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Exploration of Near Earth Asteroids (06)
Human Exploration of NEAs (1)

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DESERT RATS 2011: HUMAN EXPLORATION OF NEAR-EARTH ASTEROIDS

Abstract

The Desert Research and Technology Studies (D-RATS) 2011 field test involved the planning and execution of a series of exploration scenarios under operational conditions similar to those that would be expected during a human exploration mission to a near-Earth asteroid (NEA). The focus was on understanding the operations tempo during simulated NEA exploration and the implications of communications latency and limited data bandwidth. Anchoring technologies and sampling techniques were not evaluated due to the immaturity of those technologies and the inability to meaningfully test them at D-RATS. Reduced gravity analogs and simulations are being used to fully evaluate Multi-Mission Space Exploration Vehicle (MMSEV) and extravehicular (EVA) operations and interactions in near-weightlessness at a NEA as part of NASA's integrated analogs program. Hypotheses were tested by planning and performing a series of 1-day simulated exploration excursions comparing test conditions all of which involved a single Deep Space Habitat (DSH) and either zero, one, or two MMSEVs; three or four crewmembers; one of two different communications bandwidths; and a 100-second roundtrip communications latency between the field site and Houston. Excursions were executed at the Black Point Lava Flow test site with a Mission Control Center and Science Support Room at Johnson Space Center (JSC) being operated with 100-second roundtrip communication latency to the field. Crews were composed of astronauts and professional field geologists. Teams of Mission Operations, Science, and Education Public Outreach (EPO) experts also supported the mission simulations each day. Data were collected separately from the Crew, Mission Operations, Science, and EPO teams to assess the test conditions from multiple perspectives. For the operations tested, data indicates practically significant benefits may be realized by including at least one MMSEV and by including 4 versus 3 crewmembers in the NEA exploration architecture as measured by increased Scientific Data Quality, EVA Exploration Time, Capability Assessment Ratings, and Overall Acceptability ratings by Crew, Mission Operations, Science, and EPO. A combination of text and voice was used to effectively communicate over the 100-second roundtrip communications latency and increased communication bandwidth yielded a small but practically significant improvement in Overall Acceptability as rated by the Science team, although the impact of bandwidth on scientific strategic planning was not assessed. No effect of increased bandwidth was observed with respect to Crew, Mission Operations, or EPO team ratings of Overall Acceptability.