Paper ID: 66944
student

24th IAA SYMPOSIUM ON HUMAN EXPLORATION OF THE SOLAR SYSTEM (A5)
Interactive Presentations - 24th IAA SYMPOSIUM ON HUMAN EXPLORATION OF THE SOLAR SYSTEM (IP)

Author: Mr. Oscar Ojeda
Purdue University, United States

Prof. Barrett Caldwell
Purdue University, United States

CHARACTERIZATION OF INFORMATION FIDELITY IN ANALOG RESEARCH APPLIED TO COMMUNICATIONS FOR MARS CREWED EXPLORATION MISSIONS

Abstract

Human exploration of Mars evokes popular interest, and recently has gained notoriety thanks to the efforts by several agencies and companies. Despite several technological advances, many details of actual mission design are still unresolved. One key element for the success of Mars missions in general, and crewed missions in particular, is that communication between assets on Earth and Mars is delayed or not available, imposing additional challenges to the accomplishment of the mission goals. The restrictions on communication include limits on the amount of information to be transferred, how often the communication will happen, and the modalities that be used; all these are mediated by a delay of between 4 and 20 minutes in each direction. Analog research has been used as a tool to simulates one or more aspects of space exploration at a lower cost and risk. Such research, which often takes place in remote locations on Earth, can be used to evaluate how communication issues will impact missions to different degrees. It is important to answer the question of how to characterize Earth-Mars simulated communications within an analog setting. Based on previous uses of the concept of fidelity in an analog setting, the concept of information fidelity is defined as to what extent the analog communications represent the constraints observed in the baseline architecture of the Earth-Mars network and environment. From that definition, the concept of figure of merit is considered as an aid in the applications of analog designs to Mars mission concepts of operations. A figure of merit for information fidelity is conceptualized as a qualitative vector that consists of the parameters of communication delay, bandwidth, communication availability, modality, and task-related urgency of message exchanges. For each parameter, a rubric is established to evaluate to what level an analog resembles the actual constraints of a crewed Mars mission. The use of this concept will help to shed light on the impact of communication restrictions associated with each parameter, individually and together, on aspects such as logistics, science operations, and human factors. Future work will allow the characterization of techniques for better simulation of restrictions in analogs.