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CHARACTERIZATION OF SURFACE SCIENTIFIC EXTRAVEHICULAR OPERATIONS IN THE CONTEXT OF THE HADEES-C ANALOG STATION

Abstract

Several agencies are currently developing plans for the future crewed exploration of planetary surfaces such as the Moon and Mars. An important part of the operations on the planetary surfaces will be Extravehicular Activities (EVA) both with scientific and technical goals. However, the only practical antecedent of these efforts are the 6 surface Apollo missions, which deployed experiments and collected samples on the surface of the Moon. Considering that EVA time is a scarce and valuable resource, future missions will require planning operations that maximize the generated relevant scientific outcomes despite the limitations of resources and communication. Some of the limitations include ergonomic restrictions imposed onastronauts by the use of Space Suits, which may hinder their expertise. The main goal of the scientific EVAs will be observational characterization and collection of samples. For this, analog stations can be used to study certain aspects of the operations on a planetary surface, allowing an approach to characterize the performance of them, and decide which operation may result in a more efficient and more effective scientific collection. This study explored a methodology for the evaluation and comparison of two types of operations that were analog to an astronaut visiting a geological site. The methodology started by defining an analog scientific activity that provided a random distribution that could be measured. By the use of dice and marbles to recreate a geological site, and with crewmembers performing characterization activities, the efficiency and efficacy of each operation were measured by comparing the sampling performance with the actual data distribution, characterized out of the simulation. Two types of characterization operation were proposed, by not revisiting and by revisiting the site, while using space suit simulators and performing the operation within simulation restrictions. The data was captured during rotations 5 and 6 in the HAdEES-C analog station by crews Olympus and Athenova. The methodology carried 10 repetitions of each type of operation. After the data was collected, two figures of merit were used in order to evaluate efficiency, with the time used for the EVA, and the efficacy, comparing the reported characterization and the actual distribution. This study shows that the proposed methodology is able to capture the difference between the performance of two types of operations with statistical significance in the context of an analog, which serves as a tool for comparing further iterations of scientific EVA operations with different characteristics or resources.