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# PROJECTION-BASED VISUALIZATION TECHNOLOGY AND ITS DESIGN IMPLICATIONS IN SPACE HABITATS

**Abstract**

The variety of stressors inherent to space missions and other extreme environments can cause crewmembers to experience complex psychological difficulties (Bishop, 2010). Such conditions will likely become more severe during long-duration space flights exposing crewmembers to situations of extreme sensory deprivation and loneliness (Bachman, et al., 2012). Means to integrate novelty and reduce monotony in space habitat environments can minimize the negative psychological impacts of long-term space missions (Bachman, et al., 2012). Although various physical and psychological countermeasures have been successfully implemented in orbital spaceflight, deep space travel poses new challenges that will require existing strategies to be adapted and redesigned, and new solutions to be developed. In this context, mixed reality technologies provide new opportunities for the creation and delivery of stimuli, eliciting desired emotional responses and enabling flexibility and novel design opportunities.

Mixed reality has a long history of implementation for astronaut training purposes (Loftin, 1992). Some studies have shown evidence of the benefits of virtual reality systems to individuals in stress-inducing situations (Valtchanov, et al., 2010, Botella, et al., 2016). However, more work is required to explore the application of these technologies as a psychological countermeasure in conditions associated with confinement and prolonged monotony during a long-term space flight (Bachman, et al., 2012, Vessel Russo, 2015).

This paper presents on-going research on the implementation of immersive visualization technologies as a psychological countermeasure for space habitats. The paper reports the results of an exploratory study in which a series of projections were used to augment the perception of space and time in a particular environment. The goal of the study is to investigate how these visualizations can be used as a design element to alter the perception of the interior space and alleviate psychological stressors associated with spaceflight. The projections were designed to integrate seamlessly and ubiquitously with a particular wall of the physical environment to modify the personal impression of the interior volume. Study participants experienced visualizations directly without the need for Head Mounted Displays and had to perform a simple and mundane task during the test. Participants were asked to estimate the interior volume of the habitat and time spent inside. The paper presents results of the initial stage of the validation study and describes the implications of the technology for the space habitats design. A set of recommendations for improvements of habitat architectures is proposed with emphasis on human factors and technology integration strategies.