



LaSPACE Fall 2025 Council Meeting Student Poster Abstract Booklet

“Multidimensional approach to Remote Species Classification and Vegetative Health Monitoring to Inform Louisiana Forested Wetland Management”

Grant Erbelding | University of Louisiana at Monroe (ULM) | GIRAF | Poster # 1

Presenting Team Members: Grant Wallace Erbelding, Biology

Increasingly frequent climatic extremes and habitat disruption inflict long-lasting, and sometimes irreparable, costs on the most vulnerable and valuable ecosystems, with Louisiana being no exception. Specifically, Louisiana's characteristic bottomland hardwood forests (BHF), forested wetland ecosystems that serve as a crucial transitional stage between terrestrial and riverine systems, now constitute less than 1/4th their historical range. Consistent, long-term monitoring of large-scale ecosystem dynamics is needed to preserve these remaining, fragmented forests from further degradation. This project leverages satellite, near-surface (multispectral and LiDAR), and in-situ remote sensing technologies with intensive ground validation to develop a comprehensive, scalable methodology for monitoring and modeling canopy-contributing tree species community and vegetative health dynamics of a BHF ecosystem. To achieve this, the project aims to (1) use multidimensional remote sensing data and machine learning techniques to develop a robust canopy species classification model, (2) detect and characterize vegetative health across spatial and temporal scales, (3) demonstrate practical application by incorporating methods into active forest management practices. A preliminary species classification model trained on a small subset achieved an overall accuracy of 81.8%, while also identifying canopy structural metrics, canopy density and rugosity, crucial to accurate classification. These promising results highlight the necessity of integrating diverse data types and direct future work toward refining model accuracy, adapting models for individual vegetative health identification and classification, and applying models directly in the management of Louisiana's forested wetlands.

“Assessing Impacts of Droughts and Storm Events on Wetland Vegetation”

Nicholas Lonergan | Louisiana State University and A&M College (LSU) | GIRAF | Poster # 2

Presenting Team Members: Nicholas Lonergan, Oceanography and Coastal Science

As global environmental change intensifies, extreme weather anomalies, including prolonged droughts and stronger storm surges, are becoming more frequent and threatening the resilience of coastal ecosystems worldwide. In Louisiana, coastal wetlands are vulnerable to a range of hydrological stressors that can destabilize vegetation and accelerate land loss. This study investigated how drought-induced salinity increases and storm surge events affect wetland vegetation health in the Terrebonne and Barataria basins. Using a combination of satellite-derived Normalized Difference Water Index (NDWI) and salinity data from the Coastal Reference Monitoring System (CRMS), we evaluate spatial and temporal patterns of vegetation browning in response to extreme salinity fluctuations. Our target interest was the prolonged drought of 2023, during which salinity spikes exceeded those recorded during major hurricane events, specifically in freshwater marshes. By comparing the impacts of short-term storm surge salinity pulses to sustained drought-driven hypersaline conditions, this research evaluated their respective effects on plant stress, mortality, and subsequent erosion risk. Preliminary results show strong spatial correlation between elevated salinity and early vegetation browning, signaling



vegetative stress beyond normal late season senescence. These findings will provide critical insights for coastal managers by demonstrating a potential link of climate extremes to vegetation decline and habitat transformation, ultimately informing strategies for wetland conservation and resilience planning into the future.

“Advanced Bayesian Estimation and Global Sensitivity Optimization for Unmanned Aerial Systems”

Karan Baker | Louisiana State University and A&M College (LSU) | GSRA | Poster # 3

Presenting Team Members: Karan Baker, Mechanical Engineering

Due to rising interest in intelligent aerospace technology and increased involvement in higher-risk missions, research into Unmanned Aerial Systems has seen dramatic strides in progress. In many experiments and missions, there will always be sources of uncertainty of varying degrees in complexity and weight on the system. The effects of uncertainty could make initially well-designed systems infeasible for maintaining acceptable real-time performance in certain mission objectives. It is also difficult to collect enough data to make informed decisions on the uncertain parameters that can be directly applied to a physics-informed model. As such, the work presented here considers uncertainty quantification techniques to encompass mission-critical design parameters that would otherwise be difficult to assess solely with a physical model of the system. With the methodology of Bayesian inference, it is possible to develop posterior distributions for unknown variables in the system based only on limited data and informed priors. In parallel to this, it is also possible to train a surrogate model to compress the computational complexity for large sets of uncertain parameters. These two methods can then work in tandem with global sensitivity analysis, which can improve the efficiency of the uncertainty quantification process by assigning worth to more important parameters, thus reducing the cost of a simulation. By identifying the most important parameters, the simulation can also improve the optimization of the controller by guiding the results towards the mission's main objectives. With these methods in mind, optimal trajectory, performance, and reliability can be obtained even in high-risk missions.

“Graph-Theoretic Analysis of Student Interaction Networks for Enhancing Group Effectiveness”

Kayla Biggs | Louisiana Tech University (LaTech) | GSRA | Poster # 4

Presenting Team Members: K. Nicole Biggs, Computational Analysis and Modeling

Since its founding in 1958, teamwork has remained a core value of NASA, and has been recognized as of vital importance to the operations and advancement of NASA's missions. This can be observed in NASA's mission directorate of Space Operations, and their mission directorate of Science highlights the importance of interconnectivity between the STEM branches. We seek to find an innovative method to form effective groups rooted in the mathematical field of graph theory. Recent research has shown that using a graph theory model is an effective way to examine the dynamics of a group discussion by treating the speakers as vertices and forming an edge between the vertices when one person speaks after another, defined as a “talk-turn”. We will assess the groups performance using data from their design project showcase scorecards, peer and instructor evaluations, and instructor scores for their project. This performance data will be connected and compared to each individual's graph profiles and the graphs developed for their group to identify each person's communication patterns and



habits and which groupings prove most effective. This analysis will be used to draw conclusions on group dynamics and potential optimal group formation.

“Lanthanide β -Diketonate Complexes for Optical Environmental Sensing in Extreme Conditions”

Seth Doughty | Louisiana Tech University (LaTech) | GSRA | Poster # 5

Presenting Team Members: Seth Doughty, Molecular Science & Nanotechnology

Sensitization of Terbium and Europium complexes with β -diketonate ligands is an important area of study due to their narrow characteristic emission bandwidths and strong luminescence in the visible region at low molar concentrations, which feeds into their potential use as environmental sensors, and as optical probes for extraterrestrial environments where compact, low mass sensing platforms are required. We have found that some Eu and Tb β -diketonate complexes can detect the presence of water and function as a thermometer through emission wavelength shifts, suggesting their use as an in-situ life-support systems monitor. A wavelength shift, from green to red, is exhibited in Tb compounds doped with small amounts of Eu when heated to 333K. These compounds also undergo emission quenching when exposed to vacuum in samples with Tb³⁺ doped with Eu³⁺. This vacuum dependent quenching response can potentially perform as a visual indicator for passive pressure sensing for leak-detection hull coatings. These different environmentally induced emission phenomena are hypothesized to be a consequence of intermolecular structural rearrangements. Through the use of different β -diketonate ligands, Hexafluoroacetylacetone, Benzoyltrifluoroacetone, and Benzoylacetone; trends in sensitization were observed. Variable Eu doping into Tb-dominant complexes shows promise for detecting environmental fluctuations through tunable luminescent responses. Collectively, these findings point towards a class of lanthanide-based optical materials capable of autonomous, low-power environmental sensing in extreme environments. These applications support NASA's goals for long-duration mission sustainability, in-situ diagnostics, and intelligent material systems for deep-space exploration.

“Reducing the risk of brain tumor development in astronauts post-spaceflight: a molecular approach using glioblastoma-derived extracellular vesicles”

Hope Hutson | Louisiana Tech University (LaTech) | GSRA | Poster # 6

Presenting Team Members: K. Hope Hutson; Guoting Qin; Chengzhi Cai; Gergana G. Nestorova

Ionizing radiation is emitted at high levels in space, which significantly increases the risk of astronauts developing neurological diseases post-spaceflight, including glioblastoma brain tumors. Glioblastoma is highly aggressive and carries a poor prognosis, making it crucial to develop studies on the molecular pathways involved in the progression of the disease. Extracellular vesicles (EVs) are released by donor cells and encapsulate RNA, DNA, and proteins that influence gene and protein expression upon uptake by recipient cells. Transcriptomic and proteomic cell alterations have been associated with the development and progression of glioblastomas. Comparative mass spectrometry proteomic analysis was performed using the LN-229 glioblastoma cell line and healthy human brain cells. Data analysis was performed using Spectronaut software (version 18.3, Biognosys). Our results pointed to an upregulated Mitogen-Activated Protein Kinase-Activated Protein Kinase 2 (MK2) pathway in glioblastoma.



compared to healthy cells. MK2 is known to contribute to tumor proliferation, migration, and therapeutic resistance, which makes this pathway of significant interest for mitigating the risk of glioblastoma development in astronauts post-spaceflight. Future studies will focus on characterizing a consistently upregulated glioblastoma-derived EV, Thrombospondin-2 (THBS2), and assessing the efficiency of plant-derived EVs as nanocarriers.

