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INVESTIGATION ON THE DIGITAL TWIN SYSTEM FOR THE CHANG'E-6 DORN INSTRUMENT

Abstract

The Detection of Outgasing Radon (DORN), a lunar radon gas detection payload proposed a French-Sino team led by the French Institute of Astrophysics and Planetary Sciences (IRAP), is scheduled to be onboard the Chang'e-6 lunar lander. Utilizing alpha particle spectrometry, DORN aims to explore lunar surface radon isotopes, contributing to the understanding of the transport and diffusion of volatiles across the lunar surface, lunar dust, and the outer lunar exosphere.

This research focuses on the health monitoring, scientific investigation, and operational requirements of the collaborative French-Chinese payload within the Chang'e-6 Radon Gas Detector (DORN). We establish comprehensive mission scenarios and end-to-end system models, developing a digital parallel system with multiple physical parameters, various scales, and high fidelity. Key technologies addressed include overcoming challenges related to long-distance Earth-Moon synchronization, virtual-real mapping, high-reliability state estimation based on multi-physical models, and visualization of multidimensional data from diverse, heterogeneous sources.

This study aims to enhance the scientific output and outreach effectiveness of the Sino-French collaborative payload. The DORN digital twin system is designed to contribute to the advancement of our knowledge about lunar volatile distribution, aiding in unraveling the complexities of lunar surface processes and outer space interactions. The research outcomes are anticipated to have a significant impact on both scientific exploration and public engagement.