s):

Guangzhen Jin (Information Technology); Rajesh Kalyanam (Information Technology)

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

Virtual Presentation Abstract Number: 9006
Presentation Time: July 25-August 1

Anvil REU

Automating Research Software Deployment - PLENUM Pipeline

Mathematical/Computation Sciences

Author(s):

Jeffrey Winters†

Abstract:

Much of modern research requires HPC resources to facilitate the use of complex scientific software, however the installation of this software is often cumbersome and tedious. Additionally, the baseline technical skillset required to use tools intended to install such software places elevated demands on researchers. The PLENUM (Purdue Local ENvironment User Modules) Pipeline allows for the remediation of this. The intention is to provide a software toolset that removes technical barriers, automates software setup tedium, accommodates software installation repeatability, and is modular enough to be used at any institution. Technologies utilized include Spack, Jenkins, PostgreSQL, Kubernetes, Charm.sh TUI (terminal user interface) Golang libraries.

To access PLENUM, users may SSH into a frontend node or log into a web-based cluster portal, such as Open OnDemand. After invoking PLENUM, users enter the parameters needed for each software they would like installed. Once each set of parameters has been finalized, the parameters are sent to Jenkins to automate the Spack installations. The user receives live feedback on the progress of each build in addition to the ability to view the full Spack spec for their builds. Once the installations are completed, they are added to their local system modules to be loaded whenever necessary.

Keywords: HPC; Automation; CI/CD; Spack; Software Deployment

Mentor(s):

Amiya K Maji (Information Technology); Robert A Campbell (Information Technology)

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Virtual Presentation Abstract Number: 9007
Presentation Time: July 25-August 1

Anvil REU

AI-Powered Operational Data Analytics: Predicting Job Queue Times on ANVIL

Mathematical/Computation Sciences

Author(s):

Philip Wisniewski† (Science|JMHC); Austin Riley Lovell† (Science)

Abstract:

Predicting wait times for jobs submitted and queued in high-performance computing systems is an important feature that helps users conduct research efficiently and optimize the use of resources. Wait time prediction has proven to be a difficult task due to the complexity of the data and the imbalanced nature of jobs submitted to HPC systems. Models have been developed in the past to predict queue times for specific clusters. However, these models lack the accuracy for confident predictions, and many are outdated. In this work, we have investigated and developed a feed-forward, densely connected neural network-based model to accurately predict wait times for jobs submitted to Purdue University's ANVIL cluster. We used log-transformed data from the Slurm Workload Manager on ANVIL before performing additional feature engineering from jobs' priorities, partitions, and states. Using the PyTorch Python library, we used jobs longer than ten minutes to train the regression model. The model was evaluated against other models, such as XGBoost and Decision Tree Regressors, based on absolute percentage error and outperformed all. We will integrate our model into a command line tool where users can submit their job ID to estimate the start time of their job. Overall, we developed a model to allow users to remain more efficient with their time in conducting research and provided a valuable tool for assisting in resource management by better understanding how different features can affect queue times in the cluster.

Keywords: Neural Network; Queue Time; High Performance Computing; Cluster

Mentor(s):

Sarah Rodenbeck (Information Technology); Ashish Ashish (Information Technology)

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

Virtual Presentation Abstract Number: 9008
Presentation Time: July 25-August 1

ASPIRE REU

Optimizing EV Charging Infrastructure: Strategic Stop and Road Locations

Innovative Technology / Entrepreneurship / Design

Author(s):

Abdellah Amrhar†

Abstract:

Electric vehicle (EV) infrastructure is essential to overcoming range anxiety and promoting EV adoption. High-power infrastructure is necessary for electrified freight operations as duty-cycle and operator schedule limits stop times and locations. This study focuses on two objectives: Understanding existing dwell and truck stops for long-haul freight where EVSEs can be installed and assessing road segments for Dynamic Wireless Power Transfer (DWPT). An analysis is conducted using RSD Container Yard Services freight data to identify frequent stop locations and high-use roadways. Our K-means clustering algorithm shows 32 potential sites for direct current fast charging (DCFC) electric vehicle supply equipment's (EVSE) installation for electrified freight. These locations would enable most freight along the large interstate corridors to feasibly transition to battery-electric propulsion and mitigate the pollution of heavy-duty freight.