"Effects of Salinity on Germination of Spore-Forming Bacteria"

Henry Johnson II | Louisiana Tech University (LaTech) | GSRA | Poster # 7

Presenting Team Members: Henry Johnson II, MSNT

Space exploration continues to be an ever-increasing interest yet presents a risk of forward contamination to other planets with terrestrial microorganisms. Planetary protection policies seek to mitigate the risk of contamination through biological control processes such as spacecraft mission assembly facility clean rooms (COSPAR NPR 8715.24, NASA-STD 8719.27). Bacterial endospores, specifically those of *Bacillus*, represent a specialized, dormant cell type with robust resistance capabilities and, potential survivability of space travel making them candidates for forward contamination. Spores can be reactivated with nutrients by a process called germination which includes rehydrating the spore. Water found on Mars contains levels of $MgSO_4$ salt concentrations higher than seawater. There is a fundamental gap in knowledge of how high salinity environments will affect spore germination. Therefore, five bacterial isolates with ties to space biology (EXPOSE-E study) were selected for this study. The goal of this study is to test the effects of NaCl and $MgSO_4$ at increasing concentrations (0- 3.6 M) on germination. Germination was measured by the loss of optical density (OD) at 580 nm. Strains were tested for salt tolerance and showed an ability to germinate under increased salt concentrations up to 2.4 M. This research suggests that NaCl and $MgSO_4$ impact germination in a similar fashion even though $MgSO_4$ can sometimes promote germination at low concentration while still inhibiting germination at higher concentration. Further testing will determine salt tolerances of the remaining strains. Studying microorganisms' ability to germinate under salt stress may inform future planetary protection protocols.

"Spaceflight-related stressors converge to cause "space fog" symptoms and cognitive deficits; insights into potential therapeutic interventions"

Katelyn Lofton | Louisiana State University Health Sciences (LSUHSC) | GSRA | Poster # 8

Presenting Team Members: Katelyn Lofton, Pharmacology, Toxicology, & Neuroscience

"Space fog " is a term coined by astronauts to describe reduced cognitive function, disorientation, and impaired attention experienced during spaceflight. Long-duration spaceflight exposes astronauts to multiple stressors, such as galactic cosmic radiation (GCR), microgravity, and psychosocial isolation, that together pose serious risks to the central nervous system. Each of these factors can independently damage neuronal DNA, yet their combined effects may amplify genomic instability and disrupt the molecular mechanisms that support learning and memory. Emerging evidence suggests that DNA double-strand breaks (DSBs) are not solely detrimental but are transient, regulated events essential for memory formation, acting as "molecular barcodes" that tag active neurons during engram encoding. When the DNA damage response (DDR) becomes excessive or uncoordinated, these adaptive



breaks can accumulate and impair neural circuitry, contributing to the cognitive dysfunction often described by astronauts as "space fog." This project investigates how spaceflight-related stressors alter neuronal genome stability and DDR signaling to drive neurocognitive decline. Using molecular, genetic, and behavioral approaches, we assess how chronic low-dose heavy-ion irradiation and simulated microgravity produce persistent DSBs, activate inflammatory pathways, and disrupt synaptic plasticity. Preliminary data from our lab using Brookhaven National Laboratory's GCR simulations show sustained γ H2AX foci, increased neuroinflammatory markers, and impaired autophagic signaling, features consistent with accelerated brain aging. By linking molecular DNA repair dynamics to neural network function, this research defines how spaceflight stressors compromise the genomic resilience of the brain.

"Object Identification Under Known Dynamics: A PIRNN Approach for UAV Classification"

Sean Maki | Louisiana State University and A&M College (LSU) | GSRA | Poster # 9

Presenting Team Members: Sean Maki, Mechanical Engineering

This work addresses object identification under known dynamics in unmanned aerial vehicle applications, where learning and classification are combined through a physics informed residual neural network. The proposed framework leverages physics-informed learning for state mapping and state derivative prediction, while a softmax layer enables multi-class confidence estimation. Quadcopter, fixed-wing, and helicopter aerial vehicles are considered as case studies. The results demonstrate high classification accuracy with reduced training time, offering a promising solution for system identification problems in domains where the underlying dynamics are well understood.

"Dose Characterization of Galactic Cosmic Rays In The Human Brain: A PHITS-Based Study With a Segmented Anatomical Phantom"

Shanice Manning | Louisiana State University and A&M College (LSU) | GSRA | Poster # 10

Presenting Team Members: Shanice Manning, Medical and Health Physics

Astronauts aboard the International Space Station (ISS) are chronically exposed to a complex space radiation environment composed of galactic cosmic rays (GCR), solar particles, and Earth's trapped radiation. These high-energy particles interact with spacecraft shielding, producing secondary particles that can penetrate inside and deposit energy in sensitive tissues. Although animal studies have been useful in assessing space radiation risks, anatomical and physiological differences limit their applicability to human anatomy, especially neuroanatomy. To address this gap, we developed a computational framework to model radiation dose distribution within the human brain using Monte Carlo simulations in the Particle and Heavy Ion Transport code System (PHITS). This study consists of three major components: (1) construction of an intravehicular (IV) radiation environment using an simplified shielding configuration and validated Low Earth Orbit (LEO) GCR spectrum; (2) simulation of dose deposition in both water and ICRP reference phantoms to assess spatial distribution; and (3) estimate the mean absorbed dose delivered to the sub-regions of the brain. By integrating accurate radiation transport physics with anatomically segmented geometry, this work enables region-specific mapping of dose accumulation within the



brain. The results will improve understanding of how radiation is distributed across different neural structures, serving as a foundation for future biological and risk-based evaluations.

“Exploration of Regolith-based Nanothermite for Lunar Infrastructure through Grain Boundary Engineering”

Emma McCarthy | Louisiana State University and A&M College (LSU) | GSRA | Poster # 11

Presenting Team Members: Emma McCarthy, Mechanical Engineering

NASA's Plan for Sustained Lunar Exploration and Development aims to establish a lasting human presence on the Moon with a focus on in-situ resource utilization (ISRU). This research aims to develop regolith-derived thermite for ISRU and understand mechanisms of thermite reactions to engineer the most efficient formulations that minimize resupply from Earth. Thermites are reactive mixtures of particulates that produce intense heat through an oxidation-reduction process, and thermite reactions have shown potential for separating metals (e.g., iron) from mineral-rich regolith, thus supporting NASA's goal of building sustainable infrastructure. This proposed research will focus on engineering nanostructured thermites by increasing the number of atomic-scale interfaces and increasing the reactivity of each grain boundary via interfacial engineering. The main tasks are to conduct cryogenic arrested reactive milling using Mg and/or LiH mixed with LHS-1 regolith simulants to tailor thermite microstructures, employ atomic-resolution electron microscopy to assess thermite reactions, and verify thermite performance by completing bomb calorimetry measurements. Our findings will form the basis of an "interface-by-design" approach, thus enabling the creation of high-performance thermites for lunar construction.

“Resilient Control for CubeSat's Power System Through Digital Twinning”

Savion Siner | University of Louisiana at Lafayette (ULL) | GSRA | Poster # 12

Presenting Team Members: Savion Siner, Electrical Engineering

One of the most critical components of a CubeSat when it comes to resilience is the electrical power system. That is because, while the compact form factor may be one of the CubeSat's more attractive characteristics, the size and weight constraints severely limit what can be done regarding power production and power management. With little margin to work with, it is vital that the fitted components have a robust response to both common and extreme disturbances. This requires a system with real-time health assessment mechanisms and advanced control and monitoring systems which will allow for autonomous operation in a harsh space environment. This poster proposes a method to design such a system through the utilization of a high-fidelity digital twin model of a real-world CubeSat power system—a model capable of accurately representing the behavior of the physical electrical power system under various operating conditions. The main advantage of this approach is the ability to perform comprehensive testing of resilience strategies without the risks and costs associated with physical hardware testing.



“Crystal and Electronic Structure of Ba₁₂Ga₁₅As₂₂”

Spencer Watts | Louisiana State University and A&M College (LSU) | GSRA | Poster # 13

Presenting Team Members: Spencer Watts, Chemistry

The novel ternary Zintl phase Ba₁₂Ga₁₅As₂₂ was synthesized and structurally characterized. Structural data collected via single-crystal X-ray diffraction methods revealed the presence of homoatomic [Ga₂]⁴⁺ bonds embedded within chains of edge- and corner-sharing [GaAs₄] tetrahedra. Synchrotron powder diffraction data, processed via Rietveld refinement, further confirm the structural model. Ba₁₂Ga₁₅As₂₂ crystallizes in the monoclinic crystal system with space group P2₁/c (*a* = 13.3334(10), *b* = 20.6392(16), *c* = 20.0336(15), β = 108.7168(14)) and adopts a previously unreported structure type. Ba₁₂Ga₁₅As₂₂ is heavily disorder and its charge-balance can be described using the Zintl concept as follows: Ba₁₂Ga₁₅As₂₂ = (Ba²⁺)₁₂(Ga³⁺)₁₂([Ga₂]⁴⁺)_{1.5}(As³⁻)₂₂. Electronic structure calculations were performed to further investigate the bonding and electronic properties, motivated by expectation of semiconducting properties and suitability for thermoelectric applications. Ba₁₂Ga₁₅As₂₂ was found to exhibit a theoretical band gap of approximately 0.61 eV.

“Bio-Inspired Lignin-Based Superhydrophobic Films for Sustainable Space Infrastructure”

Jermiya Wilson | Louisiana Tech University (LaTech) | GSRA | Poster # 14

Presenting Team Members: Jermiya Wilson, Engineering - Micro and Nanoscale Systems

Lunar and Martian environments pose severe challenges to the longevity of metallic infrastructure due to abrasive regolith impacts, extreme temperature fluctuations, and low atmospheric pressure. These conditions promote pitting and corrosion, which compromise structural integrity and increase payload requirements for habitat construction. To address this, the proposed research explores the creation of a sustainable, superhydrophobic coating derived from rice husk lignin, a potential byproduct of extraterrestrial agriculture. Building on current work developing lignin-silica hybrid films for corrosion protection in oceanic conditions, this study extends the approach to simulate extraterrestrial environments. Lignin will be extracted from rice husks using natural deep eutectic solvents (NADES), then purified through enzymatic hydrolysis to remove residual cellulose and hemicellulose. Functionalization with silica-based moieties will enhance adhesion to metal substrates and mechanical stability, while crosslinking will yield a durable, water-repellent film. This coating is expected to mitigate corrosion, resist regolith abrasion, and improve the shock-absorbing capacity of lightweight metals, enabling reduced structural mass and extended material lifespan. Future testing will assess the film's superhydrophobicity, corrosion resistance, and mechanical durability under simulated lunar and Martian conditions.

