

Analyzing Extended Reality Technologies for Human Space Exploration

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Abstract : Extended reality (XR) technologies share an intertwined history with spaceflight and innovation. New advancements in XR technologies offer expanding possibilities to advance the future of human space exploration with increased crew autonomy. This paper seeks to identify implementation gaps between existing and proposed XR space applications to inform future mission planning. A review of virtual reality, augmented reality, and mixed reality technologies implemented aboard the International Space Station revealed a total of 16 flown investigations. A secondary set of ground-tested XR human spaceflight applications were systematically retrieved from literature sources. The two sets of XR technologies, those flown and those existing in the literature were analyzed to characterize application domains and device types. Comparisons between these groups revealed untapped application areas for XR to support crew psychological health, in-flight training, and extravehicular operations on future flights. To fill these roles, integrating XR technologies with advancements in biometric sensors and machine learning tools is expected to transform crew capabilities.

Keywords : augmented reality, extended reality, international space station, mixed reality, virtual reality

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