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A MISSION CONTROL ARCHITECTURE FOR JOINT HUMAN AND ROBOTIC LUNAR EXPLORATION MISSIONS, AS TESTED TERRESTRIAL ANALOGUE MISSIONS

Abstract

A mission control architecture is presented for a lunar sample return mission involving joint human and robotic surface exploration. It builds upon the experience of the landed missions of the NASA Mars Exploration Program, and a previous robotic-only analogue mission. The architecture consists of four processes working in parallel at Mission Control. The first, called Science, is responsible for processing of data returned from the field, and for interpretation of the resulting data products. Science also assesses whether scientific goals are being met and determines which new data products to be obtained to satisfy these goals. The Planning process develops EVA plans for the astronaut crew and robotic field assistant which aim to meet the science goals by collecting the requested data products. A Tactical process supports the astronauts on EVA, providing guidance, amending plans as events warrant, and acting as a conduit between the remote science team and the astronaut crew. Finally, a Mission Evaluation process fosters inter-process communications and documentation.

This mission architecture was tested in various implementations during a series of lunar exploration analogue missions to the Mistastion (Kamestatin) impact structure in Labrador, Canada, and the Meteor (Barringer) Crater structure in Arizona, United States, from August to November 2011. A first scenario tested joint human and robotic operations. A second tested the structure for simultaneous robotic and human operations at separate but nearby sites. The third scenario tested astronaut-only operations with enhanced communications, including real-time voice and video link to the astronauts. Lessons learned from the deployments are discussed, and the variations in implementation of the architecture are described for each of the three scenarios.