“X-59 Ground Operations Intern at Armstrong Flight Research Center”

Vinh Le | Louisiana State University and A&M College (LSU) | Internship | Poster # 15

Presenting Team Members: Vinh Le

During my internship at NASA's Armstrong Flight Research Center, I contributed to the Quesst Mission (Quiet SuperSonic Technology), which aims to demonstrate that supersonic aircraft can fly over land with a quiet “thump”



instead of a loud boom. I worked on the Phase 2 Dry Run, a large-scale rehearsal using F-15 aircraft to test the procedures and systems that will later measure the X-59's acoustic footprint. My responsibilities included assisting with the deployment and retrieval of over sixty Ground Recording Systems (GRS) across the Mojave Desert, coordinating with flight operations, and ensuring accurate data collection for acoustic analysis. As part of the operations engineering team, I gained firsthand experience in flight logistics, mission planning, and inter-team communication. I also trained with NASA's X-59 and F-15 simulators and shadowed robotics engineers at JPL.

"Detecting Charged Particle Interactions in High Altitude to Investigate the Pfozter Maximum"

Abigail Jesmer | Louisiana State University and A&M College (LSU) | LaACES | Poster # 16

Presenting Team Members: Chloe Hebert, Mechanical Engineering; Alex Price, Mechanical Engineering; Michael Simon, Physics and Astronomy; Michael Uwaifo, Mechanical Engineering; Owen Weber, Mechanical Engineering

DeltaY contains members from two undergraduate student teams from Louisiana State University (LSU) taking part in the Louisiana Aerospace Catalyst Experience (LaACES) ballooning project funded by the Louisiana Space Grant (LaSPACE). The two teams designed two payloads intended to make measurements on charged particles interactions with the payload throughout the flight. These measurements were made on May 20th, 2025, at the Columbia Scientific Ballooning Facility in Palestine, Texas. The purpose was to create a payload that would produce data mirroring the Pfozter Maximum using a Geiger counter and record the physical conditions of the flight. For both payloads, the data collected gave an appropriate altitude for the Pfozter Maximum, however there were errors in the measurements for the physical conditions. Delta Y believes this could have been due to faulty wiring or loose connections.

"Demonstration of Lightweight Thermal Regulation for High-Altitude Balloon Payloads"

Alex Price | Louisiana State University and A&M College (LSU) | LaACES | Poster # 17

Presenting Team Members: Abigail Jesmer, Physics; Chloe Hebert, Mechanical Engineering; Alex Price, Mechanical Engineering; Michael Simon, Physics; Michael Uwaifo, Mechanical Engineering; Owen Weber, Mechanical Engineering

Maintaining temperature is one of the biggest challenges for anything that travels to the edge of space. At high altitudes, the thin atmosphere provides almost no insulation, and temperatures can plunge below -55°C . These conditions can freeze electronics, drain batteries, and disrupt sensors. These issues can also affect any system meant to carry or preserve temperature-sensitive materials such as biological samples, chemical reagents, or delicate instruments. Reliable thermal regulation, therefore, has broad implications for future balloon experiments, small satellites, and even atmospheric transport technologies. Building on temperature data from this past LaACES flight in May 2025, which showed sharp drops well below operational limits, this year's project explores how different levels of thermal protection perform in near-space conditions. Our payload includes four experimental bays: a control bay with no protection, a passive bay insulated with reflective and foam materials, a passive + active bay that adds a small heating element, and a fully active bay designed for continuous temperature



control. An ambient sensor, vented through the bottom of the payload in a radiation shield, records the outside air temperature to provide a true reference. By comparing each bay's data to the ambient and control readings, we can visualize how insulation and active heating each contribute to maintaining a stable environment. This investigation aims to demonstrate that even within a 500g, \$500 student payload, meaningful thermal regulation can be achieved, and that understanding how heat behaves at 30 km above Earth can help guide future missions that depend on keeping critical systems warm and reliable.

"Jupyter Notebook Thermal Model for High Altitudes"

Kelsey Reitmeyer | Delgado Community College (DCC) | LaACES | Poster # 18

Presenting Team Members: Kelsey Reitmeyer

Thermal temperature regulation of experimental payloads is critical for their successful operation. With spacecraft, mass limitations force payload developers to ensure that thermal regulation is sufficient without being overbuilt. A simple heat conductivity model will be used to predict internal payload temperature after defining payload power, surface area, k-value, thickness. It will also use historical external temperature data to input as the external temperature. Results will be compiled into an instructional Jupyter Notebook with a use case for student high altitude ballooning payloads. The model will be used to assist in the construction of a payload by predicting the internal temperature values given the specific insulating values of a material. It will also assist in material innovation by helping students understand what thermal insulating values a material must have in order to be used in the construction of a payload.

"Effects of Cadmium Toxicity from Wetland Pollutants on Brain Glutamate Levels in Mice"

Josephine Day | Louisiana Tech University (LaTech) | LASSO | Poster # 19

Presenting Team Members: Josephine Day, Biomedical Engineering

Cadmium (Cd), a toxic heavy metal from industrial waste, has contaminated Louisiana wetlands for decades, posing serious environmental and public health threats. Commonly used in chemicals, dyes, plastics, and corrosion-resistant alloys, Cd persists in soil and water due to its resistance to degradation. This long-term contamination harms aquatic ecosystems, affecting over 200 fish and shellfish species, including several of commercial importance. Cd exposure also presents significant human health risks. Consuming contaminated seafood can cause acute effects such as headaches and gastrointestinal distress, while long-term accumulation in organs like the kidneys, liver, and brain may lead to chronic conditions such as kidney disease, bone demineralization, and neurological disorders. Cd can cross the blood-brain barrier and disrupt the glutamatergic system, which is essential for learning, memory, and neural communication. Elevated glutamate (GLU) levels due to Cd exposure may lead to excitotoxicity and potential brain damage. This study aims to assess the chronic effects of Cd exposure on GLU concentrations in the brains of mice and to examine the dose-dependent relationship between Cd intake and GLU elevation. Mice will be exposed to varying concentrations of Cd through drinking water over four weeks. GLU levels will then be measured using flexible, enzymatically functionalized microelectrode arrays (MEAs) previously developed by our group. This research will enhance the understanding of



Cd's neurological effects and provide an undergraduate researcher with valuable training in environmental toxicology, neuroscience, and bioengineering.

“Isolation and Characterization of Soil-Derived Bacteriophages for Sustainable Seafood Safety Applications”

Alexis Ortega | Northwestern State University of Louisiana (NSULA) | LASSO | Poster # 20

Presenting Team Members: Alexis Ortega, Biology

Seafood spoilage and contamination are major drivers of food loss and safety risk worldwide. Bacteriophages, viruses that specifically infect bacteria, are lightweight, host-specific agents with potential to reduce spoilage and pathogen loads without chemical preservatives or antibiotics. This project isolates bacteriophages from terrestrial sediments and evaluates their potential to control seafood-relevant bacterial pathogens (*Pseudomonas aeruginosa*, *Clostridium beijerinckii*, *Vibrio parahaemolyticus*, *Listeria monocytogenes*, and *Salmonella enterica*). Soil samples are suspended in phosphate-buffered saline (PBS), clarified and 0.22 μm -filtered, then used to amplify phages on host cultures. Candidate phages are detected by double-layer plaque assays and purified through iterative isolation cycles. To date, preliminary amplifications have produced distinct plaques against *Pseudomonas* and *Clostridium* hosts, with plaque morphology and initial PFU estimates being documented. Ongoing work includes phage isolation/purification, host range profiling, and stability testing under seafood-relevant conditions (temperature, salinity, pH). Subsequent experiments will apply characterized phages to inoculated fish to quantify reductions in CFU and changes in spoilage metrics over storage. The pipeline incorporates environmental sample sourcing from an operational fishery (Natchitoches National Fish Hatchery at Cane River, Natchitoches, LA) and soil from local riverbanks to connect discovery with locally relevant microbial communities. This soil-to-seafood approach aims to develop a scalable, cost-effective phage-based biocontrol strategy for sustainable fisheries and closed-loop food systems, offering a selective, renewable method to improve seafood safety and reduce waste.

“Exploring Mechanical Properties of 3D Printed Resin for Aerospace Applications”

Nour Abdelmageed | Southeastern Louisiana University (SELU) | LURA | Poster # 21

Presenting Team Members: Nour Abdelmageed, Engineering Technology

The main objective of this project is to investigate the mechanical properties of 3D printed resin using a Phrozen printer. ASTM standard tensile and impact specimens will be prepared and tested to measure toughness, strength, and reliability. The results will be compared with published data and ASTM standards to evaluate the potential applications of resin 3D printed materials for aerospace applications. Tensile testing measures strength under load and impact testing measures its resistance to sudden impacts. Together they will give us a good understanding of how 3D printed resin may perform in aerospace applications.



"Real Time Autonomous Defensive Interception of Unwanted UAVs"

Yousuf Atteia | Louisiana State University and A&M College (LSU) | LURA | Poster # 22

Presenting Team Members: Yousuf Bashir Atteia, Mechanical Engineering

This project focuses on the development of an autonomous Unmanned Aerial Vehicle (UAV) for counter-drone applications. The defensive UAV incorporates a closed-loop system that integrates a ZED 2i stereo camera, a National Defense Authorization Act (NDAA) certified NVIDIA Jetson Orin NX 16 combined with an ARKV6X flight controller to achieve real-time detection, tracking, and interception. The Jetson Nano will utilize a machine learning algorithm to analyze data from the camera to identify and track hostile UAVs. The results are fed directly to the flight controller via a telemetry connection from the Nano in order to autonomously adjust the flight path and neutralize the target. Once the Jetson-guided tracking loop has localized the threat, the ARKV6X flight controller commands a spring-launched net-payload system mounted on the defensive UAV, executing an autonomous interception that physically captures and neutralizes the target.