Keywords: DCFC, freight operations, I-15, I-80, EV infrastructure, range anxiety, duty-cycle, EVSE, DWPT, K-means clustering, battery-electric propulsion, pollution reduction.

Mentor(s): Mario Harper (Computer Science)

Keywords: DCFC; EV Infrastructure; Range Anxiety; Duty-Cycle; EVSE

Mentor(s):

Brandon Chase Myke Allen (Engineering)

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

Virtual Presentation Abstract Number: 9009
Presentation Time: July 25-August 1

ASPIRE REU

Analyzes of Salt lake city, US, environmental and health impacts of electrification of roadways in an Urban setting

Innovative Technology / Entrepreneurship / Design

Author(s):

Elsia Rodriguez-Linares†

Abstract:

As global temperatures rise, the incidence of heat waves is increasing, significantly impacting human health. From 1995 to 2002, heat was the leading weather-related cause of mortality in the U.S., a trend likely to continue in the coming decades. Heat-related illnesses and mortality rises with higher temperatures and are influenced by factors such as environment, socioeconomic status, demographics, mental health, and pre-existing conditions. Vulnerable populations include the elderly, infants, lower-income communities, and people of color. Hyperthermia, heatstokes and overheating are serious heat-related illnesses that if not taken care seriously or given medical help can be fatal. Urban areas are particularly susceptible to heat due to the Urban Heat Island (UHI) effect, where surfaces retain and emit heat, raising temperatures. Disadvantaged neighborhoods often experience more intense UHI effects due to historical inequalities in infrastructure and green spaces. Policies like redlining have left minority communities with fewer green spaces and greater exposure to pollutants, increasing their vulnerability to heat-related illnesses. Using ARCGIS maps to create maps of Salt lake city, the area of study, to analyze green spaces and roadways in the city that may affect UHI effects. Further analysis of which populations would be vulnerable to heat increases near highways if electrification of the roadway is to occur in an urban setting. While electric vehicles (EVs) reduce greenhouse gas emissions and particulate matter, there is limited research on the potential heat generated by in-road charging technologies and its effects on local environments.

Keywords: [no keywords provided]

Mentor(s):

Brandon Chase Myke Allen (Engineering)

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Virtual Presentation Abstract Number: 9010
Presentation Time: July 25-August 1

ASPIRE REU

Increasing Electric Vehicle Charger Availability with a Mobile, Self-Contained Charging Station

Innovative Technology / Entrepreneurship / Design

Author(s):

Robert D Serrano†

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Brandon Chase Myke Allen (Engineering)

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

Virtual Presentation Abstract Number: 9011
Presentation Time: July 25-August 1

VIP

Improved Interrupt Controller Design for SoCET x08 Chip

Innovative Technology / Entrepreneurship / Design

Author(s):

Aishwarya Saikrupa Anand† (Engineering); Aryan M Kadakia† (Engineering); Benjamin Liming Zou‡ (Engineering)

Abstract:

[Abstract Redacted]

Keywords: Interrupt Controller; Design; Optimization; RTL; Chips

Mentor(s):

Cole Aaron Nelson (Engineering)

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

Virtual Presentation Abstract Number: 9012
Presentation Time: July 25-August 1

VIP

FPGA MUX Space Optimization

Mathematical/Computation Sciences

Author(s):

Colin James Chambers† (Engineering|JMHC)

Abstract:

[Abstract Redacted]

Keywords: FPGA; MUX

Mentor(s):

Timothy Francis Hein (Engineering)

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

Virtual Presentation Abstract Number: 9013
Presentation Time: July 25-August 1

VIP

Geolex: Cloud-based Public Database of Global Geologic Formations

Physical Sciences

Author(s):

Kevin Ming Chang† (Engineering); Sabrina Chang‡; Aditya Krishnan Sivathanu‡ (Engineering)

Abstract:

The Geolex is an extensive cloud-based lexicon of global geologic formations developed in collaboration with geoscientists worldwide, hosting detailed geological information and visual representations of various geologic formations. This resource can be used by geologists and educators to quickly access information about various geologic formations and gain a better understanding of our planet's history.

