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Oral Presentation Abstracts
(listed in alphabetical order)

1. Zackee Dosky
Senior
Mechanical & Manufacturing Engineering
Tennessee State University
Dr. Muhammad Akbar
Oral

Computational Fluid Dynamics (CFD) Study of Boeing 737-800 Propulsion System

This research aims to study the propulsion system of a Boeing 737-800 aircraft by using the Computational Fluid Dynamics (CFD) model to accurately assess its performance. The initial use of SolidWorks is to create an underlying concept of manufacturing and the development of the current features of the propulsion system. The modeling is done based on the known dimensions that are readily available in the open literature. The setup and analysis of the research is done using multiple tools such as SolidWorks, ANSYS, and MATLAB. In the present study, SolidWorks will be used for the geometry and CAD model of the Boeing 737-800. Then the CAD will be used in ANSYS to simulate combustion and compressible fluid flow through the propulsion system. The ultimate goal is to understand how the propulsion system contributes to the thrust and aerodynamics of the Boeing 737-800 aircraft.

2. Keturah Badie
Sophomore
Biology
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Dr. Koen Vercruysse
Oral

Impact of amino acids or other compounds on the synthesis of melanin

Melanin can be synthesized through air-mediated oxidation of a catecholic or indolic compound under alkaline conditions. Despite the simplicity of this reaction, a complete description of the chemistry and an explanation of the physical properties of melanins is lacking. An obvious physical characteristic of melanins is their capacity to absorb light over a broad range of the electromagnetic spectrum leading to their characteristic dark appearance. However, it is unclear whether this dark appearance is due to chemical or physical features of the material. Melanin-like materials can be synthesized from a wide variety of precursors. Depending on the precursor involved and the reaction conditions, materials with different physical appearances, e.g., dark brown to black vs. light brown to yellow, can be generated. Earlier observations indicated that the presence of cysteine in the reaction mixture leads to materials with much darker appearances. These earlier observations were expanded through the testing of 1) other amino acids, e.g., methionine, 2) amino acid derivatives, e.g., tryptamine, and 3) protein. The goal of the experiments was to determine if the addition of such compounds would impact the appearance, lighter or darker in color, of the melanin-like material synthesized. Our experiments indicated that the addition of some additives to the reaction leads to an increased precipitation of melanin. These observations could have significant impacts on the ability of melanin to coat surfaces. The potential applications of these findings will be discussed.

3. Rashi Gupta
Sophomore
Chemistry
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Dr. John McLean
Oral

Development of Advanced Mass Spectrometry Methods for Pharmaceutical Enantiomer Characterization

Drug enantiomers can have different effects on the human body, varying in bioavailability and potency. In the famous case of thalidomide, one enantiomer can alleviate morning sickness during pregnancy while its chiral counterpart causes birth defects during gestation. The thalidomide crisis highlights the tragic consequences of enantiomeric differences in drug biological activity and underscores the importance of developing rapid analytical techniques for enantiomeric discrimination. Popular methods for enantiomer differentiation are limited by high sample consumption, long analysis times, and low sensitivity. Ion mobility-mass spectrometry (IM-MS) enables rapid gas-phase separation of many isomeric and isobaric compounds, but small molecular enantiomers share many chemical and physical properties, making them a famously difficult class of molecules to separate. A potential avenue to overcome this challenge is the use of chiral shift reagents which can interact enantioselectivity with the two chiral forms of a drug to impart measurable structural differences. This noncovalent complexation can render the two forms directly resolvable using IM-MS. Our previous work explored copper-amino acid complexes as chiral selectors, and current work seeks to complement this data by investigating beta cyclodextrin's capacity to separate chiral drugs. Recent literature suggests the unique properties of β-cyclodextrin (βCD) show great potential in enantiomeric differentiation through the utilization of a host-guest mechanism for chiral selection. βCD has been demonstrated to enantioselectivity complex amino acid enantiomers, rendering them differentiable by ion mobility-mass spectrometry (IM-MS). Thus, this study will assess the separation capacity of βCD for pharmaceutical drug enantiomers such as thalidomide.