"Stak'em® - A Rocket Science Educational Kit for K-12 and Beyond"

Susannah Donoghue | University of Louisiana at Lafayette (ULL) | LURA | Poster # 23

Presenting Team Members: Susannah Donoghue; Dr. Dhan Fortela; Dr. Ashley Mikolajczyk

We asked: what if K-12 students can interact with rocket assembly and testing while learning rocket science? We introduce Stak'em® - a rocket science educational kit. This project specifically aligns with the focus area of the Space Technology Mission Directorate (STMD) and the NASA Office of Stem Engagement (OSTEM). STMD is tasked to lead NASA in transforming future missions while ensuring American leadership in aerospace. With this goal, one of STMD's programs is the "Prizes, Challenges, and Crowdsourcing" program that outsources the public in solving some of NASA's challenges. Our proposed Stak'em® project will start a platform (the Stak'em® Kit) that directly contributes to education of future workforce for space industry and to cultivate collaborative minds in the youth of America. The project product Stak'em® Kit will be a demonstration-ready and market-ready kit targeted for K-12 students with the potential to diffuse into a mainstream recreational learning kit for the broader public.

"Composting Human Hair with Arboreal and Food Production Biomass Wastes for Plant Fertilizer"

Janae Dotson | Louisiana Tech University (LaTech) | LURA | Poster # 24

Presenting Team Members: Janae T. Dotson, Chemical Engineering

Sustainable life-support systems for long-duration space missions require efficient recycling of available materials to reduce waste and support plant growth. One potential resource is human hair, which is rich in keratin protein and nitrogen, a critical nutrient for plant fertilizers. While typically discarded, human hair could be composted with food production wastes to create a closed-loop nutrient cycle that minimizes resource loss. This study investigates whether human hair can be composted with arboreal and food crop residues to generate nutrient-rich fertilizers suitable for space agriculture. Hair was collected, cut, and combined with dried sweet potato vines, fallen leaves, and inoculated soil microbes to initiate composting under controlled conditions. After 60 days, composted



mixtures were used to grow spinach, and plant growth was evaluated by leaf height and spread under controlled light and watering regimes. Preliminary results indicate that hair-amended compost increased nitrogen retention and supported spinach growth comparable to or exceeding that of controls. These findings suggest that human hair can serve as a viable nutrient source when composted with plant residues, contributing to sustainable fertilizer production in resource-limited environments. By transforming human biowaste and food crop waste into plant-supporting fertilizers, this research demonstrates a promising strategy for advancing NASA's closed-loop life-support systems. Future work will explore scaling, microbial dynamics, and integration into extraterrestrial agricultural cycles, further supporting waste-to-resource technologies for lunar and Martian exploration.

“Real-World Implementation of Time-Delay Filters for Systems with Nonzero Initial Conditions: A Gantry Crane Case Study”

Dutch Dunphy | Louisiana State University and A&M College (LSU) | LURA | Poster # 25

Presenting Team Members: Dutch Dunphy, Mechanical Engineering

Many modern dynamic systems involve nonzero initial conditions that introduce unwanted oscillations that can affect performance and reliability. There are a multitude of methods for solving this issue, but each comes with a compromise to the overall performance of the system. This project utilizes a novel approach of input shaping, in this case a Time delay Filter, towards rest-to-rest maneuvers and justifies the simulation through an experiment. The simulation consists of a dynamic model for a velocity driven gantry crane with a Time Delay Filter applied to the input in a feed forward control scheme. The primary goal for designing the experiment is the construction of a gantry crane system that leverages servomotors to control a trolley's position considering an attached payload with nonzero initial conditions. The secondary goal for the experiment is to prove the Time Delay Filter can function effectively even with uncertainty within system parameters. Validation of the input shaper provides useful insights into feed-forward controls applications of high value such as additive manufacturing and UAV payload transport.

“Printing and sintering of metal nanoparticles for fabrication of metal components and parts used in aerospace systems”

Samuel Goutierrez | University of Louisiana at Lafayette (ULL) | LURA | Poster # 26

Presenting Team Members: Samuel Goutierrez, Mechanical Engineering

The project aims to analyze varying sequences of sintering processes utilized in removing organic substances from metallic nanoparticle inks. As 3D printing dominates the space of fabricating electronics, emphasis on ensuring optimal conductance within a reasonable budget has emerged. Nanoparticle inks have proved to produce higher conductance than other available inks. These inks contain additives to achieve desired properties for printing and must be removed from the metal patterns to reduce impedance. The patterns are dried after printing, which results in some, but not all, of the additives being removed. Sintering procedures, which include thermal treatment and laser irradiation, are used to eliminate excess organic additives from the tracks. This project will employ these two sintering methods in combination and in different orders to assess the best sintering process for producing electronics, particularly ones made with silver, copper, nickel, and copper-nickel alloy inks. Sintering processes



are divided into four groups: laser irradiation only, thermal treatment only, thermal treatment then laser irradiation, and laser irradiation then thermal treatment. Another layer of ink may be applied to achieve certain metallic structures, resulting in another sequence of drying and sintering. Microstructure, morphology, crystallinity, chemical structure, residual organic material, and electrical resistance are properties that will be analyzed after each trial.

“Maximizing CO₂ Capture and Biomass Productivity of Chlorella vulgaris using Human-Derived Waste and Mars In situ Resources”

Averie Guidry | University of Louisiana at Lafayette (ULL) | LURA | Poster # 27

Presenting Team Members: Layla C. Campbell, Chemical Engineering

This study investigates the potential of *Chlorella vulgaris* to support human life and contribute to in-situ resource utilization for future Mars missions by enhancing CO₂ capture, biomass production, and calcium carbonate (CaCO₃) formation. The research aimed to identify the CO₂ concentration that maximizes carbon uptake and microalgal growth in a medium of diluted human urine simulant and Martian regolith extract, and to assess how varying calcium levels influence biomass productivity and CaCO₃ formation. Experiments were conducted in two phases using 2-L photobioreactors under continuous illumination (21 $\mu\text{mol m}^{-2} \text{s}^{-1}$) at 25 °C. In Phase 1, calcium was fixed at 5 ppm while CO₂ levels were varied (5%, 10%, 15%, 20% v/v). Both 15% and 20% CO₂ achieved 100% sequestration, but 15% CO₂ supported higher biomass productivity (1.42 g L⁻¹ day⁻¹) and viable cell growth (0.32 g L⁻¹ day⁻¹), with biomass containing 5.54% w/w CaCO₃. In Phase 2, CO₂ was fixed at 15%, and calcium levels were varied (5, 15, 25, 35 ppm). The 5 ppm Ca condition again yielded the highest biomass productivity and cell viability, while higher calcium reduced both algal growth and CaCO₃ formation, though CO₂ sequestration remained 100%. Overall, the results show that 15% CO₂ with 5 ppm Ca provides the most favorable conditions for CO₂ capture, biomass productivity, and controlled CaCO₃ formation. These findings offer critical insights for designing microalgae-based life support systems that recycle waste and enable biologically mediated construction, addressing key challenges for sustainable Mars habitation.

“Fabrication Strategies for Conductive Hydrogel-Based Wearable Sensors”

Riley Guillory | University of Louisiana at Lafayette (ULL) | LURA | Poster # 28

Presenting Team Members: Riley Elizabeth Guillory, Chemical Engineering

This project proposes a literature-driven design for a non-invasive wearable sensor that uses a dual-network conductive hydrogel as its active sensing material. The goal of this work is to outline a fabrication strategy informed by current research on conductive polymers and hydrogel-based sensors. The proposed sensor design incorporates a chitosan-based hydrogel matrix for structural stability and biocompatibility, combined with a conductive polymer such as poly(3,4-ethylenedioxythiophene) (PEDOT) or poly(vinyl alcohol) (PVA) to enable electrical responsiveness. Conductive MXene nanoparticles are incorporated to enhance mechanical strength, electroconductivity, and long-term stability. To fabricate the hydrogel component, digital light processing (DLP) 3D printing and electrospinning will be used to achieve precise geometry and fibrous reinforcement within the sensor.



The literature review supporting this proposal highlights how these techniques have been applied in recent scaffold and hydrogel systems to control structure, porosity, and conductivity. The outcome is a conceptual roadmap detailing materials selection, fabrication steps, and testing plans for future experimental validation. Future work will focus on evaluating mechanical robustness, conductivity, and self-healing properties once prototypes are produced. This design proposal represents an early-stage framework for developing flexible, conductive hydrogel-based wearable sensors guided by current literature and fabrication experience.

“Natural Countermeasures for Astronaut Mitochondrial Health”

Corinne Lansing | Louisiana Tech University (LaTech) | LURA | Poster # 29

Presenting Team Members: Corinne Lansing, Biology

Maintaining cellular and mitochondrial integrity under oxidative stress is essential for astronaut health during long-duration spaceflight. Plant-derived nanovesicles (PDNVs) offer a natural and biocompatible strategy for delivering bioactive compounds that protect against cellular stress. This project investigates the antioxidant potential of rosemary-derived nanovesicles (RNVs) as a foundation for developing plant-based countermeasures that promote cellular resilience. RNVs were isolated from rosemary leaves through vacuum infiltration of apoplastic fluid and characterized using nanoparticle tracking analysis, yielding an average concentration of 3.01×10^8 particles mL^{-1} and a mean diameter of 130 nm. Their antioxidant capacity and polyphenol content were compared to an aqueous rosemary extract, and cellular uptake was confirmed in human dermal fibroblasts (HDFs) using fluorescent membrane labeling. Treatment of HDFs with RNVs reduced intracellular reactive oxygen species (ROS) levels and improved cell viability and morphology under oxidative stress induced by tert-butyl hydrogen peroxide (TBHP). These findings demonstrate that RNVs can deliver stable, phenol-rich antioxidants directly to cells, mitigating stress-related damage. Building on these results, future work will evaluate mitochondrial responses to RNV treatment to better understand their potential as natural countermeasures for maintaining cellular and mitochondrial health in extreme environments, including spaceflight.

