CESO 22-1: Lunar Uncrewed Explorer Tool (LUNEXT)

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Start TRL: 3 **End TRL:** 4

Prime STMD Taxonomy:
TX13.1.5 Ground and Surface Logistics, TX13.4.1 Mission Planning, TX13.4.3 High-Fidelity Simulation and Visualization, TX13.4.5 Operations, Health and Maintenance for Ground and Surface Systems

This work also addresses Integrated Exploration Capability Gaps 13-01 to 13-09, in which high-fidelity simulations and visualizations for uncrewed surface activities are needed to identify and resolve interface compatibilities, surface operations, support inefficiencies (time/material/logistics flow) and hazards.

Secondary STMD Taxonomy:

TX07 Exploration Destination Systems, TX04.6.2 Modeling and Simulation for Robots

Project Description:

Develop a software tool for planning uncrewed lunar surface operations that simulates illumination conditions on the surface and displays environmental data, such as temperature and induced plume effects, into an integrated lunar operational environment simulation that does not require high-end computing hardware. This prototype tool is a capability that fills a gap, and it does not compete with existing KSC/agency simulation/visualization tools.

Anticipated Benefits:

The KSC Uncrewed Surface Operations Team, in support of ESDMD Architecture Development and Technical Integration Offices and the Lunar Architecture Team (LAT), identified a need and capability gap for an easy to use, interactive simulation tool for planning uncrewed surface operations and support activities such as surface traversals, logistics transfers, maintenance, and repairs. LUNEXT addresses this need and significantly benefits the team supporting the Moon-to-Mars architecture formulation. The software tool simulates illumination conditions on the lunar surface and displays environmental information that aids in conducting trade studies and assessing operational scenarios, constraints, and use cases. It creates a user-friendly integrated lunar operational environment simulation for time-sensitive mission and surface planning. The tool runs on low-end computers, increasing accessibility and reducing iteration time between surface planning activities.

Project Closeout Summary:

When planning surface operations on the Moon, there are distinct environmental factors that set it apart from Earth: lower gravity (⅙g), virtual lack of an atmosphere, soil characteristics, extreme surface temperature fluctuations, illumination conditions and permanently shadowed regions, and exposure to space radiation. Another factor is the induced environmental effects of plume surface interactions and ejecta impacts on nearby surface assets. LUNEXT combines preprocessed data sets from known and trusted sources and calculates potential plume ejecta impact points using orbital physics and trajectories equations, creating an integrated operational environment simulation that addresses some of these environmental factors.