2023 SOE Summer Research Symposium

Friday, August 4, 2023

(Program Outline with four Breakout Sessions)

GENERAL PROGRAM

10:00 - 10:15 am: Greetings - Dean Oscar Barton
Introductions - Dr. A. Cole-Rhodes

10:15am – 12:00 PM: Concurrent Breakout Sessions 1, 2, 3, 4

SESSIONS CHAIRS

Session 1: Civil and Environmental Engineering (Dr. J. Hunter)
Session 2: Transportation & Urban Infrastructure Systems (Dr. Y.J. Lee)
Session 3: Artificial Intelligence and Machine Learning (Dr. C. Cole)
Session 4: Industrial, Systems Engineering and Rocketry Applications (Dr. G. Chen)

SYMPOSIUM COMMITTEE

Dr. Arlene Cole-Rhodes, Dr. Stephen Egarievwe, Dr. James Hunter, Dr. Young-Jae Lee, Dr. Cliston Cole, Dr. Guangming Chen

Session 1: Civil and Environmental Engineering (Dr. James Hunter)	
10:15 AM - 10:30 AM	**Investigation of self-healing characteristics of bacteria-based concrete** Izhar Ahmad Research Mentor: Dr Mehdi Shokouhian
10:30 AM - 10:45 AM	**Examining the Synergistic Impacts of Stormwater Management, Land Use, and Climate Change on Water Resources: A Case Study** Julia Atayi, Bello M. Zailani, Adriélli B. Pagnoncelli Research Mentor: Dr James Hunter
10:45 AM - 11:00 AM	**Removal of heavy metals from stormwater systems with Poultry Litter Biochar** Kayla Brown, Quenterrius Mason and Willet Debrah Research Mentor: Dr Donghee Kang
11:00 AM - 11:15 AM	**Sustainable Outcomes for Community-Driven Project Delivery: An Assessment of the Clean Water Partnership in Prince George's County, MD** Bello Mahmud Research Mentor: Dr James Hunter
11:15 AM - 11:30 AM	**Stable Isotope Analysis as a Tool for Verifying Interconnection between Different Aquifer Layers** Olajide Ipindola, Sunil Lamsal, and Ben Walrath Research Mentors: Dr Zhuping Sheng, Dr Yi Liu
11:30 AM - 11:45 AM	**Implement AI on image processing for Stormwater BMP (Best Management Practice) Assessment Using Unmanned Aerial Vehicle (UAV)-acquired Imagery** Kayla Brown, Rowland Oloye and Joshua Hamlett Research Mentor: Dr Donghee Kang
11:45 AM - 12:00 PM	**Investigation of soil health parameters for bioretention performance** Ida Mougang Ntonifor Research Mentor: Dr James Hunter

Session 2: Transportation & Urban Infrastructure Systems (Dr. YoungJae Lee)	
10:15 AM - 10:30 AM	**Application of Artificial Intelligence, Machine Learning, and Computer Vision in Smart Transportation Management System of an Underserved Community** Oyinkansola Aladeokin, Andrew Kelly, Shane Miller, and Tyrek Russell Research Mentor: Dr Oludare Owolabi
10:30 AM - 10:45 AM	**User Preference and Willingness-to-Pay Analysis for Mobility-as-a-Service (MaaS)** Hassan Rezapour and Abdulmalik Musa Maleka Research Mentors: Dr Young-Jae Lee, Dr. Hyeon-Shic Shin
10:45 AM - 11:00 AM	**Real Time Road Damage Detection Using YOLOv8** Joseph Aina, Benjamin Famewo, Terine Lambert Research Mentor: Dr. Steve Efe
11:00 AM - 11:15 AM	**The Impact of Experiment-centric Pedagogy on Motivation of Undergraduate Transportation Engineering Students** Adebayo Olude and Pelumi Olaitan Research Mentor: Dr Oludare Owolabi
11:15 AM - 11:30 AM	**Simio object-oriented modeling of a Car manufacturing plant** Opeyemi Fadipe, Joseph Moses, Chinonso Ubbaonu, and Michael Awotoye Research Mentors: Dr Seong Lee, Dr Jessye Talley
11:30 AM - 11:45 AM	**Air Pollution and Electric Vehicle Adoption: A literature Review** Pelumi Abiodun Research Mentor: Dr Oludare Owolabi

Session 3: Artificial Intelligence and Machine Learning (Dr. Cliston Cole)	
10:15 AM - 10:30 AM	**Multi-Stage Classification of Retinal OCT using Multi-Scale Ensemble Deep Architecture** Oluwatunmise Akinniyi Research Mentor: Dr Fahmi Khalifa
10:30 AM - 10:45 AM	**Cybersecurity Risk Assessment in Food and Beverage Plant at JBS Food Company – A Review** Rukayat O. Bello Research Mentor: Dr Cecilia Brown
10:45 AM - 11:00 AM	**An Intrusion Detection System (IDS) capable of analyzing event dependencies using association rule learning to classify network traffic flow** Olanrewaju Bucknor Research Mentors: Dr Richard Dean, Dr. Farzad Moazzami
11:00 AM - 11:15 AM	**Developing and Implementing a Neural Network-based Channel Estimation Scheme for an OFDM Communication System** Funmilola Akeju, Morgan Kokolika-Ngbalet Research Mentor: Dr Arlene Cole-Rhodes
11:15 AM - 11:30 AM	**Deep Learning Techniques for DNA Sequence Classification: Extracting Relevant Features for Improved Biomedical Data Analysis** Blessing Isoyiza Adeika, Danielle Wade, Daniel Little Research Mentor: Dr Saroj Pramanik
11:30 AM - 11:45 AM	**3D Storm Segmentation and Visualization Using Virtual Reality** Abiola Olayinka Ajala, Bocar Jallow, Ajan Coleman Research Mentor: Dr Xiaowen Li