“An Automated Variability Monitor and Flare Advocate System for the Future NASA Mission COSI”

Garrett Latiolais | Louisiana State University and A&M College (LSU) | LURA | Poster # 30

Presenting Team Members: Garrett Latiolais, Astronomy

This project aims to develop an automated, real-time flare detection and alert system for blazars, providing live notifications to the COSI science team. Active Galactic Nuclei (AGNs) are among the most powerful gamma-ray sources, with a subset known as blazars-AGNs whose relativistic jets point close to our line of sight-dominating the observed gamma-ray sky. Blazar variability, especially during flaring episodes, offers critical insight into jet composition, magnetic fields, and the physical mechanisms powering these extreme environments. Flaring states are of particular interest, as they help constrain the size of the emission region and the timescales of energy release. These events are tracked by the Fermi Large Area Telescope (Fermi-LAT) through its Light Curve Repository (LCR), which monitors over 1,500 sources and provides the most complete and up-to-date database of blazar light curves. The upcoming NASA mission COSI (Compton Spectrometer and Imager) will extend this monitoring into



the MeV range (0.2-5 MeV), with added polarimetric capabilities. We now are building an automated pipeline that continuously pulls data from the Fermi-LAT LCR, flags potential flaring activity, and sends alerts to the COSI team. If sustained flux increases are detected, the system will trigger timely internal analyses and enable rapid alerts to the broader community for multiwavelength follow-up. This effort will significantly enhance COSI's time-domain capabilities and foster cross-observatory coordination, advancing our understanding of relativistic jets and high-energy transient phenomena.

“Enhancing Drone Detection with Adaptive Wiener Filtering in Noisy and Dynamic Environments”

Neil Muralles | Louisiana State University and A&M College (LSU) | LURA | Poster # 31

Presenting Team Members: Neil David Muralles, Mechanical Engineering

This work presents a framework that integrates adaptive Wiener filtering into real-time unmanned aerial vehicle (UAV) tracking systems to address the visual degradation challenges common in noisy and dynamic environments. Traditional UAV trackers often struggle with sensor noise, motion blur, and transmission artifacts, which can cause significant instability and target drift. The proposed method dynamically estimates local image statistics within each frame to adjust the Wiener filter parameters in real time, effectively suppressing noise and motion-induced blur while preserving key spatial details essential for tracking. By pairing this adaptive preprocessing with a correlation filter-based tracker, the system maintains computational efficiency while significantly improving tracking accuracy. Experimental evaluations on both indoor and outdoor datasets show notable reductions in tracking error, with the filter's responsiveness to motion intensity proving critical in cluttered or visually degraded scenes. These results demonstrate the potential of adaptive noise filtering to enhance UAV perception without reliance on deep learning models, offering a lightweight yet robust solution for future autonomous and vision-based aerial systems.

“Validating the New Wayfinder System of the InterPlanetary Network”

Emily Reily | Louisiana State University and A&M College (LSU) | LURA | Poster # 32

Presenting Team Members: Emily Reily, Physics

The Interplanetary Network (IPN) is a collaboration of spacecraft that detect, localize, and alert the scientific community to gamma-ray bursts (GRBs) as they occur. GRBs last only seconds and require rapid, precise localizations for effective follow-up observations. Accurate spacecraft positions are essential for determining these localizations. To automate this process, the IPN has developed Wayfinder, a predictive system that generates real-time spacecraft coordinates. Its accuracy will be tested by comparing predicted positions from five missions with their respective historical data. This will assess the reliability of the system, contributing to more efficient high-energy astrophysical observations in the future.

“The Effects of Microgravity on Serotonin and Dopamine in the Brain”



Carl Robbins | Louisiana Tech University (LaTech) | LURA | Poster # 33

Presenting Team Members: Carl Robbins, Biomedical Engineering

Human spaceflight exposes astronauts to a variety of environmental stressors that can disturb the central nervous system, including ionizing radiation, isolation, and microgravity. While microgravity's impact on musculoskeletal and cardiovascular systems has been extensively studied, its effects on neurochemical homeostasis remain poorly understood. This is due to the challenges of reproducing reduced gravity and the lack of tools capable of sensing neurotransmitters in vivo. Changes in behavior, spatial orientation, sensory processing, and social interactions experienced by astronauts suggest changes in key neurochemicals, such as serotonin (5-HT) and dopamine (DA), which play vital roles regulating mood and cognition to sleep and memory. This project seeks to bridge this knowledge gap by implementing novel electrochemical sensing technology for real-time measurement of 5-HT and DA in the mouse brain under simulated microgravity conditions. We will functionalize implantable glassy carbon microelectrode arrays (GCMEAs) with a poly(3,4-ethylenedioxythiophene)/carbon nanotube (PEDOT/CNT) coating, previously demonstrated to afford high selectivity and sensitivity for each target transmitter when coupled with optimized square wave voltammetry (SWV). These MEAs will be implanted into the hippocampus of adult mice undergoing weight unloading in partial weight suspension (PWS) microgravity model. By mapping the temporal profiles of 5-HT and DA under PWS, this study will interpret the neurochemical signatures of microgravity stress, leading to the development of targeted countermeasures to protect astronaut mental health and performance.

"Clean Hydrogen Fuel from Methane for Propulsion Engines"

Piper Smith | Louisiana Tech University (LaTech) | LURA | Poster # 34

Presenting Team Members: Piper Smith, Biomedical Engineering; Kaleigh Louque, Chemical Engineering; Caroline Cresap, Chemical Engineering

Hydrogen (H₂) is abundant on Earth and is considered a clean fuel, as its combustion produces only water. With an energy density three times higher than kerosene, H₂ is ideal for storage and delivery to rocket engines, offering a pathway to the decarbonization of the aerospace sector. However, current H₂ production methods generate significant CO₂/CO emissions, contributing to global carbon emissions. Most hydrogen is produced through catalytic methane (CH₄) steam reforming, classified as "Grey Hydrogen" due to its high carbon footprint. Achieving affordable, carbon-free H₂ production at a target cost of <\$2/kg remains a major challenge. Our prior research demonstrates that CH₄-to-H₂ conversion can be achieved over platinum (Pt) nanolayer catalysts supported on molybdenum titanium carbide (Mo₂TiC₂), a member of the MXene family of two-dimensional materials. This system exhibits excellent catalytic activity, superior coke resistance, high turnover frequencies, and long-term stability (over nine days of continuous operation). Additionally, the co-product ethylene (C₂H₄) is a high-value chemical with a large market for polyethylene production. The primary objective of this project is to develop active, selective, and stable high-entropy MXene (HE-MXene) catalysts that maximize noble metal utilization for affordable, carbon-free H₂ production tailored for rocket propulsion applications. This project aligns with NASA's Aeronautics Research Mission Directorate by enabling more affordable spaceflight, supports NASA's Science Mission Directorate through advancements in catalysis science, and fulfills NASA's Space Technology Mission



Directorate goals by promoting a new alternative to traditional water electrolysis for clean hydrogen production using HE-MXene catalysts.

“Impact of low dose rate neutron irradiation during gestation on fetal development”

Catherine Sorrels | Louisiana State University Health Sciences (LSUHSC) | LURA | Poster # 35

Presenting Team Members: Catherine Sorrels

The combined effects of space environmental stressors cause multiple organ system pathologies. Specifically, musculoskeletal system pathologies will be very dangerous for the health and performance of astronauts on extended-duration missions beyond low-Earth-orbit (LEO). To enable extended duration Missions beyond LEO or setting up settlements off Earth, we need to better understand the impact of continuous radiation exposure on mammalian physiology. There is a critical gap in knowledge surrounding the impact of the space radiation environment on skeletal health and fetal skeletal development. In this LURA project, we will extend the use of mouse fetal samples from a NASA Space Biology grant examining the effects of continuous neutron radiation exposure during pregnancy on maternal and fetal skeletal physiology. The parent study placed recently mated female mice into housing in the Colorado State University neutron irradiator. Animals were exposed to high-energy neutron particles (1mGy/day) for 23 hours/day. Following either 12 or 18 days of radiation exposure, the maternal hindlimb bones and all fetal tissues were collected and stored for later analysis. All animal work for the parent study was completed in 2019. For this LURA we extend the understanding we can gain from the gestational day 18 fetal samples by sending them to NASA Ames for microCT analysis at a better resolution than possible at our home institution. The 127 raw images were assessed for whole body skeletal formation differences between the control and radiation groups. Scans are ongoing for the remaining samples, but delayed due to funding priorities within the scanner use programming.

