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HUMAN AUTONOMY TEAMING FOR TASK EXECUTION SUPPORT IN NEXT GENERATION DEEP SPACE HABITATS

Abstract

Traditionally, space habitat (International Space Station) repair, maintenance and inspection operations are performed by on-board astronauts with real-time support from mission control center personnel on Earth. For future deep space habitats, it has been proposed that autonomous (AI) agents be used to help astronauts on board to perform repair and maintenance tasks in lieu of human operators on Earth due to lengthy communications delays. Determining the minimum viable capabilities required of the autonomous (AI) agent for procedure execution support is critical since it is not possible to replicate the capabilities of all mission control personnel in an artificial intelligence entity. One way of tackling this challenge is to select a limited number of capabilities and investigate the possibility and effectiveness of human autonomy teaming when these limited capabilities are implemented via an autonomous (AI) agent in a physically simulated environment. The study covered in this paper is focusing on the feedback traditionally provided by mission control for an inspection task (can also be applicable to repair or maintenance), and is intended to answer the fundamental questions of "what kind of feedback needs to be provided to an astronaut from an autonomous (AI) agent so the astronaut(s) can execute the procedures successfully and how the human autonomy team can function to achieve maximum safety and efficiency?". Our hypothesis is that successful procedure execution support can be provided with a limited feedback strategy within a human autonomy teaming context by considering the realistic limitations of autonomous systems. We define the limited feedback strategy as preselected generalizable options delivered by the autonomous agent to give visual (display) and/or aural (speech) feedback to improve performance of astronauts performing intra vehicular repair, maintenance and inspection operations. This paper covers the development of the pilot experiment and a discussion of preliminary results. Additionally, the paper discusses possible future steps including: the effect of feedback transparency on performance, the effect of anthropomorphism on perception of the autonomous agent for teaming, the effect of on-demand feedback on teaming and performance, and capability definition for future autonomous agent(s) for adequate human autonomy teaming in deep space habitat during repair maintenance operations.