Session 4: Industrial, Systems Engineering and Rocketry Applications (Dr. Guangming Chen)	
10:15 AM - 10:30 AM	**Synthesis and Characterization of Ferromagnetic Iron Alloys Using DC Magnetic Sputtering Device at Different Deposition Temperatures** Frank Efe Research Mentor: Dr. Abdellah Lisfi
10:30 AM - 10:45 AM	**Stress Indicators of the Urban Watershed Using Satellite Images** Benjamin Walrath Research Mentor: Dr Zhuping Sheng
10:45 AM - 11:00 AM	**Experimental Centric Pedagogy as Scaffolding for a Better Understanding of Calculus in the Mathematics Discipline** Tijesunimi Adeyemi and Pelumi Abiodun Research Mentor: Dr Oludare Owolabi
11:00 AM - 11:15 AM	**Application and Reliability of Robotic Process Automation** Chibuike Nosiri Research Mentor: Dr Guangming Chen
11:15 AM - 11:30 AM	**Heat Transfer Modeling in Laser Powder Bed Fusion Additive Manufacturing Process** Raphael Okafor Isaac Research Mentor: Dr Guangming Chen
11:30 AM - 11:45 AM	**Macro modeling of steel-concrete composite shear walls using PERFORM-3D** Seyedehnakisa Haghi Research Mentor: Dr. Steve Efe

Session 1: Civil and Environmental Engineering

Session Chair: Dr. James Hunter

10:15 AM - 10:30 AM

Project Title: **Investigation of self-healing characteristics of bacteria-based concrete**
Presenter: **Izhar Ahmad**
Research Mentor: **Dr. Mehdi Shokouhian**

Abstract: Concrete is highly susceptible to cracking due to its porous nature, and developments in its composition have increased its strength but done little to fix the tendency to form cracks. These cracks must be repaired otherwise would cause deterioration of concrete structure. Robust self-healing concrete, which requires less maintenance and repair throughout its service life than ordinary concrete, can be used for the development of sustainable infrastructure. This research aimed at investigating the self-healing properties of a bacteria-based concrete through experimental methods at microscopic and macroscopic levels. Three different kinds of bacteria from bacillus family were chosen as self-healing agents such as bacillus subtilis, bacillus magaterium and bacillus sphaericus. Light weight aggregates (LWA) were used as a carriers for bacteria. LWA were encapsulated with bacteria and nutrient solution. Tests performed were compression test, flexural test, ultraviolet pulse velocity test and scanning electron microscopy test. The resulting bio-engineered concrete showed very promising properties in terms of self-healing behavior. The results of this research study will help the construction industry to reduce maintenance costs and increase the durability of concrete in transportation infrastructure systems.

10:30 AM - 10:45 AM

Project Title: **Examining the Synergistic Impacts of Stormwater Management, Land Use, and Climate Change on Water Resources: A Case Study**

Presenters: **Julia Atayi, Bello M. Zailani, and Adriélli B. Pagnoncelli**

Research Mentor: **Dr. James Hunter**

Abstract: The degradation of natural water ecological systems poses a significant challenge for urban development. Research indicates that global precipitation patterns are changing, leading to alterations in hydrological systems worldwide. Several research have highlighted the intertwined influence of urbanization and climate change dynamics on these hydrological changes. Given the rapid growth of the global economy and the continuous increase in urbanization, this study employs a case study approach to investigate the effects of land use and climate change on stormwater variability. To examine the study variables, data from the National Land Cover Database (NLCD) and the National Water Information System (NWIS) were utilized in Prince George's County, USA. The research reveals valuable insights, indicating that despite the variations in precipitation, temperature, and urbanization, the implementation of effective stormwater management strategies can address the persistent environmental challenges caused by urbanization and climate change dynamics. Based on the findings, strategic mechanisms are recommended to enable the sustainable implementation of nature-based solutions that promote the natural hydrology of stormwater. These mechanisms would help address the negative impacts of urbanization and climate change while fostering the resilience of water ecological systems. Furthermore, the study highlights the importance of understanding the interplay between land use, climate change, and stormwater variability. In conclusion, this study highlights the significance of adopting appropriate stormwater management strategies and embracing nature-based solutions in urban areas. By doing so, urban areas can effectively navigate the challenges posed by urbanization and climate change, ultimately ensuring the sustainability and health of water ecological systems.

