The Metaverse for Space: Opportunities and Challenges

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Abstract

The Metaverse is a virtual environment that integrates physical and digital realities, enabling real-time interactions through immersive technologies such as extended reality. Its persistent nature allows for continuous content creation and experiences without physical limitations. In the context of space exploration, the Metaverse serves as a valuable tool both on Earth and in space during various phases of crewed missions. On Earth, Metaverse applications provide realistic training environments that help astronauts develop muscle memory and allow engineers to test protocols and systems. In space, the Metaverse can serve as a companion, helping to mitigate isolation and confinement during long-duration missions. However, virtual environments can cause adverse effects such as cybersickness, which manifests through symptoms including oculomotor disturbances, nausea, disorientation, and cognitive fatigue. This study investigates these side effects with the aim of developing countermeasures to improve the adoption and effectiveness of Metaverse technologies for space missions.

Keywords: Metaverse, Virtual World, Virtual Reality, Extended Reality, Augmented Reality, Mixed Reality, Space Exploration, Astronaut Training, Cybersickness, Human, Machine Interaction, Physiological Response, Immersive Technologies

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