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PROJECT MOONWALK: LESSONS LEARNT FROM TESTING HUMAN ROBOT COLLABORATION SCENARIOS IN A LUNAR AND MARTIAN SIMULATION

Abstract

There is a global interest to send humans to the moon and to Mars and diverse early preparations are underway. One important aspect in preparing for future challenges is to develop technologies and tools that can help in simulation activities to train for future missions. Humans will be supported by robots on their missions in exploring and conducting science on extra-terrestrial surfaces.

The paper summarizes all the efforts undertaken by 6 European partners as part of a research and technology project in the European Union's Space Framework Programme. Under the lead of the DFKI (German Centre for Artificial Intelligence), industry partners Comex - France, Airbus Group UK, Space Applications Services - Belgium, LIQUIFER Systems Group - Austria and the research institutions NTNU – Norway (Samfunnsforsking,Centre for Interdisciplinary Research in Space) and INTA (Centro de Astrobiologia) – Spain collaborated to develop simulation hardware (space simulation suit, assistant rover) and tools (communications system, sampling) for human robot interaction.

The general objective of MOONWALK was to enhance European capabilities for future human space exploration, especially surface Extra-Vehicular Activity (EVA) for the Moon and Mars. This was targeted through research, development, evaluation of operations concepts and technologies for exploration and exobiology related EVA tasks focusing on human-robot collaboration and the development of earth-analogue simulation equipment.

During a two-week simulation campaign in Rio Tinto, Spain conducting Martian scenarios the simulation astronaut and the assistant rover collaborated as partners in mapping, surveying and sampling

activities. Rio Tinto, as internationally recognized Martian Analogue, is located in an old mine and allows to search for extremophile life in similar ways than one would do on Mars. SHEE, the first European self-deployable simulation habitat served as local mission control and as ingress/egress for the suited astronaut. Lunar simulations were conducted in 10 metres underwater off the coast of Marseilles in open sea, which additional to the logistic challenge added a psychological challenge. Mission control was located near Brussels.

The paper will describe the set-up, components, the analysis and validationof the performed analogue missions with respect to technical and human factors. A dataset comprising of 120 variables, 75 responses and 14 respondents was analysed. Additionally, an open question survey was collected, 52 lessons learned, including many comments about components. Data was gathered from 28 different EVAs, comparing an astronaut-astronaut team versus the astronaut-robot team in terms of performance and psychological impact.