10:45 AM - 11:00 AM

Project Title: **Removal of heavy metals from stormwater systems with Poultry Litter Biochar**
Presenters: **Kayla Brown, Quenterrius Mason, and Willet Debrah**
Research Mentor: **Dr. Donghee Kang**

Abstract: Water contamination is produced from human activities in various fields: industries (such as metallurgical, mining, chemical, tannery, battery and nuclear), agriculture, shipping, and others. It causes aquatic pollutants (antibiotics, heavy metals, nutrients, and organic pollutants) which has become the most serious issue related to human health risks. One of the methods used in order to decontaminate the water system from these pollutants is biochar (BC). Biochar is found to be the most effective and sustainable agent for water decontamination because of its diverse properties. The efficiency and type of a specific mechanism depend on various factors (temperature, feedstocks, heating rate, and particle size largely), and the target pollutants. Biomass waste materials appropriate for biochar production include crop residues, as well as yard, food and forestry wastes, and animal manures. The biochar used is prepared three different ways using wood chips, rice, and poultry litter. Poultry litter biochar is produced from fresh poultry litter heated at 300 °C temperature for 10 min in a muffle furnace. It is created through the pyrolysis process at temperatures 300 °C and 500 °C. Pyrolysis is the breaking down (lysis) of a material by heat (pyro) and is performed in oxygen-free conditions. We have a total of 15 different samples. For each sample we measure different weights (0.01, 0.03, 0.06, and 0.12 g) and test with different chemicals. The chemicals used are lead (Pb) and copper (Cu). Then we put on shaker for 18 hours, test the substance through a centrifuge to separate the solid substance from the liquid, filter, and measure the pH. We measure the data using an Atomic Absorption Spectrometer to measure the amount of metal that was removed and remained in sample.

11:00 AM - 11:15 AM

Project Title: **Sustainable Outcomes for Community-Driven Project Delivery: An Assessment of the Clean Water Partnership in Prince George's County, MD**
Presenter: **Bello Mahmud**
Research Mentor: **Dr. James Hunter**

Abstract: Municipalities in the United States have partnered with the private sector to address increasing environmental challenges posed by stormwater runoff. Low Impact Development (LID) can be used to establish green infrastructure assets, which can ultimately offer unique opportunities for social equity and workforce development. A sustainability triple-bottom-line framework was used to examine the Clean Water Partnership (CWP), the first Community-Based Public Private Partnership (CBP3) in the US focused on implementing LID projects in Prince George's County, MD. Results show that adopting a community-driven approach to delivering and maintaining stormwater infrastructure assets can provide long-term sustainable benefits to host communities. This study also highlights the role of outreach programs in enabling minority inclusion and workforce development, especially when it comes to delivering and maintaining green infrastructure assets.

11:15 AM - 11:30 AM

Project Title: **Stable Isotope Analysis as a Tool for Verifying Interconnection between Different Aquifer Layers**

Presenters: **Olajide Ipindola, Sunil Lamsal, and Ben Walrath**

Research Mentors: **Dr. Zhuping Sheng and Dr. Yi Liu**

Abstract: Isotopes have been successfully used in the field of hydrogeology to define groundwater recharge sources and mechanisms, to determine groundwater age, rate of movement, and to quantify the mixing of groundwater between aquifers. Managed aquifer recharge (MAR) has been considered for conjunctive management of regional water resources in Anne Arundel County, Maryland. One of the major concerns is the movement of injected water between aquifers. This study employs the stable isotopes of $^{2}H/^{1}H$, $^{18}O/^{16}O$ and $^{13}C/^{12}C$ to verify interconnections between the upper Patapsco, lower Patapsco and Patuxent aquifers at the anticipated MAR site in Anne Arundel County. Groundwater samples were collected from wells pumping from the aquifers under investigation and their isotopic composition were analyzed using mass spectrometry technique to verify possible interconnections. In addition, chemical analysis of the aliquot was conducted to ascertain its quality. Initial results indicate progressive depletion of heavier isotopes with depth in the aquifers investigated. The results of the stable isotope analysis were also compared with established empirical techniques based on hydraulic properties retrieved from well log information of the sampled wells.

11:30 AM - 11:45 AM

Project Title: **Implement AI on image processing for Stormwater BMP (Best Management Practice) Assessment Using Unmanned Aerial Vehicle (UAV)-acquired Imagery**
Presenters: **Kayla Brown, Rowland Oloye, and Joshua Hamlett**
Research Mentor: **Dr. Donghee Kang**

Abstract: AI systems are computer programs that leverage machine learning and other advanced techniques to process and analyze large amounts of data, recognize patterns, make predictions, and generate responses or perform actions. They are built upon algorithms and models that learn from data and improve their performance over time through training. AI systems rely on data to learn and make predictions or decisions. They can be trained using supervised learning which involves providing labeled data to train the system. Unsupervised learning allows the system to identify patterns in unlabeled data. Reinforcement learning involves training the system through a reward-based system, where it learns from feedback on its actions. The objective of this project is to use the AI system to monitor BMPs, bioswales, and temperature. We will train the AI using supervised learning by entering data to help it identify what is plant, concrete, and monitor temperature. In order to do this, we will be collecting data using DJI Mavic 2 Pro, OpenCV, WebODM, and ArcGIS pro. The drone is used to take aerial images which are uploaded to image processing programs in order to analyze the data. Image processing will allow us to check the status of the BMPs and bioswales and create a code in order to make predictions of future maintenance needed in the future to keep it functional. It will also analyze and color code the temperature of the environment when the picture was taken and make predictions of the temperature in the future. The temperature will help us determine how it will affect the function of the BMPs and bioswales.

