

Lunar Exploration (2)
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Author: Mr. Kjetil Wormnes

European Space Agency (ESA), The Netherlands, kjetil.wormnes@esa.int

Dr. William Carey

European Space Agency (ESA), The Netherlands, william.carey@esa.int

Dr. Thomas Krueger

European Space Agency (ESA), The Netherlands, thomas.krueger@esa.int

Mr. Leonardo Cencetti

ESA - European Space Agency, Switzerland, cencetti.leonardo@gmail.com

Mr. Emiel den Exter

ESA - European Space Agency, The Netherlands, emiel.den.exter@esa.int

Mr. Stephen Ennis

European Astronaut Centre, Germany, stennis@tcd.ie

Mr. Edmundo Ferreira

European Space Agency (ESA), The Netherlands, edmundo.ferreira@esa.int

Mr. Antonio Fortunato

European Astronaut Centre, Germany, antonio.fortunato@esa.int

Mr. Levin Gerdes

European Space Agency (ESA), The Netherlands, levin.gerdes@esa.int

Mr. Lukas Hann

ESA - European Space Agency, The Netherlands, lukas.hann@esa.int

Mrs. Chiara Lombardi

ESA - European Space Agency, The Netherlands, chiara.lombardi@esa.int

Ms. Erica Luzzi

Jacobs University Bremen, Germany, e.luzzi@jacobs-university.de

Mr. Sebastian Martin

ESA - European Space Agency, Germany, sebastian.martin@esa.int

Prof. Matteo Massironi

University of Padova, Italy, matteo.massironi@unipd.it

Dr. Samuel Payler

European Space Agency (ESA), Germany, samuel.payler@esa.int

Dr. Aaron Pereira

DLR (German Aerospace Center), Germany, aaron.pereira@dlr.de

Prof.Dr. Angelo Pio Rossi

Jacobs University Bremen, Germany, an.rossi@jacobs-university.de

Dr. Riccardo Pozzobon

University of Padova, Italy, riccardo.pozzobon@unipd.it

Mr. Francesco Sauro

Alma Mater Studiorum - University of Bologna, Italy, cescosauro@gmail.com

Mr. Philippe Schoonejans

European Space Agency (ESA), The Netherlands, philippe.schoonejans@esa.int

Mr. Frank van der Hulst

ANALOG-1 - AN ANALOGUE MISSION TO GUIDE ESA'S ROBOTIC MOON EXPLORATION EFFORTS

Abstract

The METERON project is a European initiative to prepare for future human-robotic exploration missions to the Moon, Mars and other celestial bodies. The project aims to implement infrastructure and tools to test and evaluate communications, operations and robotic control strategies in the context of future exploration missions. It is in collaboration between three directorates of the European Space Agency (ESA); Human and Robotic Exploration (HRE), Technology, Engineering and Quality (TEC), Operations (OPS).

The ANALOG-1 experiment is the culmination of the METERON project, implementing the knowledge gained in the 12 distinct METERON experiments between 2011 and 2020. These all address aspects of teleoperating a robotic asset from an orbital platform, i.e. technical implementation user interfaces, autonomy and operations. The ANALOG-1 technology demonstration and operations concept experiment is based upon the surface mission scenario segment of the notional EL3 sample return mission. This segment focuses on the control of a lunar surface robotic asset from the Earth and from the Lunar Gateway.

In November 2019, the first part of this experiment was successfully completed from the ISS. It assessed the effectiveness of a state-of-the-art robotic control interface to control a complex mobile robot from orbit, as well as evaluating the scientific interactions, during robotic-assisted geology exploration, between crew in orbit and scientists on the ground. Luca Parmitano drove this robot in a lunar analogue site in the Netherlands, and controlled its arms, while he was on the ISS. For this experiment, a complex control station had been installed on the ISS, including a Sigma-7 haptic device. This device allowed the astronaut to feel forces felt by the robotic arm. The experiment demonstrated the advantage of having an immersive control station and high level of robotic dexterity, with Luca finishing all his assigned and secondary geology targets ahead of time.

The second part of Analog-1 extends the ISS experiment with a full ground-based analogue, in which further technical experiments and a full mission scenario will be played out. The analogue is in cooperation with the DLR ARCHES space demo mission, and includes a rover operations centre based at ESOC as well as an outdoor lunar analogue site on Mount Etna. The astronaut, in this case, is on ground. We expect to further demonstrate the advantages of a state-of-the art interface for both fully teleoperated and semi-autonomous rover and robotic arm control for lunar missions, in order to guide ESA's Moon exploration efforts.