4. Danielle Jathan
Junior
Biology
Lemoyne Owen College
Dr. Mark Kahn
Oral

"Investigating proliferation of murine placental endothelial cells *in vivo*"

During gestation, the placenta serves as a temporary but invaluable link between the mother and fetus, mediating nutrient and oxygen exchange to the conceptus and subsequently preserving its capacity for normal development. Placental dysfunction can lead to many severe pregnancy complications, such as preeclampsia and intrauterine growth restriction (IUGR). Therefore, understanding the mechanisms of placental development is crucial to better address these complications and ultimately ensure successful pregnancy outcomes. Furthermore, endothelial cells (EC) play a significant role in vascularizing the placenta to facilitate nutrient and oxygen exchange between maternal and fetal blood. Understanding both normal and abnormal mammalian development requires specific knowledge of ECs; however, the mechanisms that govern placental EC functionality and behavior are not well understood. Particularly, there is a lack of information addressing the timing, rates, and extent to which EC proliferation occurs at different developmental stages. Therefore, this project aims to explore these characteristics *in vivo*, using the wildtype murine placenta. Click-iT EdU assay and other proliferating markers were applied to visualize proliferating cells in placentas at both early (E11.5) and late (E15.5) gestational timepoints. Different conditions of EdU administration to pregnant dames were also considered, which helped to gain insight into the timing of placental cell cycles. The results suggested that most proliferating cells detected in the placenta were non-endothelial and rather of trophoblast origin, with proliferation signals expressing relatively higher at the early gestational timepoint. For future directions, this information can be used to compare cell proliferation in mutant placentas to characterize phenotypes.

5. Sona Javadi
Junior
Computer Science
Vanderbilt University
Dr. Maizie (Xin) Zhou
Oral

Autoencoder with Differentially Expressed Genes and Imputation for a Robust Spatial Transcriptomics Clustering

Recent advancements in spatial transcriptomics (ST) sequencing technology have enabled a more in-depth understanding of tissue by allowing the measurement of gene expression among spots in tissue along with the spatial location of spots. There are multiple studies that have worked on further understanding the variation of gene expression in tissue, but most of the literature have utilized tools that were developed for single-cell RNA sequencing (scRNA-seq), only using the gene expression values of spots. However as stated, ST datasets also contain the spatial location of spots and often contain high-resolution histology images. These are very important aspects of the data which can allow a better understanding of tissue; however, they are seldom exploited thoroughly. In this study, we will discuss a novel graph-based multi-stage deep clustering method which integrates differentially expressed gene selection and imputation modules to refine clustering results.

6. Elise Russ
Senior
Civil Engineering
Tennessee State University
Dr. Shihui Liu
Oral

The Benefits and Construction Advances of Hempcrete

Hempcrete is an important construction industry advancement that focuses on replacing current non-bearing construction materials that negatively impact the environment. Hempcrete provides an alternative to costly materials and negative environmental factors, the typical cost of concrete is between $110 and $165 per cubic yard. Concrete contributes to negative environmental effects which include soil erosion, water pollution, and flooding. In the research methodology used, I have tested the compressive strength of hempcrete to identify its longevity and use in the field. The compressive strength of the samples is tested after 28 days with the relative humidity for the curing environment is 95%. It is important to identify various building materials as our world is evolving and we are looking to improve the environmental conditions around us.

7. Jymon T. Scott
Senior
Electrical Engineering
Tennessee Technological University
Dr. Charles Van Neste
Oral

Cost Effective Analysis and Experimental Design for an Axial Flux Motor Core Assembly

The objective of this research experiment is to understand the efficiency difference between an axial flux motor with a steel core and one with a core made up of magnetic PLA. Along with efficiency, cost is also analyzed to find out if magnetic PLA could ever be a successful alternative solution. For this experiment, an axial flux motor core was constructed and assembled based on the blueprints provided by Dr. Charles Van Neste titled, "Null Field Gen. V3". Two cores were produced; One being made of steel and the other magnetic PLA. After tedious coil winding, we hope to find and a difference in each of the mutual inductances with however still being able to output an efficient power and induced voltage.

8. Pierre Zakaria
Junior
Biomedical Engineering
Vanderbilt University
Dr. Justin Baba
Oral

Peripheral Artery Disease Detection with Thermographic Imaging

Peripheral artery disease (PAD), a cardinal manifestation of atherosclerosis, affects 8.5 million Americans and causes significant ambulatory impairment, accelerated functional decline, and enhanced loss of mobility that is resistant to medical therapy. Calf skeletal muscle perfusion better predicts limb function than the severity of limb atherosclerosis or whole limb blood flow. For this reason, a sphygmomanometer cuff occlusion will be conducted on the patient's lower leg. Simultaneously, thermographic imaging via skin thermography will also be conducted while the occlusion is in progress. The results of thermographic imaging consist of pairs of pictures: a VIS (optical) image and an IR (infrared) image. After image pair registration and segmentation, each image pair is separated into two segments: the foot and the lower leg. An analysis is then performed on the segmented data, quantifying the average temperature of each segment, and finding the temperature difference between the two segments. The result of the analysis is a graph showing the difference in the average temperature of the segments over time. The characteristics of the graph, especially around the time when the cuff pressure is released and circulation begins to return to a normal state, are used to identify whether a patient has PAD or not.