“Temperature-Dependent Behavior of Memory Resistors for Neuromorphic Computing Applications”

Erin Stallings | Louisiana Tech University (LaTech) | LURA | Poster # 36

Presenting Team Members: Erin Stallings, Mechanical Engineering; Al mothashim Sabbik, MS Engineering, Electrical Engineering Concentration

This LaSPACE funded LURA project aims to investigate the synaptic-like behavior of fabricated thin film memory resistors for neuromorphic computing applications. Unlike traditional computers, which store and process data separately, neuromorphic systems can combine the two into one device, like the brain. The key experiments that will be performed are gradual set and reset tests for resistance programming where the top electrode functions as the presynaptic neuron, the cobalt ferrite (CoFe₂O₄) active layer (produced by spin coating sol-gel precursors) serves as the synapse, and the bottom electrode acts as the postsynaptic neuron. Here, we present the Ag/CoFe₂O₄/Si memory resistor fabrication procedure and electrical characterization for operating temperatures in the range of 20-70 deg C. The high-resistance state was modeled using an exponential temperature dependence, enabling us to calculate the activation energy and time constants for temperature-induced resistance changes for two sets of devices. These findings help us better understand the behavior of the memory resistors under various



thermal conditions and provide a basis for future tests on potentiation and depression behaviors related to neuromorphic computing. This project is most relevant to NASA's Space Technology Mission Directorate and aligns with advanced computing, autonomous systems, and small satellite (CubeSats) technologies.

"Investigating the Effects of SSRIs on Serotonin Regulation Under Microgravity Conditions"

Seth Standley | Louisiana Tech University (LaTech) | LURA | Poster # 37

Presenting Team Members: Seth Standley, Biomedical Engineering

As long-duration space missions become more common, including future three-year trips to Mars, maintaining astronaut health-especially mental health-becomes increasingly important. Depression and anxiety, often triggered by isolation and stress, pose significant risks to crew performance, decision-making, and cohesion. Although medications such as Selective Serotonin Reuptake Inhibitors (SSRIs) are available, little is known about how microgravity affects their efficacy and safety. Changes in pharmacokinetics under altered gravity may reduce drug effectiveness or increase adverse effects. This study investigates how simulated microgravity influences the action of SSRI Fluoxetine. Using two groups of mice, we will compare serotonin (5-HT) levels under normal gravity and simulated microgravity conditions. The mice will be housed in identical custom-built acrylic enclosures; for the group under microgravity conditions, a spring-and-harness system will simulate weightlessness without altering enclosure conditions. The enclosures, along with an attachable device to simulate microgravity, have been previously designed and fabricated by our lab. Both groups of mice will receive Fluoxetine (30 mg/kg/day) over two weeks. Testing will be done in successive sets of two mice over 20 weeks. After treatment, carbon-based multielectrode arrays (MEAs), also developed by our lab, will be surgically implanted into the medial prefrontal cortex to measure 5-HT via square wave voltammetry (SWV). Findings from this study aim to improve our understanding of antidepressant efficacy in microgravity, contributing to safer and more effective mental health treatment on long-duration space missions.

"Explainability of Unsupervised Machine Learning Methods for High-Energy Astrophysics"

Skye Strain | Louisiana State University and A&M College (LSU) | LURA | Poster # 38

Presenting Team Members: Skye Strain, Physics

The goal of this project is to increase our understanding of how accurately unsupervised machine learning algorithms group data sets. Our algorithm is trained through waterfall plots, from Fermi-GBM, of gamma ray bursts (GRB). It currently uses three autoencoders to produce 30-dimensional latent spaces for three groupings of GRBs, long, medium, and short. This goes through a dimensionality reduction, UMAP, which give two and three-dimensional graphs of distributions of GRBs. The focus of this research is to optimize this algorithm and produce a reliability score for the distribution. The hope is to have an algorithm that can take GRB data from gamma ray detection devices and classify the burst's progenitor class quickly and reliably, so that scientists can observe the event.



“Design and Development of a Small-Scale Centrifuge for Simulating Hypergravity Conditions”

Bryleigh Wickham | Louisiana Tech University (LaTech) | LURA | Poster # 39

Presenting Team Members: Bryleigh Wickham, Biomedical Engineering

Space exploration has significantly advanced human knowledge, yet many physiological effects of spaceflight, particularly those related to hypergravity, remain poorly understood. Hypergravity, defined as gravitational forces greater than Earth's 1g, has been shown to increase bone and muscle mass, elevate thrombotic risk, and cause psychological stress. Although research often focuses on microgravity, astronauts experience periods of hypergravity during launch and re-entry. Ground-based studies of hypergravity are constrained by the high cost and large footprint of professional-grade centrifuges. This project proposes the design and construction of a compact, low-cost, and reproducible centrifuge capable of simulating hypergravity conditions in small animal models, specifically laboratory mice. The design is inspired by the European Space Agency's centrifuge, featuring four rotating arms equipped with gondola-style cages. The structure will be built using aluminum sheets and hollow aluminum bars, all mounted on a motorized central shaft. The proposed centrifuge will be significantly smaller than the 150 cm-radius model previously described in the literature, making it suitable for use in benchtop laboratory settings. Device performance will be evaluated by measuring rotational speed, balance, and the resulting g-forces using onboard accelerometers. The primary focus of this project is the engineering and development of the centrifuge device itself. No animal testing will be conducted at this stage; however, the final product will lay the groundwork for future biological research involving hypergravity exposure in laboratory models.

“Intelligent PID Control Augmented with Input Shaping for Precision Motion Control in Dynamic Systems”

Bradley Wight | Louisiana State University and A&M College (LSU) | LURA | Poster # 40

Presenting Team Members: Bradley Wight, Mechanical Engineering

This work presents a model-free control frame-work that integrates an intelligent PID controller with input-shaping techniques to improve trajectory tracking in uncertain, noisy and vibration-prone systems. The iPID controller compensates for unknown dynamics, while input shaping suppresses residual oscillations without requiring detailed modeling. The effectiveness of the proposed approach is demonstrated through simulations on spring-mass and DC motor systems, where it outperforms classical PID and alternative model-free controllers in terms of settling time, robustness, and vibration suppression. The method provides a lightweight and adaptable solution for precision motion control.

“The Impacts of Continuous, Low-Dose-Rate Neutron Radiation Exposure on Maternal and Fetal Skeletal Physiology”

Carlie Beard | Louisiana State University and A&M College (LSU) | Other | Poster # 41

Presenting Team Members: Carlie Beard, Kinesiology



Radiation effects on biological systems depend on dose, dose rate, and exposure duration. Galactic cosmic radiation (GCR), especially secondary neutrons, poses a major challenge for shielding and has strong biological impacts. As extra-Earth colonization becomes more realistic, understanding the physiological consequences of GCR, particularly for reproduction, is essential. Skeletal physiology during pregnancy is a critical yet understudied aspect of maternal health in space. While skeletal adaptations to the space environment have been examined, the influence of continuous, low-dose, low-dose-rate neutron radiation on maternal bone remains unknown. This study aimed to determine whether such exposure alters maternal skeletal physiology, with the hypothesis that continuous neutron irradiation reduces the expected pregnancy-associated bone loss. Female C57BL/6J mice were bred, and plug-positive dams randomized to irradiated or nonirradiated groups. Irradiated dams were exposed to neutron radiation (Californium-252 source, 1 mGy/day) for 23 hours daily. Subgroups were euthanized at day 12 (E12.5; ~8 weeks of human development) or day 18 (E18.5; ~end of the human first trimester). Calcein injections were given two (E12.5) or four (E18.5) days prior to euthanasia to mark bone formation. Hindlimb bones (tibia and femur) were collected for histological analysis, micro-computed tomography (μ CT) imaging, biomechanical testing, and spherical micro-indentation. These assessments will establish how continuous low-dose-rate neutron exposure affects maternal skeletal structure and function, filling a critical knowledge gap and informing astronaut health strategies for long-duration missions.

“The Potential of Multispectral and Hyperspectral Data to Estimate Photosynthetic Capacity Parameters”

Chi Qiu | Louisiana State University Agricultural Center (LSU-Ag) | Other | Poster # 42

Presenting Team Members: Chi Qiu, Environmental Science, Soil Science, Photosynthesis, Remote Sensing; Peng Fu, Remote Sensing, Plant Physiology, Soil Science, Environmental Science, Earth System Modeling

The maximum carboxylation rate (V_{cmax}) and maximum electron transport rate (J_{max}) are two key parameters determining photosynthetic potential. Traditional methods for measuring V_{cmax} and J_{max} are time-consuming and produce point measurements rather than spatially continuous data, which makes large-scale application difficult. Satellite remote sensing, especially hyperspectral and multispectral sensors, has the potential for large-scale monitoring of photosynthetic traits. However, these satellite data differ substantially in spectral, spatial, and temporal resolution, and remain to be evaluated in their ability to predict photosynthetic parameters. Four synthetic multispectral and hyperspectral datasets, simulating Landsat, Sentinel-2A, EnMAP, and PACE data, were generated using spectral response functions applied to hyperspectral data curated in the Global Spectra Trait Initiative (GSTI). The GSTI is a dataset that integrates photosynthetic parameter data. A Convolutional Neural Network (CNN) model was used to evaluate whether the deep learning techniques are good for photosynthetic parameters estimation. We expect that models based on hyperspectral data will outperform those using multispectral data in predicting photosynthetic parameters, due to the richer spectral information. Among the simulated sensors, PACE is anticipated to achieve the highest prediction accuracy, followed by EnMAP, Sentinel-2A, and Landsat, given their differences in spectral resolution and band coverage. Our research evaluates the theoretical potential of different sensors for capturing photosynthetic traits, providing guidance for future sensor design and the development of globally applicable trait estimation models.



