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Systems and Infrastructures to Implement Future Building Blocks in Space Exploration and Development (2)

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MECHANICAL DESIGN OF A MODULAR EXPERIMENT CARRIER FOR A TERRESTRIAL ANALOG DEMO MISSION AND ITS POTENTIAL FOR FUTURE SPACE EXPLORATION

Abstract

The ROBEX (Robotic Exploration Under Extreme Conditions) alliance formed by the German Helmholtz Association has the aim to find and use areas of overlapping competencies between institutions involved with the exploration of deep sea and space environment. To demonstrate the developed systems and technologies two test campaigns are conducted, one for the deep sea in the area of Svalbard, Norway and one on the volcano Mt. Etna in Sicily, Italy as an Moon environment analogue test ground.

The objective of the volcano mission is to demonstrate seismic experiments built-up and conducted autonomously by robotic elements. It shall serve as scientific benchmark to validate concepts reproducing and extending experiments from the Apollo program and at the same time demonstrate robotic capabilities to do so without direct human interaction. The overall test infrastructure consisting of a stationary lander, a mobile element and instrument carriers has been developed within the ROBEX alliance. The modular instrument carrier, referred to as Remote Unit (RU), is deployed and positioned by a robotic system and supplies the payload, in this case the seismometer, with power, data-handling and communication. It also provides mechanical interfaces to the lander and a grapple interface for robotic handling. The RU's primary structure is a differential CFRP framework with a dedicated payload and bus compartment. Two types of RUs have been developed: one basic version that complies with a mass limitation of 3 kg (RU3) and one extended version of 10 kg (RU10). While the basic version has a fixed seismometer as well as limited lifetime due to the lack of photovoltaics, the extended version is equipped with a self-leveling seismometer, photovoltaics and an inductive power/data interface for unit charging and TM/TC. Both designs use the identical main structure to meet the envisaged modularity approach. The mission scenario includes one RU10 and four RU3s.

Even though the hardware was never meant to enter the space environment, the design approach for

the units was always driven by principles which could be functional under space conditions while respecting the peculiarities and the financial framework of this terrestrial demonstration. This paper presents the functionalities of the RU with a special focus on the overall configuration, structural concept as well as included mechanisms. Moreover, starting with the baseline design for the terrestrial application, it analyzes the differences and derives necessary changes and modifications to further develop the system towards a usage in an actual Moon mission.