The current main Geolex domain contains geologic formation data for the following regions: Africa, Belgium, China, the Indian Plate, Malaysia, the Middle East, Niger, Panama, Qatar, Thailand, and Vietnam. Users can select multiple regions to display geologic formations within different periods of the geologic time scale, or those of a specific date. Each of the formations listed after such a filtered search can be clicked for more information regarding their age, lithology, type locality and naming, distribution across the Earth, and much more. Additionally, clicking a region on the Geolex home page's map will redirect users to that associated region's lexicon, which offers similar detailed geological information and visual reconstructions of various formations using models of ancient Earth paleogeography. With its user-friendly interface, extensive database, and regularly updated and enlarging content, the Global Lexicon is a valuable tool for anyone interested in geology.

Keywords: Database; Geology; Vertically Integrated Projects; Geologic Timescale Foundation; Earth History Visualization

Mentor(s):

James G Ogg (Science); Aaron C Ault (Engineering)

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

Virtual Presentation Abstract Number: 9014
Presentation Time: July 25-August 1

VIP

VIP AMP

Innovative Technology / Entrepreneurship / Design

Author(s):

David Talabadze† (Engineering)

Abstract:

[Abstract Redacted]

Keywords: [no keywords provided]

Mentor(s):

Shreya Ghosh (Engineering)

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

Virtual Presentation Abstract Number: 9015
Presentation Time: July 25-August 1

VIP

Chiplet Integration on PCB

Innovative Technology / Entrepreneurship / Design

Author(s):

tri Than† (Engineering); Brady Owen Philhower† (Engineering); Rauf Emre Erkiletlioglu† (Engineering); Gilbert Chang† (Engineering)

Abstract:

[Abstract Redacted]

Keywords: Chiplets; PCB Design; SoC

Mentor(s):

Jacob Chappell (Engineering); Cole Aaron Nelson (Engineering); Boyuan Chen (Engineering)

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

Virtual Presentation Abstract Number: 9016
Presentation Time: July 25-August 1

VIP

A Command-Line Framework for AFTx07

Mathematical/Computation Sciences

Author(s):

Justin Yasuumi† (Engineering); Yi-Hsuan Cheng† (Science)

Abstract:

This project aims to develop a command-line interface (CLI) for controlling and monitoring the peripherals of the AFTx07, a system-on-chip (SoC) design by Purdue's SoCET Team. The significance of this work lies in providing a flexible and accessible means for users to interact with the AFTx07 peripherals. Users interact with the AFTx07 through a terminal emulator such as PuTTY, where commands are executed and sent to the AFTx07 via its UART interface. The methodology involves implementing command parsing logic, developing peripheral control functions, and creating a state monitoring system. Although the project is ongoing, initial steps will include verifying the interface's functionality through rigorous testing and simulations. The anticipated outcome is a reliable and user-friendly CLI that not only demonstrates the capabilities of the AFTx07 but also serves as a foundation for a scripting language, enabling users to write higher-level programs and enhancing peripheral accessibility, development, and testing.

Keywords: System on Chip; SoC; Software Application Demo

Mentor(s):

Mark Johnson (Engineering); Cole Aaron Nelson (Engineering)

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

Virtual Presentation Abstract Number: 9017
Presentation Time: July 25-August 1

SoCET Memory System Development

Innovative Technology / Entrepreneurship / Design

Author(s):

Michael Jeffery Dick† (Engineering); William Milne‡ (Graduate)

Abstract:

AHB is a high performance bus architecture used to connect and manage the functional blocks of a system-on-chip design. SoCET's AFTx07 SoC design utilizes the AHB bus to connect the CPU to different blocks of the design as well as connecting to the slower APB bus that connects to the design's peripherals. The task of our research this summer has been to make updates to the implementation of the AHB bus to allow for different data widths and address widths to be used. This involves implementing parameterization into AHB components to select address and data bus widths. This also includes updating the implementation of the HSIZE signal to match the AMBA 5 spec. Then once these changes are implemented a bridge is required to connect buses that are different sizes as well as an update to the bridge that connects the faster AHB bus to the slower APB bus. This bridge along with the updates to the AHB bus implementation will allow the CPU to request larger data widths than other blocks can provide in a single transaction.