11:45 AM - 12:00 PM

Project Title: **Investigation of soil health parameters for bioretention performance**
Presenter: **Ida Mougang Ntonifor**
Research Mentor: **Dr. James Hunter**

Abstract: Bioretention systems are commonly used to ease stormwater runoff and have gained in popularity over the past two past decades and their performances have been validated over time. Stormwater professionals have expressed concern about the lack of clarity in how these best management practices are to be inspected, maintained, and effectively verified. During the present study, standard inspection of the facilities was performed using inspection checklists and soil health assessments to corroborate results obtained from ordinary inspections. Soil health in this study was assessed in three separate but synchronized pathways. The biological assessment includes the soil microbial respiration (Measurement of the rate of CO_2 production by the soil), was taken as an indicator to quantify microbial activity. The chemical pathways include soil pH, salinity, and organic matter. Moreover, physical evaluation also takes place to complete soil health assessment. Alongside, lab-scale experiments were carried out to appreciate different soil media amendments to determine the most advantageous amendment that promote higher soil respiration, healthy plant coverage regime and performance scenarios of the bioretention system. Fifty-eight bioretention systems were assessed and the results indicate that soil health parameters of 98% of investigated practices corroborate results obtained from the traditional inspection. In addition, correlation between CO_2 level and percentage of fungi population was also characterized as well as most advantageous amendment that promotes healthy performing practice.

Session 2: Transportation & Urban Infrastructure Systems

Session Chair: Dr. YoungJae Lee

10:15 AM - 10:30 AM

Project Title: **Application of Artificial Intelligence, Machine Learning, and Computer Vision in Smart Transportation Management System of an Underserved Community**
Presenters: **Oyinkansola Aladeokin,Andrew Kelly, Shane Miller, and Tyrek Russell**
Research Mentor: **Dr. Oludare Owolabi**

Abstract: The emergence of cutting-edge technologies such as the Internet of Things (IoT); artificial intelligence, machine learning, and computer vision, has enabled the exploitation in addressing the demand for intelligent solutions in transportation systems due to the increased population and globalization. For a robust and resilient transportation system, a city must be smart and intelligent. Smart cities are distinguished by intelligent traffic planning, efficient, safe transportation systems, and efficient connectivity of all road users, which are critical to smart transportation management. The significance of artificial intelligence approaches such as machine learning-based approaches for addressing these demands and needs in transportation systems has been redefined due to the availability of greater computer power and the collection of large amounts of data. This research focuses on the application of artificial intelligence, machine learning, and computer vision in data, information, and smart decision-making process to solve transportation challenges such as safety, congestion, and mobility in smart transportation management systems. It also gives an overview of the current state, trends, and future developments of these intelligent computer-based technologies.

10:30 AM - 10:45 AM

Project Title: **User Preference and Willingness-to-Pay Analysis for Mobility-as-a-Service (MaaS)**
Presenters: **Hassan Rezapour and Abdulmalik Musa Maleka**
Research Mentors: **Dr. Young-Jae Lee and Dr. Hyeon-Shic Shin**

Abstract: Mobility-as-a-Service (MaaS) is an emerging concept in transportation which seeks to find the best solution for improving passenger mobility services. It was developed within the last decade, but has already become a popular concept in the transportation and mobility field. MaaS describes a shift away from personally-owned modes of transportation and towards mobility provided as a service. It is enabled by integrating transportation services from public and private transportation providers, such as transit, bike sharing, e-scooter sharing, shared mobility and ride hailing, through a unified gateway that creates and manages the trip, for which users can pay with a single account. In this research project, the research team will explore to what extent MaaS can be a sustainable and promising choice for users through estimating users' willingness-to-pay and user preference structure. Then the results of user preference and willingness-to-pay will be used as an input in an MaaS simulation for the State of Maryland to assess the impact of MaaS adaptation, such as on conventional transit usage, traffic congestion and the environmental. The following techniques will be employed by the research team. First, an adaptive choice based conjoint (ACBC) survey (an online survey using Sawtooth Software's) and analysis will be conducted to estimate people's acceptance of and willingness to pay for MaaS. To establish a hypothesis for the study's main method, a structural equation model revealing the characteristics of MaaS will be built.

