2026 EL SURF Projects

Project Name: **Investigating degradation and microplastics formation of polypropylene (PP) using NIST SPHERE**

Division: 731

Advisor: Sung, Lipiin

Description: This project will investigate how UV exposure, temperature, and water affect the photodegradation and potential microplastics formation of polypropylene (PP), a common material used in food and drink packaging, fabrics, and consumer goods. The study will expose PP samples to controlled UV radiation, temperature, and water to simulate environmental aging during service using the NIST SPHERE. The physical & chemical degradation and surface morphology of the laboratory-exposed samples will be characterized using various spectroscopic techniques (confocal, FTIR, Raman). These techniques will help quantify particle size, morphology, and chemical identity. The overall goal is to determine how environmental factors contribute to the formation of microplastic particles and assess the potential environmental and health implications.

Project Name: **Tornado Strikes on Critical Facilities Database**

Division: 731

Advisor: Levitan, Marc L.

Description: The student will participate in an ongoing project to develop a database of tornado strikes on critical facilities (e.g., schools, hospitals, fire stations, etc). This will entail data mining from a wide array of sources, including the technical literature, government databases, and many sources of media, along with geospatial analysis (intersecting historical tornado tracks with critical facility databases).

Project Name: **Concrete Characterization for Pyrrhotite (FeS) and Reaction Products Using Molecular Spectroscopy**

Division: 731

Advisor: Watson, Stephanie S.

Description: Damage to concrete building structures in Connecticut and Massachusetts was attributed to the mineral pyrrhotite and results in decomposition and structure cracking. States passed building and DOT codes to prevent this issue, but there are no standardized methods or concentration limits to assess pyrrhotite abundance. NIST is also examining mitigate methods on existing structures using concrete sealants. This project focuses on optimizing pyrrhotite reaction species analysis using near infrared spectroscopy to identify and quantify the species in aggregate and concrete foundation specimens and examine the sealant concrete interface. This study will optimize sample preparation and spectrometer parameters for consistent results.

Project Name: **Interlaboratory Study on Sulfur Quantification using NIST Pyrrhotite in Concrete Reference Material**

Division: 731

Advisor: Watson, Stephanie S.

Description: Damage to concrete buildings in Connecticut and Massachusetts was attributed to the mineral pyrrhotite (pyh) and results in decomposition and structure cracking. States have passed building/ DOT codes, but there are no standardized methods or concentration limits for pyh abundance. To provide for accurate, consistent analysis of pyh in concrete, NIST produced a reference material (RM) for calibration/validation and represents the host rock and concrete matrix. A RM interlaboratory study will be conducted with common S test methods to optimize a mix design and standardize test methods for aggregate/ concrete. This study will monitor participants, collect and analyze the data collected.

Project Name: **Dynamic Characterization of Thermal Interface Materials for Chip Cooling and Packaging Reliability**

Division: 731

Advisor: Gu, Xiaohong

Description: Thermal interface materials (TIMs) are a critical component of advanced semiconductor packaging, essential to reliable chip cooling. The highly dynamic heat loads of today's AI chips pose a challenge to the performance and reliability of TIMs. This project seeks to develop a MEMS (microelectromechanical systems)-based device to characterize dynamic thermal behaviors of TIMs. The student will design and fabricate a MEMS device

integrating micro-heaters, temperature sensors, and force-controlled contact structures to enable time- and spatially resolved measurements of interfacial thermal resistance during transient heating and thermal cycling. This platform will probe how TIM performance evolves on different timescales, providing insights into how TIMs response to thermal transients.

Project Name**: Analyzing and Applying Data from Irradiance Database for Indoor Light Reference Spectra**

Division: 732

Advisor: Shore, Andrew M.

Description: Internet-of-Things devices are increasingly more prevalent in homes. Harvesting the available indoor light energy using Photovoltaic (PV) mini-modules can help power these devices. To assess the feasibility of this approach and the impacts of the built environment on the light's spectrum, the PV Characterization Lab measured the spectral irradiance of the available light at three different locations in the Residential Test Facility. The student intern will analyze this data to determine the typical available spectra and intensities at each location. The student will have further opportunities to synthesize reference spectra and model the performance of PV cells under these spectra.

Project Name**: Internet of Things (IoT) Devices for Measurements of HVAC System Performance**

Division: 732

Advisor: Payne, Vance (Wm.)

Description: The Student will aid the principal investigator in developing measurement devices using Internet of Things devices, such

as Raspberry Pi single board computers and microcontrollers to measure energy use, temperatures, pressures,

air humidity and other variables to assess the performance and control of heating, ventilation, and air-conditioning equipment.

