Paper ID: 87751
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IAF HUMAN SPACEFLIGHT SYMPOSIUM (B3)
Flight & Ground Operations aspects of Human Spaceflight - Joint Session of the IAF Human Spaceflight and IAF Space Operations Symposia (4-B6.4)

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A LUNAR MISSION TO TEST AND VALIDATE OPERATIONS STRATEGIES TO BE EXPLOITED IN HUMAN MARS EXPLORATION MISSIONS

Abstract

The distance between Earth and Mars causes long delays during communications, making it impossible to conduct operations with real time support from Earth, like it is usually done in the ISS. Moreover, the possibility of a fast return to Earth is not feasible since the return trip will require several months and a very specific launch window. For these reasons, a crew on the surface of Mars will have to operate without instantaneous feedback from Earth, not only during nominal conditions, but also for off-nominal conditions needing solutions in a brief time.

A human outpost on Mars will require a high level of autonomy to perform maintenance tasks when no crew is present on the planet. Similarly, the crew will not have immediate communication with Earth and will need local access to necessary information for emergency situations. To face these new operative conditions and constraints, future manned exploration missions on Mars surface will require a novel approach to end-to-end communication, as well as different technologies and operations, to plan, perform and monitor the operative phase.

This work proposes how the tasks and responsibilities of the crew and the ground segment on Earth could be re-organized, while also considering the contribution of artificial intelligence and rovers to increase autonomy and to assist the crew. Finally, this study devises a plan to test these strategies during a lunar mission by simulating artificially the communication delays.