



Research Scholars Program

List of CRSP students and their abstracts presented at the 2024 CRSP Symposium

Temperature Sensor DC Fan with LED as its Indicator

About Bah

Mentor: Professor Dimitrios Pavlidis

Tracking and managing temperature is the foundation of many industries, with systems ranging from common large air conditioning units to smaller designs such as water-cooled heat sinks in computers. This system is based on a proportional-control mechanism that addresses high temperatures at specified locations. The system will manage temperature like how computer systems use a fan curve, ramping up fan speed to better control temperature. By using this method, the system activates a DC fan whose speed adjusts in real-time based on the temperatures that are detected. Fan speed increases in reaction to higher temperatures, resulting in an effective cooling response. LED indicators are incorporated into the system to improve user interaction and offer a clear depiction of the thermal conditions. Users can select a target temperature, for example 20°C, and the LEDs will then visually convey whether the measured locations are above, below, or in-line with the desired temperature. People can successfully monitor and control temperatures thanks to this user-friendly interface, which helps maintain a controlled and optimal thermal environment.

How Circular Vegetation Shapes Water Flow

Ahmad Basyouni

Mentor: Professor Kamau Kingora

Traditionally, plant life has been arranged in linear rows. But what if we looked at nature's design? Circular vegetation patches are becoming very common, and researchers are starting to wonder if they might offer hidden benefits. This research dives into the impact of circular vegetation arrangements compared to traditional linear layouts. Utilizing computational fluid dynamics (CFD) simulations, the study investigates water flow patterns and the transfer of materials (like heat or pollutants) within colonies of different densities. The findings show distinct flow patterns within circular colonies, characterized by zones of both faster and slower water movement compared to linear configurations. Furthermore, the research suggests that these circular layouts cause variations in turbulent kinetic energy, which might influence how efficiently materials are transferred within the system. These insights suggest that circular vegetation arrangements could be a valuable tool for enhancing agricultural practices.

Tumor Grade Associated Collagen Signatures and Overall Patient Survival in Gliomas: A Developing Story

Caitlen Carela, Melina Turco, and Ambar Alvarenga

Mentor: Professor Nancy Liu-Sullivan

Glioblastoma multiforme (GBM) is the most aggressive type of brain cancer with an abysmal survival rate of merely 14.6 months and with no known cure yet. Indeed, GBM is on a short list of extremely challenging cancers to therapeutic interventions. Among multiple factors, desmoplasia, the protective wall surrounding GBM tumor microenvironment (TME) has been recognized as a major contributing factor in tumor resistance against medical interventions. Collagens which are a group of key structural proteins in the skin and connective tissues have been recognized as playing major roles in desmoplasia scaffolding in GBM. To our knowledge, however, most published literature compares collagens found in GBM versus collagens in the normal brain. More in-depth comparison in differential roles of collagens in GBM, such as the high-grade glioma (HGG) versus low-grade glioma (LGG), would provide an additional dimension to the characterization of collagens in TME. Considering how certain LGG can deteriorate to become HGG with tougher collagen-embedded desmoplasia and, therefore, enhanced resistance to therapeutics, characterizing tumor grade associated collagen expression alterations would help expand our knowledge of collagen biology in TME with potential to identify collagen as well as collagen-associated tumor markers and new drug targets in GBM. To this end, we explored whether or not differential collagen gene expression exist in HGG versus LGG and identified previous unappreciated roles of collagen types and their association with the overall survival of glioma patients. Here, we present our current findings as part of an ongoing project.

A Study on Wind Turbine Nacelles Using Festo Nacelle Learning System

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Mentor: Professor Syed Rizvi

The College of Staten Island has invested in Festo Nacelle's learning systems. A nacelle is housing at the top of the tower that keeps everything needed for the wind power station including gearbox, brakes, generator, and supporting electronics except the blades. Blades are connected to the generator through a gearbox with low and high-speed shafts. The nacelle training system gives CSI students the opportunity to use these cutting-edge technologies in engineering and tech-related careers. There is a shortage of workforce trained to operate and maintain the wind power stations. Training on the Festo nacelle improves the chances of consistently providing power to large cities such as New York. The investment of CSI in these machines gives its students a competitive edge in their careers. We achieve this by first developing an understanding of the components of the nacelle learning system. Also, these components can be observed while the nacelle is operating to understand the power-production process. The HMI (HumanMachine Interface) informs us about all the necessary information. And with the help of professors at CSI's engineering department, students learn to use these machines for a brighter future. Wind simulations are also conducted to comprehend the function of wind turbine components. The HMI is utilized for these simulations and to adjust the internal components of the nacelle. For example, we learn through experimentation which angle of the blades can best harness nature's wind supply to generate more electricity for the highest percentage of generated power. At CSI, engineering students get to have hands-on experience, giving them unique career opportunities and the ability to innovate.

Beneath the Binary: A Journey into Covert Communication

David Liao

Mentor: Professor Sos Agaian

In an era where digital advancements continue to transform the landscape of secure communication, the need for discreet information transmission methods has never been more crucial. Amidst this, steganography emerges as an arcane technique; adept at embedding information within digital images to avoid unauthorized detection perfectly. This study introduces a steganographic method that harnesses the technique of bit plane slicing. By decomposing digital images into their constituent bit planes, this approach facilitates the nuanced alteration of pixel bits, targeting the least significant bits (LSBs) for the inclusion of hidden messages. This modification is ingeniously designed to remain below the threshold of human perception, thus preserving the visual identity of the original image. A critical examination of this method reveals a careful equilibrium between the imperatives of data concealment and the integrity of image quality, underscoring its resilience to steganalysis; efforts aimed at uncovering such clandestine information. Through a series of experiments, our investigation corroborates the method's proficiency in embedding and retrieving data with negligible impact on visual quality, thereby underscoring its utility in secure and inconspicuous communication. The outcomes of this exploration not only contribute significantly to the burgeoning domain of digital image processing but also pave new pathways for research into sophisticated steganographic methodologies to meet rising concerns.

Emphasis in Speech: The Individual's Perspective

Jade Smith, Ashley Mesa, Kayla Goldstein, Cristina Pineda

Mentor: Professor Jason Bishop

The present study explores how personality might influence the way people perceive vocal emphasis in speech. More specifically, we investigate how differences in perspective-taking ability influence a person's sensitivity to emphasis in recordings of spoken English. Perspective-taking abilities, sometimes referred to as "empathy," vary from person to person and may play an important role in interpreting the intentions of others; some of these intentions relate to emphasis and other aspects of intonation. To test this, we are measuring (in a study still in progress) the perspective-taking abilities of a large group of native English-speaking participants using tests of emotion recognition. These participants are then asked to listen to recordings of speech and try to identify words pronounced in vocal emphasis. Results will compare the performance of participants' identification of emphasis with those made by expert annotators. Findings from this study are predicted to show that individuals with lower perspective-taking abilities, because they have greater difficulty interpreting the intentions of others, will find identifying the location of speakers' emphasis more difficult.