10:45 AM - 11:00 AM

Project Title: **Real Time Road Damage Detection Using YOLOv8**
Presenters: **Joseph Aina, Benjamin Famewo, and Terine Lambert**
Research Mentor: **Dr. Steve Efe**

Abstract: Real-time road damage detection plays a crucial role in ensuring efficient transportation infrastructure maintenance and enhancing road safety. This study focuses on the application of the YOLOv8 algorithm for real-time road damage detection, aiming to provide timely and accurate information for effective decision-making and prompt repairs. The YOLOv8 algorithm was fine-tuned to identify bounding boxes associated with various types of road damage, including cracks of different sizes and irregular shapes. The model's performance was evaluated using precision, accuracy (R), F1-score, and mean average precision (mAP) indicators, demonstrating its effectiveness in detecting road damages with high accuracy. The successful implementation of real-time road damage detection systems has significant implications for proactive and targeted repairs, ultimately contributing to improved road safety and infrastructure longevity. By leveraging the power of YOLOv8 and utilizing a comprehensive dataset, this study aims to provide an accurate, efficient, and deployable solution for real-time road damage detection. The findings of this study have the potential to advance transportation infrastructure maintenance practices, particularly in the context of the United States, fostering safer and more sustainable road networks.

Keywords: YOLOv8, cracks, precision, accuracy (R), F1-score, mean average precision (mAP), real-time road damage detection

11:00 AM - 11:15 AM

Project Title: **The Impact of Experiment-centric Pedagogy on Motivation of Undergraduate Transportation Engineering Students**
Presenters: **Adebayo Olude and Pelumi Olaitan**
Research Mentor: **Dr. Oludare Owolabi**

Abstract: Motivation is an important factor in student learning. The case study focuses on a historically black university that employed a hands-on learning approach. This research describes the strategy, implementation, and development of Experiment-centric pedagogy teaching in the transportation discipline. Key constructs related to student achievement were measured using Motivated Strategies of Learning Questionnaires. The Signature assignments were used to assess students' performance before and after the pedagogy was implemented. COPUS (Class Observation Protocol for Undergraduate Students) was also used to assess instructor-student interactions throughout the laboratory session. The results indicated that some MSLQ key constructs had a significant difference, and data was analyzed using the Statistical Package for Social Sciences (SPSS).

11:15 AM - 11:30 AM

Project Title: **Simio object-oriented modeling of a Car manufacturing plant**
Presenters: **Opeyemi Fadipe, Joseph Moses, Chinonso Ubbaonu, and Michael Awotoye**
Research Mentors: Dr. Seong Lee and Dr. Jessye Talley

Abstract: The object-oriented approach of Simio allows for the modeling of various components, such as assembly lines, machines, and workers, as discrete objects that interact realistically and dynamically. The study is about a Car manufacturing plant making a crucial decision regarding expanding the existing plant's capacity or establishing a new one, considering the increasing demand for a new car model. The methodology involves problem identification, data collection, model development, model validation, scenario testing, performance analysis, optimization, and interpretation of results. By employing Simio object-oriented modeling, this study aims to demonstrate the power and versatility of simulation in improving complex manufacturing systems. The simulation results will provide insights and recommendations to help Ford and other automotive manufacturers enhance their operations The result shows that with an increase in the cost from $75700 to $99200, we have more cars produced by the existing plants, which is more cost-effective than trying to start a new plant.

11:30 AM - 11:45 AM

Project Title: **Air Pollution and Electric Vehicle Adoption: A literature Review**
Presenter: **Pelumi Abiodun**
Research Mentor: **Dr. Oludare Owolabi**

Abstract: Among the several threats that humans and the environment face daily is air pollution. The introduction of toxic and harmful substances which can be suspended in the atmosphere from various human activities stands as a major contribution to the ailing air quality status in several countries of the world. The introduction of electric vehicles has been opined to reduce transportation contribution to air pollution burdens globally. This review, which is in progress, has identified that with the increase in adoption of electric vehicles, there has been little to no attention paid on the air quality in relation to the adoption rate of electric vehicles, However, efforts are being made to investigate the sources of air pollutants in different part of the world and transportation still stands as a major source.

Session 3: Artificial Intelligence and Machine Learning

Session Chair: Dr. Cliston Cole

10:15 AM - 10:30 AM

Project Title: **Multi-Stage Classification of Retinal OCT using Multi-Scale Ensemble Deep Architecture**
Presenter: **Oluwatunmise Akinniyi**
Research Mentor: **Dr. Fahmi Khalifa**

Abstract: Accurate noninvasive diagnosis of retinal disorders is required for appropriate treatment or precision medicine. This work proposes a multi-stage classification network built on multi-scale (pyramidal) feature ensemble architecture for retinal image classification using optical coherence tomography (OCT) images. First, a scale adaptive neural network is developed to produce multi-scale inputs for feature extraction and ensemble learning. The larger input sizes give more global information, while the small input sizes focus on local details. Then, feature-rich pyramidal architecture is designed to extract features from multi-scale as inputs using DenseNet as the backbone. The advantage of the hierarchical structure is that it allows the system to extract multi-scale information rich features for the accurate classification of retinal disorders. Evaluation on public OCT data set containing normal and abnormal retinas (e.g., diabetic macular edema (DME), choroidal neovascularization (CNV), age-related macular degeneration (AMD), and Drusen) and comparison against recent networks demonstrates the advantages of the proposed architecture's ability to produce feature-rich classification with average accuracy was 97.8%, 96.8%, and 94.3% for the first (binary) stage, second (3-class) stage, and all-at-once (4-class) classification respectively using cross-validation experiments. Overall, the tangible advantages of the proposed network for enhanced feature learning might be used for various medical image classification tasks where scale-invariant features are crucial for precise diagnosis.