Project Name: **Performance of plumbing systems in modern buildings**

Division: 732

Advisor: Ullah, Tania

Description: This project aims to explore ways to improve the performance of plumbing systems in modern buildings in terms of water quality, water conservation, and energy efficiency. NIST has designed a laboratory test rig consisting of water heaters, pipe runs, and sampling faucets simulating water use in residences. The setup allows us to evaluate the performance of point-of-use treatment units, e.g., UV disinfection, by quantifying chemical and physical water quality parameters and concentrations of pathogenic and surrogate microorganisms in faucet water before and after treatment. The student will gain experience making these measurements and learning microbial analysis techniques, such as culturing.

Project Name: **Interpretable Deep Learning for Firefighter Abnormal Electrocardiogram Detection**

Division: 733

Advisor: Tam, Wai Cheong Dr.

Description: Sudden Cardiac Death (SCD) remains the leading cause of on-duty firefighter fatalities. Deep learning-based electrocardiogram (ECG) classifiers show strong potential for early detection of abnormal cardiac rhythms; however, their deployment in safety-critical settings requires a high level of robustness, transparency, and trustworthiness.

As part of the AI-Enabled Smart Firefighting project, this internship will focus on applying and evaluating model interpretability techniques to better understand how deep learning models make ECG classification decisions. The intern will work with an interdisciplinary research team to develop interpretability frameworks that validate model behavior, identify potential failure modes, and guide model improvement. The work directly supports the development of trustworthy AI for firefighter health monitoring.

Project Name: **Deployment of a Deep Learning Electrocardiogram Classification Model on Wearable Devices**

Division: 733

Advisor: Tam, Wai Cheong Dr.

Description: Sudden Cardiac Death is the number-one cause of on-duty firefighter deaths. The AI-Enabled Smart Firefighting project has developed a state-of-the-art deep learning ECG classification model, H2M, designed to detect abnormal cardiac rhythms. Firefighter training academies and safety stakeholders have expressed strong interest in deploying this technology to enhance cardiovascular health monitoring in real-world settings.

This internship focuses on the design, development, and deployment of the H2M model onto a wearable device platform. The intern will collaborate with an interdisciplinary team to assess feasibility, system performance, and real-world constraints such as latency, accuracy, and power consumption.

Project Name: **Bench-scale Fire Testing**

Division: 733

Advisor: Leventon, Isaac T.

Description: This SURF project will focus on preparing samples, calibrating measurement devices, and running tests in some of the bench- and intermediate-scale apparatus needed to maintain these capabilities, with a special emphasis on g-scale calorimetry experiments and intermediate-scale wall flame experiments.

Project Name: **Development of a bench-scale gasification apparatus**

Division: 733

Advisor: Leventon, Isaac T.

Description: This SURF project will focus on the construction and calibration of a miniaturized gasification apparatus (one of the bench-scale apparatus needed to maintain these capabilities). Focus will be maintained on measurement of system boundary conditions, design/construction of a new ignition system, and initial testing.

Project Name: **NLP and RAG Integration for Additive Manufacturing Terminology**

Division: 734

Advisor: Li, Shengyen

Description: NIST is leading the development of Additive Manufacturing (AM) technology, making advanced AI-driven technology transfer critical. This initiative extracts domain-specific terminologies from NIST publications, using a data processing procedure to improve data quality prior to analysis. We will use Natural Language Processing techniques to analyze the correlations among the terminologies and create a vector database to accommodate them. This database will serve as a source for a Retrieval-Augmented Generation function to enhance the quality of dialogue between AM practitioners and a service of large language models with NIST knowledge.

Project Name: **Benchmarking the Performance of Mobile Manipulator End-effector Trajectories**

Division: 735

Advisor: Aboul-Enein, Omar Y. Mr.

Description: Mobile manipulators have great potential in automating tasks that require the manipulator end-effector to precisely follow continuous trajectories (e.g., paint application and mobile 3D printing (M3DP)). However, increased performance uncertainty can prevent these robots from achieving acceptable manufacturing requirements. The NIST Configurable Mobile Manipulator Apparatus (CMMA) was created for cost-effective and flexible in-situ mobile manipulator performance measurement. This project extends the CMMA measurement concept to consider the benchmarking of mobile manipulator trajectory following. Objectives of this project include 1) Designing a new low-cost trajectory evaluation target, and 2) Implementing the new test scenario on a physical mobile manipulator platform.