"Light Gradient Boosting Machine-based Modeling and Forecasting of Oyster Norovirus Outbreaks"

Naresh Suwal | Louisiana State University and A&M College (LSU) | Other | Poster # 43

Presenting Team Members: Naresh Suwal; Civil and Environmental Engineering

Oyster norovirus outbreaks pose significant risks to public health and the shellfish industry globally. These outbreaks exhibit winter seasonality, with hotspots gradually shifting northward. However, the complex mechanisms driving the onset of norovirus outbreaks make accurate prediction challenging. This paper presents a Light Gradient Boosting Machine (LightGBM) model for forecasting oyster norovirus outbreaks with lead time, using environmental and location variables. Pearson correlation and Gini index values were used to select key environmental indicators. The model was developed for broad regions, including major oyster harvesting areas such as the Gulf of America, British Columbia, the Washington coast, and the southwest coast of France. The 2-day lead time model achieved a positive predictive value of 76.17%, a negative predictive value of 99.06%, a sensitivity of 88.59%, a specificity of 97.51%, and an overall accuracy of 96.77% compared to other tested lead times (3, 4, 5, 6, and up to 10 days), demonstrating the model's suitability for predicting the risk of oyster norovirus outbreaks to human health. Among the selected indicators, SHAP mean values identified solar radiation and minimum temperature as the most important predictors. However, other indicators-such as minimum gage height, cumulative antecedent precipitation, salinity, and location parameters-cannot be ignored, as their exclusion reduces model performance. The LightGBM 2-day lead time model allows public health agencies and oyster harvesters to proactively implement management strategies, shifting their approach from reacting to norovirus outbreaks after they occur to preventing - or at least minimizing - the risk of such costly outbreak.

"Achieving direct bandgap and optoelectronic enhancement in scalable stacked MoS₂ monolayers"

Muhammad Aamir Abbas | Tulane University (Tulane) | REA | Poster # 44

Presenting Team Members: Muhammad Aamir Abbas, Materials engineering and Physics

Monolayer MoS₂ exhibits a near-unity photoluminescence quantum yield, making it highly attractive for optoelectronic applications. In contrast, bulk MoS₂ undergoes a transition from a direct to an indirect band gap, which significantly limits its usefulness in such devices. In this work, we demonstrate a strategy to preserve the direct band gap of MoS₂ while enhancing its absorption, charge carrier mobility, and other optoelectronic properties through controlled stacking of monolayers. We introduce a scalable method for assembling large-area monolayer MoS₂ films grown by chemical vapor deposition (CVD). The transfer process utilizes poly(methyl methacrylate) (PMMA) as a carrier polymer and an aluminum mesh to support the films, ensuring geometric integrity and preventing folding during transfer from the donor to the receiver substrate. The resulting stacked monolayers show a systematic increase in photoluminescence, absorption, and mobility, while retaining monolayer-like Raman signatures and a direct band gap. Remarkably, a four-layer stack exhibits more than a 225% enhancement in photoluminescence, a 250% increase in absorption, and a 94% improvement in field-effect mobility relative to a single monolayer. The retention of monolayer-like Raman features and direct band gap characteristics in the stacks is attributed to the enlarged interlayer spacing and twist angles between adjacent layers.



“Robotic additive manufacturing of support-free parts using non-planar slicing algorithm and five-axis print Path”

Abdalla Abdou | Southeastern Louisiana University (SELU) | REA | Poster # 45

Presenting Team Members: Abdalla Abdou

NASA has been actively evaluating additive manufacturing (AM) technologies for off-earth manufacturing purposes. While the ongoing projects provide valuable insight into the capabilities of AM through technology demonstrations, it is also important to note that the equipment, devices, and materials need to be transported to the end use location, be it International Space Station (ISS) or off-earth locations (e.g., Moon, Mars etc.). Therefore, it is important to maximize equipment utilization and minimize launch payload for such technologies. The current 3D printers are restricted to planar movement for material extrusion which results in slower cycle times due to the need for support materials when printing complex geometries. These support materials need to be removed before the printed object can be used as an end use part. However, it is not practical to bring large amounts of support material due to payload space and weight limitations. For future use case scenarios, printing capabilities will have to be enhanced through implementation of non-planar 3D printing for maximizing equipment utilization and minimizing wait times. This can potentially be demonstrated using a robotic additive manufacturing system which integrates a 6-axis robot with a material extruder as the end effector. In this proposed research project, the researchers will design and construct a robotic additive manufacturing system, develop slicing algorithms for generating non-planar print paths, 3D print support-free complex parts leveraging on five degrees-of-freedom print paths, and compare non-planar and planar slicing in terms of dimensional accuracy and surface quality.

“Fabrication of high-sensitivity nanofiber-based glucose sensor for non-invasive Health monitoring in Space Tourisms”

Abdullah bin Bashir | University of Louisiana at Lafayette (ULL) | REA | Poster # 46

Presenting Team Members: Abdullah bin Bashir

As space tourism advances, non-invasive health monitoring becomes essential for ensuring traveler well-being. In this work, we present the development of a high-sensitivity glucose sensor designed to monitor glucose levels through sweat. Unlike conventional chemical polymerization methods that produce dense, low-surface-area films with limited reproducibility, electrospinning enables the fabrication of lightweight, flexible nanofiber mats with high porosity and tunable morphology. These features provide superior enzyme loading, enhanced electron transfer, and stable sensor performance, making electro spun nanofibers highly suitable for integration into wearable devices and for operation under the extreme conditions of space travel. The fabricated sensor employs a polyaniline (PANI)/graphene oxide nano scroll (GONS) nanofiber matrix doped with sulfuric acid to enhance electrical conductivity, coupled with a Nafion coating for selectivity. Unlike previous designs that incorporated carboxymethyl chitosan (CMC) as a stabilizing polymer, the exclusion of CMC in this work eliminates polymeric interference and improves structural order. X-ray diffraction (XRD) analysis confirmed higher crystallinity for GONS (76.6%) compared to PANI (60%), while Fourier-transform infrared spectroscopy (FTIR) verified the retention of functional groups after electrospinning. Scanning electron microscopy (SEM) revealed uniform nanofibers with



interconnected pores, enabling efficient glucose diffusion and enzyme immobilization. These material and structural improvements are translated into enhanced electron transport and overall sensor sensitivity.

“Enhancing Lunar Power System Resilience through Electromagnetic Transient Modeling and Analysis”

Toby Latino | Louisiana Tech University (LaTech) | REA | Poster # 47

Presenting Team Members: Toby Latino, Electrical Engineering

Adarsha Dhungel, Electrical Engineering

NASA's Artemis program aims to return humans to the Moon, establish a sustained presence, and lay the groundwork for future crewed Mars missions. Within the Space Technology Mission Directorate, the Lunar Surface Innovation Initiative drives critical advancements for lunar exploration. Its Surface Power focus area develops technologies for power generation, distribution, and storage on the Moon. Electrical power is essential to Artemis, enabling nearly all vital human and robotic functions. Lunar Power Systems (LPS) face unique challenges absent on Earth, including extreme temperatures, abrasive dust, radiation exposure, limited maintenance access, resource constraints, and prolonged darkness. These systems must also support loads that are critical, highly sensitive to voltage and noise, and often variable. To ensure mission success and crew safety, LPS must be robust, resilient, and high-fidelity—any compromise in performance could have catastrophic consequences. In this project, an electromagnetic transient (EMT) model of an LPS will be developed to investigate potential power transmission and distribution challenges unique to the lunar environment. The model will be constructed using validated data and insights from existing literature. Detailed simulations will be conducted to analyze voltage spikes, dips, and other transient phenomena under a range of scenarios, including overload, light load, and fault conditions. Based on these analyses, targeted mitigation strategies will be proposed to address identified vulnerabilities. The outcomes of this work will provide NASA with valuable insights into the design and operation of robust and resilient LPS architectures, supporting the development of effective solutions to ensure mission reliability and safety.

“Multifunctional, liquid metal embedded soft materials towards seals with embedded electronics for space applications”

Olutofunmi Olaoye | Louisiana State University and A&M College (LSU) | REA | Poster # 48

Presenting Team Members: Caleb Reid, Mechanical Engineering; Emiliana Grove, Mechanical Engineering; Gabriel B Freedman, Mechanical Engineering; Kyle Stack, Mechanical Engineering;

Matthew W McClung, Mechanical Engineering; Michael D Ruiz, Mechanical Engineering

Seals affected by lunar dust exposure, mechanical degradation, or material defects pose significant challenges to the longevity and operation of equipment in space environments. Seals play critical roles in ensuring the performance of space equipment and astronaut safety. Here, we introduce an approach to enhance seal functionality by developing electronic seals that provide real-time monitoring of seal health while maintaining functional sealing properties. We embedded elastomeric seals with a liquid metal (LM) and fluoroelastomer (FKM)



composite system used as electrodes for capacitive displacement sensing. These sensors enable the continuous monitoring of seal degradation by detecting compression and mechanical damage. The electronic seals are capable of detecting strains as low as 0.28%, with up to a 73% change in capacitance for 35% strain. With a gauge factor over 2, the sensors provide a means for early identification of structural alterations and potential leaks under typical compressive loading conditions. Through conventional characterization methods, we designed a seal structure for the integration of soft electronics while preserving essential properties, demonstrating sensing abilities, and maintaining functionality in a variety of extreme environments. This work advances active seal monitoring technology, which improves the reliability of future in-space systems.

“Valorization of agricultural residues to produce fuel and consumable water on space missions”

Zannatul Ferdous Tulona | Louisiana Tech University (LaTech) | REA | Poster # 49

Presenting Team Members: Zannatul Ferdous Tulona, Molecular Science and Nanotechnology

Devising a sustainable supply of fuel and consumable water on space missions has been a historically persisting challenge, one requiring innovative solutions to create recycling pathways to reduce the cost of these expeditions, both financially and in terms of resource usage. This NASA REA project created a method of valorizing rice husks, a form of agricultural waste that could potentially be grown hydroponically in space, to be transformed into a sugar solution and consumable water. The rice husks are to be subjected to hydrothermal carbonization (HTC), a low-cost, low-energy requiring treatment process that lyses the recalcitrant structure of the biomass to release the sugars into the water in the reactor, at a temperature of 200 °C. Consequently, this sugar solution is treated further by another low-energy process, direct contact membrane distillation (DCMD), to concentrate it and extract consumable water by utilizing the vapor pressure difference across the membrane in the DCMD unit caused by a temperature gradient applied between the feed side and the collector side. The water produced is of drinking quality, and the concentrated sugar solution formed possesses the potential to be converted to ethanol by fermentation, or it can be consumed as a sweetener for beverages.

