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ARCHITECTURAL DESIGN CONSIDERATIONS FOR A ROBOTIC POWER INFRASTRUCTURE ON THE MOON

Abstract

The development of a future permanent robotic base on the moon, that takes advantage of the presence of water ice as a key resource, requires multiple considerations, from infrastructure and habitat design, to operational schemes and robotic construction techniques. Within the complexity of such a challenge, a fundamental aspect is the design of a power infrastructure capable of addressing robotic deployment and operations in both permanently shadowed regions (PSR) and persistently lit regions (PLR). This paper presents relevant findings regarding ongoing work at the Jet Propulsion Laboratory conducted by the authors to understand, define and design a new type of modular power infrastructure as part of a scalable robotic base concept, taking into account both architecture and operations. Thus, this research is centered on the design constraints, preliminary requirements and concept designs for a novel approach that uses solar power as a primary energy source and nuclear power for emergency needs. Overall architecture strategies, deployment and location schemes, as well as modular multifunctional schemes tackling power transfer (wired and wireless), scalability and maintenance are presented as well. Multiple trades are developed addressing those key assumptions to create parametric models of multiple families of solutions capable of serving such complex purpose through advanced computational design and new manufacturing techniques for robotic systems (such as additive manufacturing). Finally, detailed concept designs and parametric CAD / BIM models are presented in order to better understand integration, expandability and operations. This paper and the model presented are meant to be used as an ongoing and expandable reference model for future studies of modular robotic bases on other planetary surfaces, such as our Moon, in the 21st century.