Palmetto Academy, Research Programs for 2026

1. Dr. Adem Ali, College of Charleston, Dept of Geology and Environmental Geosciences
Spatial Modeling of Climate-Driven Permafrost Thaw and Carbon Remobilization in the North Slope Borough: A Multi-Scenario GIS Approach - Discover the spatial drivers of permafrost thaw and carbon remobilization across Alaska's North Slope. This project integrates climate model projections, satellite observations, and field validation to identify high-risk zones where ground-ice thaw and carbon pools intersect. Students will engage in geospatial modeling, weighted overlays, and clustering analyses to produce high-resolution thaw and carbon vulnerability maps. The results will support improved Arctic carbon budgeting and regional climate forecasting.

2. Dr. Qiushi Chen, Clemson University, Dept of Civil Engineering
Autonomous robotic navigation and in situ characterization in simulated lunar Terrain: NASA's Artemis program necessitates the development of autonomous robotic systems for lunar surface exploration and construction. This Palmetto project will focus on developing an intelligent rover on a lab-scale lunar regolith testbed and demonstrate its use in characterizing lunar regolith. Students will gain hands-on experience in assembling the robotic rover, programming its path-planning, and using the rover to demonstrate a preliminary in-situ characterization by correlating visual features from its own wheel tracks with regolith properties.

3. Dr. Ana Oprisan, College of Charleston, Dept of Physics & Astronomy
Universality laws in pure fluids and critical point experiments under density Gradient: The race for space exploration, and more recently, the Artemis Space mission, requires reliable and efficient propellant management systems rooted in a deeper understanding of the thermophysical properties of liquid oxygen (LO). The main objective of this project is to investigate the universal power laws that govern the dynamics of LO under magnetic levitation and sulfur hexafluoride in microgravity near critical points using a novel Haralick feature method and the use of AI automated pattern classification. Our established collaboration with Drs Beysens's research team will allow us access to experimental data related to turbidity near the critical point from the Hydrogen Levitation Device (HYLDE) facility at the Commissariat à l'Energie Atomique (CEA)-Grenoble (France), which compensates gravity to within a few percent of Earth's gravitational acceleration.

4. Dr. Sorinel Oprisan, College of Charleston, Dept of Physics & Astronomy
Altered time perception under stress. The role of (micro)gravity stressor in time Perception: The ability to perceive durations is vital for survival and adaptation, playing a critical role in core cognitive functions such as decision-making, rate calculation, and action planning. Environmental stressors, including (micro)gravity, disrupt sensorimotor feedback loops and alter the brain's spatial and temporal perception. Our objective is to integrate recent advancements in understanding the cellular-level effects of microgravity into a realistic, neurobiologically informed neural network model of the cortico-thalamic-striatal loops.

5. Dr. Sudeep Popat, Clemson University, Dept. of Environmental Engineering and Earth Sciences

Miniaturized Electrochemical Systems for Spacecraft Urine Processing: This project addresses a critical challenge for NASA's Mars and Artemis missions: the regenerative purification of water from urine without reliance on hazardous consumables. Selected students will design, build, and test a miniaturized electrochemical cell capable of producing hydrogen peroxide on-demand to stabilize urine for downstream water recovery. Participants will gain rigorous, interdisciplinary experience in 3D-printed prototyping, electrochemical characterization, and analytical chemistry, directly contributing to NASA's goal of closing the water loop in space.

6. Dr. Monirosadat Sadati, University of South Carolina, Dept of Chemical Engineering

Engineering Nanostructured Load-Bearing Structural Batteries with High Ionic Conductivity: Polymer solid electrolytes for lithium-ion (Li-ion) batteries are emerging as a nextgeneration technology, offering a safer and more stable alternative to traditional liquid electrolytes. These materials use a polymer matrix to conduct ions, eliminating issues such as leakage, volatility, and flammability, and thereby significantly improving battery safety and reliability. Our research focuses on designing polymer membranes that combine high ionic conductivity with enhanced mechanical strength. Polymer design, synthesis, and characterization will be carried out in the Department of Chemical Engineering at the University of South Carolina under the supervision of Prof. Sadati.

7. Dr. Subramani Sockalingam, University of South Carolina, Dept. of Mechanical Engineering

Characterizing high strain rate mode-II delamination response of composite Material: This project is about developing a novel experimental method to characterize carbon fiber composite materials of interest to NASA subjected to debonding under impact loading conditions. The project will provide hands-on research experiences including composite material manufacturing, impact testing and finite element simulations. Additionally, the project will provide professional development opportunities including collaborating with other students, enhancing project management and technical communication skills.

8. Dr. Nader Taheri-Qazvini, University of South Carolina, Dept. of Biomedical Engineering

Dual-Cure Strategies for 3D-Printable High Solid Regolith Suspensions with Integrated Radiation Shielding - This research project addresses a fundamental processing challenge in additive manufacturing for space applications: achieving complete solidification of highly loaded opaque suspensions used in 3D printing radiation-shielding habitat structures. Building on preliminary results demonstrating thermal curing superiority over UV curing in MXene-regolith systems, student researchers will systematically investigate dual-cure strategies combining UV and thermal approaches to optimize processing of high solid formulations. The project integrates comprehensive rheological characterization with cure kinetics studies, while leveraging AI-assisted tools for literature analysis and experimental planning. Through this research experience, students will develop expertise in advanced materials processing and characterization techniques, contributing to NASA's mission of enabling sustainable human presence on the Moon and Mars through in-situ resource utilization.

9. Dr. Ralph White, University of South Carolina, Dept. of Chemical Engineering

Developing and Demonstrating Solid-State Electrolytes for Next- Generation Structural Li-ion and Na-ion Batteries - Structural batteries are novel energy-storing multifunctional materials that can be integrated directly into aircraft and vehicle structures, reducing the need for extra mass and volume. This project, guided by Prof. Ralph E. White and Dr. Coman, focuses on developing next-generation sodium-ion structural batteries using active coatings on carbon-fiber electrodes and solid polymer electrolytes. Students will gain hands-on experience fabricating and testing coin- and pouch-cell prototypes, advancing clean-energy technologies for next-generation aerospace and electric transportation.