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MODULAR MECHATRONICS INFRASTRUCTURE FOR ROBOTIC PLANETARY EXPLORATION ASSETS IN A FIELD OPERATION SCENARIO

Abstract

In 2021 the Modular Mechatronics Infrastructure (MMI) was introduced as a solution to reduce weight, costs, and development time in robotic planetary missions. With standardized interfaces and multi-functional elements, this modular approach is planned to be used more often in sustainable exploration activities on the Moon and Mars. The German multi-robot research project "Autonomous Robotic Networks to Help Modern Societies (ARCHES)" has explored this concept with the use of various collaborative robotic assets which have their capabilities extended by the MMI. Different scientific payloads, engineering infrastructure modules, and specific purpose tools can be integrated to and manipulated by a robotic arm and a standardized electromechanical docking-interface. Throughout the MMI's design and implementation phase the performed preliminary tests confirmed that the different systems of the robotic cooperative team such as the Docking Interface System (DIS), the Power Management System (PMS), and the Data Communication System (DCS) functioned successfully. During the summer of 2022 a Demonstration Mission on Mount Etna (Sicily, Italy) will be carried out as part of the ARCHES Project. This field scenario will allow the validation of the robotics systems in an analogue harsh environment and the

confirmation of enhanced operations with the application of this modular method. Among the numerous activities to be performed in this volcanic terrain there are the efficient assembling of the Low Frequency Array (LOFAR) network, the energy-saving and reduced complexity of a detached Laser Induced Breakdown Spectroscopy (LIBS) module, and the uninterrupted powered operation between modules when switching between different power sources. The field data collected during this analogue campaign can provide important outcomes when modular and non-modular systems or autonomous and teleoperated robotic units are compared. Modular and autonomous robots can certainly benefit from their versatility, reusability, less complex systems, reduced requirements for space qualification, and lower risks for the mission. These characteristics will ensure that long duration and complex robotic planetary endeavors are not as challenging as they used to be in the past.