Paper ID: 89797
oral

22nd IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Strategies & Architectures as the Framework for Future Building Blocks in Space Exploration and Development (1)

Author: Mr. Marco Giugliarelli
Italy, marcogiuglia98@gmail.com

Mr. Giuseppe Spina
France, giuspin@protonmail.com
Dr. Alessio Bellio
Italy, bellioalessio@gmail.com
Mr. Niccolò Segato
Italy, niccolo.segato@gmail.com

BENEFITS OF A MODULAR LEG-BASED LOCOMOTION PLATFORM FOR LUNAR ROVERS IN THE 10-30CM SIZE RANGE.

Abstract

As the space industry endeavors to advance exploration technologies for Lunar and Martian missions, the demand for modular and cost-efficient solutions becomes increasingly critical. Initiatives such as the Artemis program have underscored the need for innovative approaches tailored to the unique challenges of extraterrestrial environments, and the possibilities of commercial players. In this context, a cost-effective, volume and weight efficient, yet highly flexible modular platform would be game changing: such benefits are met by the renowned (and largely commercially available) CubeSat industry.

It's on this basis that the need for CubeSat-based modular technologies for surface exploration is identified: a need that new-space startup Adeon Space is set to fulfill. This paper introduces ARACNE, a CubeSat-compatible locomotion platform featuring spider-like legs, facilitating easy and cost-effective rover development. Comprising two modules with two legs each, to be connected to the Z faces of any CubeSat structure, ARACNE offers remarkable flexibility in payload development, enabling compact and efficient solutions. Complementing ARACNE, the deployer TELAM, has been developed. Its purpose is to host and release the rover and serve as an interface with commercial landers. With the help of these two simple building blocks, the tide of modular, cost-effective nano-satellites will be allowed to break down the barriers of low earth orbit, revolutionizing the market of robotic surface missions.

Objective of this paper, over than introducing ARACNE and TELAM's, is to present the results of the extensive trade-off analysis performed on the locomotion platform's design, which showed fundamental benefits of a leg-based solution with respect to classical wheel-based ones, for rovers in the sizes of 10-30cm. Key points of the leg-based solution will be provided, such as superior flexibility in traversing challenging terrains, significant reductions of weight and volume requirements, all while maintaining product's reliability.

Finally, the paper tackles the importance of Product Lifecycle Management (PLM), introducing the comprehensive Life Cycle Assessment (LCA) analysis that has been performed to maximize the sustainability of the product.