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Author: Mr. Hady Ghassabian Gilan
Space Exploration Project group, Space Generation Advisory Council (SGAC), Italy

Dr. Ilaria Cinelli
Tufts University, United States
Ms. Tajana Lucic
Space Exploration Project group, Space Generation Advisory Council (SGAC), Croatia
Dr. CARLOS SALICRUP
IFALPA, Mexico
Ms. Poonampreet Kaur Josan
University of North Dakota, United States
Mr. Joao Lousada
GMV Insyen AG, Germany
Mr. Iñigo Muñoz Elorza
Space Applications Services N.V./S.A., Germany

HIGH-FIDELITY ANALOG MISSION ENABLING PRACTICES: LESSON LEARNED FROM
RECENT ANALOGS AND GUIDELINES FOR FUTURE MISSIONS

Abstract

Powered by the human endeavour of establishing Solar System wide presence, the Global Exploration Roadmap (GER) aims at expanding human presence on the Moon, Mars, and beyond. These missions require international cooperation to address technical, psychological, physiological, operational, and economic challenges that may arise while accomplishing this ambitious plan.

Hence, simulating hypothetical extra-terrestrial mission scenarios at reduced costs on Earth draws in a great interest from both industry and the public. It also anticipates the risks and hazards of real human missions in outer space giving the opportunity to avoid or mitigate them. Analog Missions can focus on one specific aspect of a complex real-world mission. In particular, analogs are needed for establishing future mission protocols and requirements, such as sustainability, exploration tools, autonomy of critical systems, mission procedures (selection, training, support, and communication), psycho-physical countermeasures, medical/psychological monitoring techniques, and research. Remote high-fidelity analog missions performed on Earth have a significant impact on the planning and management of other long duration missions, at a fraction of the risk and costs of an actual mission whilst helping foreseeing future mission goals and challenges based on the mission destination.

The Space Exploration Project Group (SEPG) is an international group of students and young professionals fostering space activities worldwide. This project group has been assisting and contributing to the development and support of different types of analog missions, and simulating potential scenarios on the Moon and Mars. To advance the fidelity and quality of future crewed missions, SEPG proposes a lessons-learned plan of the required infrastructures and technologies for a fully capable analog habitat and facility. In addition, the impact of different types of remote mission support is included to highlight advantages and disadvantages in mission control and crew dynamic, looking at the foreseeable future of autonomous mission operations.

This paper presents challenges faced in recent analog missions, corresponding solutions, emerging technology, medical procedures and countermeasures in high fidelity missions' scenarios. The proposed

solutions are to be implemented in future analogue missions performed by the SEPG and its partners in order to achieve common goals in order to foster the current knowledge in this research area and enabling future crewed missions to other planets, in accordance to the GER. The findings of this work have the potential to be instrumental for the preparation of future crewed missions beyond low earth orbit.

Keywords: Space Analog Mission, Space Exploration, Global Exploration Roadmap