Keywords: System on Chip; Bus Protocols; AMBA

Mentor(s):

Mark Johnson (Engineering)

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

Virtual Presentation Abstract Number: 9018
Presentation Time: July 25-August 1

Analyzing Neighborhood Property Conditions in South Lafayette Neighborhood

Social Sciences / Humanities / Education

Author(s):

Shamari Garrett†

Abstract:

Understanding neighborhood property conditions is crucial for urban planning and community development. Identifying and analyzing these conditions can provide insights into a community's overall health and stability, influencing decisions on resource allocation, policymaking, and community interventions. This study employs a mixed-methods approach, combining quantitative data analysis with qualitative observations to assess the property conditions in various neighborhoods. Data were collected on factors such as the presence of street trees, roof conditions, and other visible signs of property maintenance. Specific attention was given to properties on Edgelea and Oxford Streets. The analysis reveals several significant correlations and patterns, there is a notable positive correlation between the presence of street trees and the condition of roofs. Properties with more street trees tended to have better-maintained roofs. Properties on Edgelea Street exhibited significantly better maintenance compared to those on Oxford Street, suggesting a disparity in resource allocation or community engagement. Further analysis indicated a strong relationship between overall property conditions and community engagement levels, and the impact of local policies on property maintenance. The findings underscore the importance of urban forestry and community engagement in maintaining property conditions. Policymakers and urban planners should consider these factors when developing strategies to improve neighborhood health and stability. Additionally, the disparities observed between different streets highlight the need for targeted interventions to ensure equitable resource distribution.

Keywords: Neighborhood Property Conditions; Community Development; Property Maintenance; Community Engagement; Edgelea Neighborhood

Mentor(s):

Hossein Mousazadeh (JMHC)

Additional Acknowledgement(s):

Jason Ware (JMHC); Temitope Folasade Adeoye Olenloa (JMHC)

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

Virtual Presentation Abstract Number: 9019
Presentation Time: July 25-August 1

Predicting & Optimizing the Productivity of Garment Employees: A Novel Analytics Design to Improve Resource Allocation & Efficiency

Mathematical/Computation Sciences

Author(s):

Rishita Korapati† (DSB)

Abstract:

This research demonstrates how integrating predictive analytics with prescriptive analytics (i.e., optimization) can identify key operational drivers among garment industry employees to enhance managerial decision-making. We formulate and solve an optimization model with parameters estimated from a linear regression predictive model of employee working behavior and labor outcomes in the garment manufacturing industry. This solution empowers managers to make informed decisions on optimizing employee performance to achieve desired production outputs. Motivated by studies from Rahim et al. (2017) and Imran et al. (2019), which highlight significant economic losses due to inefficiencies in the garment industry, our approach underscores the necessity of combining predictive modeling with optimization. This integration aims to identify the most effective actions to enhance productivity. The garment industry, employing millions and accounting for 84% of export earnings in Bangladesh alone, faces annual losses amounting to billions of dollars due to low productivity and escalating costs. Our findings suggest that substantial savings can be achieved with this innovative approach of integrating predictive and prescriptive analytics, compared to the use of predictive analytics alone, as previously documented in academic literature.

Keywords: Predictive Analytics; Prescriptive Analytics; Optimization Model; Garment Industry; Employee Productivity

Mentor(s):

Matthew Lanham (DSB)

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

Virtual Presentation Abstract Number: 9020
Presentation Time: July 25-August 1

Assessing Youth Learning and Development and Parental Needs in an Afterschool Program

Social Sciences / Humanities / Education

Author(s):

Hannah Krouse†; Rebekah Chaffee†; Logan Locker†; Heidi Vazquez Garcia†; Georgeia Edwards‡; Sam Heidlebaugh‡; Lourdes Sanchez‡

Abstract:

After parents and children in an afterschool program's local community shared that they needed resources to help them thrive and grow, we sought to collect their needs and brainstormed ways to meet them. Children were struggling with tension among their peers and having issues feeling confident in what they were learning at school, plus parents were stressed about their children. Our program evaluation explored how an afterschool program impacted the learning and development of youth and the needs of the parents whose children regularly attend the afterschool program. A pre-recorded focus group of four parents whose children regularly attend the afterschool program was utilized to understand parents' thoughts about the afterschool program. The audio recording was transcribed to text; coded (highlighted) when youth learning, youth development, or parental needs were shared and further analyzed to brainstorm solutions for the afterschool program. Regarding youth learning and development, parents shared that the afterschool program provided their children with positive educational assistance, improved their grades in almost every subject, built home economics skills, strengthened socio-emotional development, developed positive parental and peer relationships, and opened opportunities for future development for the youth. As for the parents, they have a need for their kids to be in a safe environment after school and have help with homework and career skills such as coding, math, and science. Overall, parents expressed that the afterschool program was effective, beneficial to academic development, and provided a safe environment for their children.

Keywords: Afterschool Program; Parent Needs; Youth; Youth Development; Learning

Mentor(s):

Temitope Folasade Adeoye Olenloa (JMHC)

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

Virtual Presentation Abstract Number: 9021
Presentation Time: July 25-August 1

Investigation of High Energy Radiation Effects on Electronic Memory Devices

Innovative Technology / Entrepreneurship / Design

Author(s):

Isabella Virginia Levine† (Engineering|JMHC); Sayan Roy‡

Abstract:

Electrically Erasable Programmable Read-Only Memory devices (EEPROMs) store critical data in spacecraft; however, they face significant challenges in the harsh space environment, notably from radiation damage. While past research has explored the effects of certain radiation types like protons, electrons, and gamma rays, the impact of heavy ions from cosmic rays remains uncertain. This study aims to investigate the reliability and memory of EEPROMs under such radiation using Purdue University's Rare Isotope Measurement Laboratory (PRIME) and its accelerator mass spectrometer. An accelerator mass spectrometer aims to speed ions to highly high kinetic energies, creating a radiation field. By subjecting EEPROMs to diverging heavy ion beams at varying radiation doses, we seek to understand their response over time and identify critical dose thresholds. Through this analysis, we aim to determine which nuclei pose the greatest threat to EEPROM functionality aboard spacecraft, informing strategies for radiation protection. The outcomes of this research will contribute to a deeper understanding of EEPROM behavior in dynamic space environments and provide insights into mitigating radiation-induced damage in spacecraft systems. Ultimately, this knowledge will be crucial for ensuring the integrity and functionality of critical electronics during extended space missions.

Keywords: Radiation; Microelectronics; Space; EEPROM; Radioisotopes

Mentor(s):

Peter Bermel (Engineering)

Other Acknowledgement(s):

Allen L Garner; Stylianos Chatzidakis

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

Virtual Presentation Abstract Number: 9022
Presentation Time: July 25-August 1

Predictive Maintenance in Drilling Operations: A Machine Learning Approach for Drill Bit Failure Prediction

Mathematical/Computation Sciences

Author(s):

Jizheng Li† (DSB)

Abstract:

This project aims to enhance predictive maintenance in drilling operations by forecasting drill bit failures using machine learning. Using the XAI Drilling Dataset, we developed a model to predict failures based on operational parameters like cutting speed, spindle speed, feed rate, and cooling levels. The goal is to reduce operational costs, prevent downtime, and increase productivity. Our Random Forest model, refined through hyperparameter tuning and cross-validation, showed high accuracy in predicting failures. This predictive maintenance approach promises significant cost savings and operational improvements for industries relying on drilling processes.