“Formation Control of Multi-Agent Systems Based on Pure Vision”

Pengzhao Wu | Louisiana State University and A&M College (LSU) | REA | Poster # 50

Presenting Team Members: Pengzhao Wu, ECE; Pranav Pothapragada, ECE

Reliable formation control is essential for cooperative multi-vehicle systems in autonomous driving applications, particularly in scenarios where cost and sensor complexity reduce accessibility. This project presents a purely vision-based leader-follower system that eliminates the need for high-cost sensors such as LiDAR or radar. The proposed system achieves real-time object detection, depth and angle estimation, and formation control using monocular camera input. A lightweight YOLOv11n [1] model is employed for detecting the QCar leader vehicle based on Real-time video streams. The follower vehicle transmits images wirelessly to a host computer, where object detection and pose estimation are performed. A calibrated pinhole camera model translates bounding box measurements into relative distance and orientation estimates. These are fed into a PID controller that adjusts the follower's steering and speed to maintain a stable and safe following distance. The system is fully implemented on



real-world hardware, and experimental validation demonstrates accurate and robust leader tracking under dynamic conditions, confirming the viability of vision-only approaches for cooperative driving tasks.

“Measuring Artificial Gravity During Suborbital Rocket Flight”

Nathaniel Wrobel | Louisiana State University and A&M College (LSU) | SAFOS | Poster # 51

Presenting Team Members: Nathaniel Wrobel, B.S. Physics & B.S. Mechanical Engineering

The primary mission of the Space Tigers payload was to produce and measure artificial gravity for a small mass during rocket flight by applying a centrifugal force via a rotating arm. This was done on a Terrier-Improved Orion pressurized rocket, reaching an altitude of approximately 70 miles and spinning 5-7 times a second. Rocket flights produce volatile states of motion, making it difficult to control a steady rotation, especially if the rocket uses spin stabilization. During flight, a rotating arm was used to produce artificial gravity and control an output force of 4 newtons on a steel ball bearing. This project was designed to fly with the RockSat-C program on a sounding rocket from Wallops Island, VA in summer 2025. The primary objective was to measure and control rotational force throughout flight on a steel ball. The LSU Space Tiger's payload achieved the main objective, achieving an output force of 4.00079N during the flight. While the force fluctuated, the RPM reached predicted values. Expected values to maintain were 920 RPM during the Terrier burn and 1178 RPM during the Improved-Orion burn. It was also expected that a spin of 842 RPM was needed when the rocket had no rotation. All of these RPM values were reached, and they occurred at times that match the burn times of the rocket. By first observing how artificial gravity works on a small scale, the concept can then be expanded into more widespread and practical systems on larger and longer flights. A micro-gravity environment has negative impacts on human health, therefore a plan to mitigate these impacts needs to be put into place before long term space flights.

“Design and Fabrication of Memristor Array for Space Application”

Hojun Lee | Louisiana Tech University (LaTech) | Senior Design | Poster # 52

Presenting Team Members: Hojun Lee, Electrical Engineering; Christine Meister, Electrical Engineering; Ian Dryg, Electrical Engineering; Amir Cazabat, Electrical Engineering

A memory resistor or memristor is an electrical device that is capable of changing and maintaining resistance based on an applied voltage or current. Memristors are promising data storage devices due to their capability to store and perform matrix multiplications within the device. The capability to perform matrix multiplications within a device is exciting due to how this technology could be used for AI applications, making on-chip AI potentially possible. This project was pursued to design and test different types of memristor devices with varying materials in hopes of developing a memristor array capable of withstanding space conditions such as X-ray and electron beam exposure. Based on previous studies, two different memristor devices consisting of Si/CoFe₂O₄/Ag were made and tested. One device is made with the sol-gel method, and another device is made by sputtering the CoFe₂O₄ active layer directly onto the Si substrate. More memristor devices with varying active layers, such as ZnO, will be fabricated and tested in hopes of creating a higher-performance memristor array.



“Dimensional accuracy of additively manufactured parts”

Joseph Robinson | Southeastern Louisiana University (SELU) | Senior Design | Poster # 53

Presenting Team Members: Joseph Robinson, Mechanical Engineering Technology; Gage Boquet, Mechanical Engineering Technology

The objective of NASA's In-Space Manufacturing initiative is to develop the technologies and processes which will enable on-demand manufacturing capability during long-duration space missions. Accordingly, NASA has been actively evaluating additive manufacturing (AM) technologies for off-earth manufacturing purposes. While the ongoing projects are providing valuable insights on capabilities of AM through technology demonstrations, it is also important to note that the dimensional accuracy of the printed parts play a crucial role when it comes to putting the parts together to form an assembly or installing a part in an existing system as a spare part. The current software and hardware implementation of 3D printing workflow results in parts that deviate from the computer-aided design (CAD) model within a certain range. This is caused by the slicing profiles implemented in the software and the type of hardware configuration used for the printer. To address this issue, a temporary workaround is to use a rule of thumb clearance between all mating joints, resulting in a workflow that requires additional trial and error prints for verification. Such workflow is not ideal for in-space manufacturing where time and resources are limited. In this proposed senior design research project, the students will identify benchmark parts, 3D print and 3D scan the benchmark parts, compare the scans with the CAD model for deviations in dimensions, and identify the effects of slicing profiles and hardware configurations on dimensional accuracy.

“LOUIS and CLARQ - Rover-Drone Coordination System for Enhanced Navigation”

Ben Sehring | Louisiana State University and A&M College (LSU) | Senior Design | Poster # 54

Presenting Team Members: Benjamin Sehring, Mechanical Engineering; Cody Carter, Computer Engineering; Jaxon Hernandez, Computer Engineering; Kyle Davis, Electrical Engineering; William Faucheux, Electrical Engineering

The Rover-Drone Coordination System for Enhanced Navigation project aims to take a previously built rover system and add a tethered drone that can use cameras to survey the area and relay that data back to the rover. The rover-drone system is intended to serve as an educational tool, and as such needs a straightforward design to be understood by students. Additionally, the designed system could be used as a reference for the creation of an unmanned rover mission. This means other planetary conditions should be considered as well as producing a reliable, autonomous system that can exist without human intervention. The drone is required to maintain a 3-hour tethered flight time, and all of this is to be accomplished within a \$ 4,000 budget. The drone system must utilize and build off the current rover's design, including the addition of a launch pad for the drone. The drone must also be designed with outdoor conditions in mind, with resistance to gusts of wind and any airborne debris. One additional objective provided by the sponsor is an untethered flight mode, for short duration, long range applications. Communication between the rover and drone will also need to be considered, as the drone needs to receive flight paths and provide video data of the area. This will be done through wireless communication, so the drone could still function in its untethered form.



"Investigating the Photophysical Properties of Cerium Complexes"

William Viator | Louisiana Tech University (LaTech) | Senior Design | Poster # 55

Presenting Team Members: Carlee Carmello, Chemistry; John Sibley, Physics/Chemistry; William Viator, Chemistry; Kamden Perkins, Chemistry/ChemEng/Physics

Trivalent cerium (Ce^{3+}) is a fast fluorescent metal center that can be used to generate scintillation materials. Ce is the most abundant and least expensive of the lanthanide metals. We are interested in synthesizing molecular compounds that can be doped into organic polymers such as polymethylmethacrylate (PMMA). However, most fluorescent Ce^{3+} scintillator materials are inorganic crystals and not molecular compounds. Previous LaSpace funded students have had success in generating a fluorescent polymer with trifluoroacetate (TFA). This $\text{Ce}(\text{TFA})_5$ compound is difficult to synthesize reproducibly because of the poor binding of TFA to Ce^{3+} . For this project, we are looking to synthesize terpyridines and use commercially available carboxylate ligands to generate luminescent Ce^{3+} complexes. In addition, we are looking to synthesize ligands that can bind multiple Ce^{3+} ions. Studying the binding affinities of various ligands to Ce^{3+} will also be conducted using NMR and UV-Vis spectroscopy. Matters are complicated by Ce^{3+} being able to be oxidized to Ce^{4+} . In addition, Ce^{3+} can facilitate a metal-to-ligand charge transfer and Ce^{4+} can facilitate a ligand to metal charge transfer. Using absorption spectroscopy both steady-state and lifetime fluorescence, we seek to determine what photophysical process is taking place. In addition, we will use X-ray photoelectron spectroscopy to determine ratios of Ce^{3+} to Ce^{4+} .

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"Entropy-Based Feature Enhancement for Autonomous Fault Recognition in Space-Based Power Systems"

Mikaela Woodard | University of Louisiana at Lafayette (ULL) | Senior Design | Poster # 56

Presenting Team Members: Mikaela Woodard, Electrical Engineering; Gia Golecki, Electrical Engineering; Nathaniel Agee, Electrical Engineering; Khairul Islam, Electrical Engineering

Autonomous fault detection is essential for space-based power systems, where remote intervention is limited and system resilience is critical. This poster covers the paper that investigates the use of Fuzzy Entropy (FuzzyEn) as a feature enhancement technique that can be used towards AI-driven fault recognition in space-based power systems. By preprocessing sensor data with FuzzyEn we quantify the complexity and regularity of time series, enabling improved discrimination between normal and faulty conditions as well as different types of faults. Comparative analysis demonstrates that entropy-based preprocessing yields a 37.5% increase in correlation-based separability and a 194.6% improvement in separability index over raw data, under stringent 0.2 ms sampling constraints. These results highlight the effectiveness of entropy enhanced features for robust, real-time fault classification in autonomous spacecraft power management, supporting mission safety and continuity in deep space environments. Continuing research is being conducted regarding fault classification using entropy-based fault detection and will be included on poster as well.