10:30 AM - 10:45 AM

Project Title: **Cybersecurity Risk Assessment in Food and Beverage Plant at JBS Food Company – A Review**
Presenter: **Rukayat O. Bello**
Research Mentor: **Dr. Cecilia Brown**

Abstract: The rapid increase in the world's population has made most commercial food processing industries to practicing digital technologies in their supply chain. However, to sustain such practices, it requires a proactive approach to mitigate any risk of cyber theft. Such a technique will allow timely, consistent, and efficient production methods while preventing or minimizing any risk of cyber theft and complications that could disrupt smooth operations. This study aims to review and assess the cybersecurity risk that is involved in the Food and Beverage Plant at JBS and other Food Companies. The research methodology was defined based on PRISMA guidelines such as assessing various methods from previous related studies which include definitions, activities at JBS food and beverage industry as compared to other food industries, management systems, cyber-attacks in food industries, the impact of the attack, their mitigating factors, and some different solutions to curb cyber-attacks. The analysis allowed us to assess the mitigating factors of cyber threats at JBS and other food and beverage industries. This assessment and comparison help give insight into some likely causes of cyber threats in the food industries, their impact on the economy, mitigating factors, and how they can be managed to prevent future occurrences and complications in the food and beverage industries. The core teachings in the food and beverage industries from this research gave more insights into how cyber threats affect the food industries, likely complications from the cyber-attack, and the management method to curb such threats. However, future research should delve more into how operations in the food and beverage industries can be managed to prevent food loss/waste that may occur due to the downtime of the equipment and machine operations caused by these cyber-attacks. The result from this review gave insight into cyber-threats in the food industries, their implications, management methods to prevent future occurrences, and the definition of future research.

10:45 AM - 11:00 AM

Project Title: **An Intrusion Detection System (IDS) capable of analyzing event dependencies using association rule learning to classify network traffic flow**

Presenter: **Olanrewaju Bucknor**

Research Mentors: **Dr. Richard Dean and Dr. Farzad Moazzami**

Abstract: An anomaly-based Intrusion Detection System (IDS) capable of analyzing event dependencies and classifying network traffic flow. The model uses association rule learning to identify event sequences derived from intercepted or logged network traffic data. The anomaly confidence score is then determined based on one or more dependencies between event sequences. This score is used to classify the network traffic flow and alert the security team of any potential malicious activity. The system is designed to be adaptable and efficient, using machine learning techniques to continuously update the model as new patterns emerge. The system also incorporates a feedback loop that allows the IDS to refine its performance over time by learning from previous false positives and false negatives. The system is also scalable, allowing it to quickly adjust to changing network traffic patterns.

11:00 AM - 11:15 AM

Project Title: **Developing and Implementing a Neural Network-based Channel Estimation Scheme for an OFDM Communication System**
Presenters: **Funmilola Akeju and Morgan Kokolika-Ngbalet**
Research Mentor: **Dr. Arlene Cole-Rhodes**

Abstract: "In order to compensate for signal attenuation and distortion in wireless communication systems
due to multipath effects, it is necessary to obtain knowledge about the channel impulse response using a channel estimation method. Orthogonal frequency division multiplexing (OFDM) is a multicarrier modulation scheme used in several broadband systems, including asymmetric digital subscriber lines, very-high-speed digital subscriber lines, digital video and audio broadcasting, and wide local area network standards. It is a promising method for achieving high speeds of data in wireless communication. In this project, we aim to develop and implement an end-to-end channel estimation and signal recovery method for an OFDM communication system. The proposed channel estimation method will be based on a neural network algorithm and developed in Python, and we will evaluate its performance and accuracy. Transmit and receive data is currently available from our previously developed MATLAB simulator, for the basic single-carrier SISO wireless communications system. This data will initially be used to train and test the developed neural network for channel estimation. The work on channel estimation and signal recovery will further be extended to cover a MIMO-OFDM system with multiple antennas at the transmitter and multiple antennas at the receiver. The development of this MIMO-OFDM communication system will be outlined.

11:15 AM - 11:30 AM

Project Title: **Deep Learning Techniques for DNA Sequence Classification: Extracting Relevant Features for Improved Biomedical Data Analysis**
Presenters: **Blessing Isoyiza Adeika, Danielle Wade, and Daniel Little**
Research Mentor: **Dr. Saroj Pramanik**

Abstract: DNA sequence classification plays a pivotal role in biomedical statistics analysis, particularly in the identification and categorization of viruses to prevent outbreaks like COVID-19. While machine learning techniques have been successfully applied to this task, the challenge lies in feature selection due to the high dimensionality and lack of explicit functions in DNA sequences. In this research, the utility of deep learning (DL) strategies are explored, specifically Recurrent Neural Networks (RNN) and Convolutional Neural Networks (CNN) combined with Bidirectional Long Short-Term Memory (LSTM) architectures, using Label and K-mer encoding techniques to address these limitations. The study builds upon existing research and references various studies and research papers that investigate the application of DL architectures for DNA sequence classification. To compare their performance against traditional machine learning models, we will present results from our experiments using diverse datasets. The findings are aimed to demonstrate that DL approaches exhibit promising results, surpassing other classifiers, and achieving high accuracy even with small sequence fragments. The proposed DL models would automatically extract relevant features from input data, contributing to the fields of bioinformatics and genomics. This research would highlight the significance of deep learning strategies in DNA sequence classification, showcasing their effectiveness and potential contributions in revolutionizing biomedical research by improving the analysis and understanding of DNA sequences.

