

Title: A Decision Support System for Extravehicular Operations Under Significant Communication Latency

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Session: ICES403: ICS - Extravehicular Activity: Space Suit and Surface Mobility Operations

Abstract (300 word max):

Within the next few decades, humanity hopes to perform extravehicular activities (EVAs) on the surface of Mars; however, several technical and operational challenges must first be overcome. Foremost among these challenges is managing a significant two-way communication latency between Earth and Mars. Current and historical paradigms of EVA operations have required near-real-time communication between the crewmember(s) performing an EVA and an Earth-based mission control.

Next-generation operational paradigms for supporting deep space exploration will necessitate a distributed decision authority system, including delayed Earth-based mission control, the on-planet extravehicular crewmember(s), and intermediate mission support from intravehicular crewmember(s) within real-time communication range. This latter group is of particular interest: they must provide operations support without the plentiful resources available to mission control on Earth.

For this purpose, NASA is developing the Personalized EVA Informatics and Decision Support (PersEIDS) software platform. PersEIDS is designed to bolster operator situational awareness and offload operator workload by automating the tracking and projection of consumables usage over an EVA timeline, providing real-time probabilistic safety assessments of an EVA timeline given consumables constraints, and recommending alternative EVA timeline(s) when the active timeline is not expected to be completed under consumables limits.

The PersEIDS concept of operations, use cases, and models will be presented. A limited version of PersEIDS was demonstrated during a three-day-long study where each day a roughly four-hour-long simulated Martian EVA was performed in virtual reality at the NASA Johnson Space Center. The first day was a control trial without PersEIDS support; the second and third days represented different levels of decision support provided by PersEIDS to the intravehicular crewmember acting as mission control. With PersEIDS support, the IV crewmember was able to manage the mission to completion faster and with more remaining consumables; however, additional testing is required to understand confounding factors, e.g. training bias.