EMMIHS-2, THE SECOND EUROMOONMARS IMA HI-SEAS 2019 CAMPAIGN: SIMULATED MOONBASE OUTLOOK AND OUTCOMES – AN ENGINEERING PERSPECTIVE
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Introduction: The EuroMoonMars IMA HI-SEAS 2019 campaigns (EMMIHS) are field research campaigns, an initiative directed by the International Lunar Exploration Working Group (ILEWG) of the European Space Agency (ESA) in collaboration with the International MoonBase Alliance (IMA). The purpose of these campaigns is to conduct scientific experiments and test technological instruments relevant to space exploration and extraterrestrial habitation. The team for the second edition of this campaign consisted of six crewmembers, based at the Hawaii Space Exploration Analog and Simulation (HI-SEAS) habitat with support from the Mission Control Centre (MCC), based at the Blue Planet Research Lab in Hawaii, and remote support based at EuroMoonMars ESA/ESTEC in Noordwijk, the Netherlands.

The campaign was a two-week simulated mission on the Moon, taking place from the 8th to the 22nd of December 2019. During the two-week Moon simulation and isolation mission at the HI-SEAS habitat, located in an isolated environment on the slopes of the Mauna Loa volcano on the Big Island of Hawaii, the EMMIHS-II crew performed various research in the space exploration field. The area has Moon and Mars-like geological features and an elevation of approximately 2,500 meters (8,200 feet) above sea level. The crew performed intense research, which featured the study of the radiation in locally-grown food, geological and drone surveys, architectural studies, lava tube exploration and space technology testing.

This paper will deliver details of the conducted research projects, an overview of the crew engineer's routine, and will present the challenges and outcomes of the mission and its activities from an engineering perspective.

For the following activities: the technological research drone operation; the assembly of a small rover to be operated remotely by remote control; HI-SEAS habitat design, operations and maintenance; network communication systems and data exchange; it was established from previous missions that at least one crewmember serving as an engineer with strong analytical, troubleshooting and hands-on technical skills is vital for the mission's success. The crew engineer is responsible for ensuring nominal operations and the maintenance of the EVA (extra-vehicular activity – any activity performed outside the habitat) equipment (EVA suits, life support systems, the communication network and devices; the habitat equipment (power systems, solar panels, inverters, batteries, generators, weather stations, surveillance systems, heating systems and the network communication systems). The crew engineer checks the status of the EVA equipment before and after each EVA, as well as gathering feedback from the EVA team. A daily Engineering Report is prepared and provided to the MCC with a summary of engineering specific activities, the status of the equipment, recommendations for improvements and any requests for further support from the MCC Engineering Support Team. The crew engineer is also responsible for supporting other crew member's research projects if needed.

Fig 1. HI-SEAS habitat view. The picture was taken during an EVA.

Fig. 2. EVA equipment.

The outcomes and feedback from the research and technological experiments conducted at HI-SEAS will be used to improve the habitat itself and will allow for further understanding of requirements in order to build a Moon base analog in Hawaii and ultimately, allow humans to build ana habitat on the Moon

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