11:30 AM - 11:45 AM

Project Title: **3D Storm Segmentation and Visualization Using Virtual Reality**
Presenters: **Abiola Olayinka Ajala, Bocar Jallow, and Ajan Coleman**
Research Mentor: **Dr. Xiaowen Li**

Abstract: Storms are complex atmospheric phenomena that present significant challenges in understanding their structure and dynamics due to their constantly changing and evolving nature, making traditional tracking, and studying methods difficult. To address this, 3D storm segmentation algorithms are utilized to identify and track different parts of the storm and identify areas with varying characteristics like cloud type, temperature, and wind speed. This research project aims to revolutionize the study and understanding of severe weather events by combining 3D storm segmentation algorithms with immersive virtual reality (VR) environments. By creating highly detailed and interactive models of storms using these technologies, one can explore storm structure and dynamics in ways previously impossible. Data is stimulated and segmented to generate a dataset for computer models, which will be rendered in 3dimensions and displayed using Unity or Unreal Engine5 within specialized VR headsets like Oculus Meta Quest2 or HTC Vive. The VR environment will enable users to immerse themselves in the storm and observe its behavior from various angles, providing a more detailed and accurate understanding of severe weather events. The objective is to label, slice, and segment the cloud data using VR, enabling the identification of different storm parts and tracking their movements over time. This information will facilitate the study of storm structure, dynamics and improved forecasting models. Overall, this research has the potential to transform how we study and understand severe weather events by leveraging cutting-edge technology, researchers can gain new insights into storm behavior, leading to better prediction and preparation.

Session 4: Industrial, Systems Engineering and Rocketry Applications

Session Chair: Dr. Guangming Chen

10:15 AM - 10:30 AM

Project Title: **Synthesis and Characterization of Ferromagnetic Iron Alloys Using DC Magnetic Sputtering Device at Different Deposition Temperatures**
Presenters: **Frank Efe**
Research Mentor: **Dr. Abdellah Lisfi**

Abstract: Iron platinum (FePt) thin film materials have attracted researchers' attention throughout the years due to their desired characteristics in device applications. As a result, it is necessary to switch the bit alignment of nanomaterial storage devices from longitudinal to perpendicular as seen in heat-assisted magnetic recording (HAMR). Thus, FePt thin films are promising for such applications, enhancing the device's storage capacities. This is a result of the film's double-switching properties at high temperatures. Various deposition techniques have been deployed by researchers in the growth of FePt thin film materials, ranging from chemical vapor deposition to molecular beam epitaxy, and magnetic sputtering devices, to mention a few. The source of the occurrence of double switching in the film's magnetic properties has not been the subject of many studies. Here, we describe the growth of FePt films on oxidized silicon, silicon wafer, and glass substrates at various temperatures via a magnetic sputtering device. We also investigate the topology, structure, chemical makeup, magnetic properties, and elemental characteristics of the produced equiatomic FePt films to understand why FePt thin films on silicon substrates exhibit double-switching properties.

10:30 AM - 10:45 AM

Project Title: **Stress Indicators of the Urban Watershed Using Satellite Images**
Presenter: **Benjamin Walrath**
Research Mentor: **Dr. Zhuping Sheng**

Abstract: This project investigates how land use influences water quality in the urban environment—specifically, Herring Run. I examined data for the watershed spanning 28 years, looking for patterns and change over time. I based my analysis on water quality observations recorded by the U.S. Geological Survey and the Maryland Department of the Environment. For context, I also included precipitation data from the National Oceanographic and Atmospheric Administration. Following methods published by the U.S. Army Corps of Engineers, I analyzed satellite imagery in Q-GIS™, which I downloaded from the Multi-Resolution Land Characteristics Consortium. To gain field experience, I collected water quality observations from multiple locations along Herring Run on two separate visits, using a HANNAH™ portable meter. Finally, I drafted a report and created a presentation summarizing my research.

10:45 AM - 11:00 AM

Project Title: **Experimental Centric Pedagogy as Scaffolding for a Better Understanding of Calculus in the Mathematics Discipline**

Presenters: **Tijesunimi Adeyemi and Pelumi Abiodun**

Research Mentor: **Dr. Oludare Owolabi**

Abstract: The field of calculus is critical to the success and advancement of many engineering and statistical systems. Calculus provides ways of analyzing transient quantities, including data collected from sensors, determining the area under a curve, fitting a line for predictive analytics, and price changes in the stock market. It is also core to the understanding of numerous probability distributions in statistics, hence, fundamental knowledge of this concept is crucial for a successful career in science, technology, engineering, and math (STEM). The proposed experiment will ease the complexities involved in the learning of calculus students by using experimental centric pedagogy (ECP), which entails providing simple yet relevant experiments that would boost the students' interest in this field. The concepts of differentiation and integration would be practically demonstrated to students using Hooke's law, velocity, acceleration with respect to time, and ruler experiment. The project would employ readily available utilities to demonstrate integration and differentiation to the students. These experiments will also enable the students to appreciate the relevance of these concepts in STEM fields.