Keywords: Predictive Maintenance; Data Mining

Mentor(s):

Matthew Lanham (DSB)

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

Virtual Presentation Abstract Number: 9023
Presentation Time: July 25-August 1

VIPER: An AI-Powered Conversational Interface for Integrated Protein Research and Structure Prediction

Life Sciences

Author(s):

Pranav Punuru† (Science)

Abstract:

The complexity and fragmentation of bioinformatics tools have long hindered efficient protein research, slowing down potential breakthroughs in structural biology and drug design. We introduce VIPER (Virtual Intelligence for Protein Exploration and Research), an AI-driven, conversational research assistant designed to revolutionize protein science by integrating and streamlining complex research processes. This study employs a novel integration of large language models (GPT-4), state-of-the-art protein structure prediction (ESMfold), and advanced molecular docking (DiffDock), all unified through an intuitive web interface built on FastAPI. VIPER demonstrates unprecedented capabilities in seamlessly connecting various bioinformatics tools, enabling complex workflows to be initiated with simple prompts. For instance, users can go from providing a protein name and a ligand to obtaining a 3D structure with the ligand docked, all in one single prompt. Moreover, VIPER can execute its own code and browse the web in real-time, significantly enhancing its ability to access and process the latest scientific information, run custom analyses, and adapt to new research challenges. This level of integration and adaptability streamlines research processes, potentially reducing the time and expertise required for complex protein analyses. The implications of VIPER extend beyond individual research tasks, potentially transforming entire drug discovery pipelines and enhancing our understanding of protein-ligand interactions on a broader scale. VIPER will be made available on ChatGPT.com, democratizing access to advanced protein research tools, and the code for the API will be provided, allowing for further development and integration into existing research workflows.

Keywords: Bioinformatics; Protein Structure Modelling; Artificial Intelligence; Large Language Models; Research and Analysis

Mentor(s):

Daisuke Kihara (Science)

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

Virtual Presentation Abstract Number: 9024
Presentation Time: July 25-August 1

Predictive Analysis of Seoul Bike Sharing Demand

Mathematical/Computation Sciences

Author(s):

Myeongin Wang† (DSB)

Abstract:

In this project, I developed a linear model to predict the number of Seoul's bike-sharing demand. The goal was to identify whether the system would function on a given day by achieving better resource allocation, maintenance planning, and customer service. The prediction is critical for operational efficiency, cost management, and customer satisfaction. The observation includes 365 days from December 2017 to November 2018. The dataset contains various features including, ‘rented bike counts’, ‘hour’, ‘temperature’, ‘humidity’, etc. Python was the main programming language for this project. For data analysis and visualization purposes, libraries such as Pandas, NumPy, Matplotlib, and Seaborn were used. Three different models - linear regression, ridge regression, and the Lasso - were conducted with 8760 observations and evaluated using 5-fold cross-validation. Model performance will be evaluated based on the adjusted R2 score.

Keywords: [no keywords provided]

Mentor(s):

Matthew Lanham (DSB)

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

Virtual Presentation Abstract Number: 9025
Presentation Time: July 25-August 1

Predictive Maintenance to Reduce Machine Downtime

Innovative Technology / Entrepreneurship / Design

Author(s):

Wei Yuan† (DSB)

Abstract:

This project analyzes the factors that affect Machine failure rates such as temperature, rotational speed, torque, tool wear, etc. This is very important for all manufacturing companies that need to produce machines as it helps the company to identify and proactively contact customers at risk of churn and try to repair the relationship in advance to reduce the risk of reduced revenue.

Machine maintenance is one of the major expenses in terms of cost and downtime due to machine breakdown affecting the entire manufacturing process. Building a highly accurate predictive model can help a company identify problem areas in advance and maximize cost reduction. The failure rate is predicted by using random forest, logistic regression, KNN, and decision trees to get a model with high accuracy.

Keywords: Machine Failure; Accuracy; Predict Model

Mentor(s):

Matthew Lanham (DSB)

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

Virtual Presentation Abstract Number: 9026
Presentation Time: July 25-August 1

Design and Development of a Soft Variable Stiffness Robotic Finger

Innovative Technology / Entrepreneurship / Design

Author(s):

Ethan Andrew Zhang†

Abstract:

[Abstract Redacted]

Keywords: Pneumatic Finger; Variable Stiffness; Controlled Actuation; Soft Robotics; 3D Printing

Mentor(s):

Dongming Gan (Polytechnic)

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

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