11:00 AM - 11:15 AM

Project Title: **Application and Reliability of Robotic Process Automation**
Presenter: **Chibuike Nosiri**
Research Mentor: **Dr. Guangming Chen**

Abstract: "
This research dissertation aims to investigate the application of robotic process automation (RPA) and its reliability in Industrial Engineering. RPA is a new modern technology that automates repetitive tasks without the intervention of human processing and data entry. Industrial engineering involves creating and deploying comprehensive systems that merge human, machine, and information resources to deliver goods and services. This encompasses designing, developing, and implementing these systems cohesively and efficiently. The efficiency and reliability of industrial systems will drastically improve if RPA is incorporated. The literature review lays out the backgrounds and history of RPA, applications, and types in industrial engineering. It also investigates the benefits and disadvantages of RPA in Industrial Engineering and the elements that influence its reliability. A review of previous research on RPA application in industrial engineering is also being researched to provide a basis for this research. The methodology section will explain the research approach and design used in this research. The research design is a mixture of both quantitative and qualitative data analysis collection methods. Data will be collected through surveys, case studies, and document analysis of organizations that have implemented RPA in their industrial processes. The data is then analyzed using statistical methods and qualitative analysis techniques. The technical keywords in researching are. ANOVA, P-value factor, RPA, Blue Prism, Automation Anywhere. The finding and results chapter will report the analysis and findings from the data gotten. The case studies will give detailed reports on the application of RPA in industrial engineering and highlight the significance of monitoring, planning, and implementation of RPA software to guarantee their reliability. In general, the research will make some contributions to RPA in the field of industrial engineering and engineering overall. It will create a new awareness of the applications of RPA in industrial engineering and its ability to improve productivity and efficiency.

11:15 AM - 11:30 AM

Project Title: **Heat Transfer Modeling in Laser Powder Bed Fusion Additive Manufacturing Process**

Presenters: **Raphael Okafor Isaac**

Research Mentor: **Dr. Guangming Chen**

Abstract: Inadequate knowledge of the quantity of heat needed to melt powder bed is an aspect yet to be researched in laser powder bed fusion additive manufacturing process (or selective laser melting). This can be solved by numerical simulation while considering the surrounding powder bed modeled to have an effective thermal conductivity. In order to accurately determine the quantity of heat required to melt the powder bed, there is need to know some important physical parameters of the type of powder material to use, such as melting temperature, boiling temperature, latent heat of vaporization, surface temperature, net mass flux, and saturated vapor pressure. For example, Copper is selected for the study and its thermal conductivity is a critical property considered for the heat transfer modeling. The aim of the study is to determine how much heat energy can melt the metal powder to the desired solid state. This can be achieved by calculating the quantity of heat energy that goes into the powder, the quantity of heat stored in the powder and quantity of heat that leaves the powder considering some of its physical properties and substituting its parameters into a relevant equation. The result of the study shows that heat transfer contribution due to evaporative cooling (21,085,985.44 J) is more significant compared to heat transfer contribution due to radiative cooling (38,030.70 J). Heat transfer contribution due to convective cooling (10,650 J) has much less influence compared to the evaporative cooling and radiative cooling of the melt pool. Hence, the total heat required to melt the copper is 21,037,304 J. The study showed that copper was selected because of its high thermal conductivity. The result showed that the higher the laser power P, the higher the surface roughness Ra of the desired part produced irrespective of the different scanning speed v and hatch distance hd; for example, Ra = 9.92 µm is lowest when P = 120 W, v = 250 mm/s and hd = 0.08 mm. Ra = 35.75 µm is highest when P = 360 W, v = 250 mm/s and hd = 0.14 mm.

11:30 AM - 11:45 AM

Project Title: **Macro modeling of steel-concrete composite shear walls using PERFORM-3D**

Presenter: **Seyedehnakisa Haghi**

Research Mentor: **Dr. Steve Efe**

Abstract: Abstract: Although several macro models exist to simulate the global response of steel plate and reinforced concrete shear walls, no robust macro model has been developed yet for the simulation of the cyclic inelastic response of steel-concrete (SC) composite shear walls. Herein, a novel macro model is proposed for steel-concrete shear walls in order to expand the application of such systems to the building industry and infrastructures. The proposed model is implemented in the CSI PERFORM-3D program to simulate the nonlinear seismic response of the SC shear walls. The proposed model is validated using 17 available test data of SC wall specimens consisting of various geometries. This new model is proven to appropriately predict the global response of SC shear walls including the initial stiffness, peak shear strength and associated displacement, stiffness and strength degradation, and pinching behavior.