

Spatial Interfaces in Space Exploration

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Abstract

Renewed interest in space exploration is paving the way for humanity's future among the stars, with ambitious new programs being launched aiming to establish human presence on the Moon, Mars, and beyond. The realization of this vision will depend on the development of a new generation of reliable, safe, and efficient technologies, along with accompanying astronaut work procedures, to underpin future missions.

Novel prototypes and procedures are typically developed, tested, and refined through field deployments in Earth-based analog environments. These environments, such as the underground cave systems in Sardinia, replicate some of the extreme conditions associated with extraterrestrial settings, thereby providing an operationally valid context for astronaut drills and prototype studies. While generally effective, this approach is facing criticism due to its logistical complexity and often prohibitive costs.

In response, the European Space Agency (ESA) is exploring the potential of virtual and mixed reality technologies as a cost-effective alternative to these traditional analog environments. This talk will present ESA's initiative, focusing on the benefits and limitations of using immersive and spatial interfaces in the context of human spaceflight. We will conclude by discussing how these interfaces might evolve as we look toward the future.

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Bio

Tommy Nilsson is a postdoctoral research fellow at the European Space Agency, where his work explores novel applications of virtual and mixed reality for visualization, scientific preparation, and training for human spaceflight. His primary interest lies in future human operations on the Moon.

His methodology is centered around digital twinning and simulation of prospective lunar surface scenarios, which are subsequently evaluated by astronauts and other space experts. To maximize operational validity, several of these simulators have been deployed and assessed in reduced gravity conditions during a parabolic flight campaign, as well as aboard the International Space Station (ISS).

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Before joining ESA, Tommy held various research positions at Roche Diagnostics, the University of Cambridge, and the Czech National Institute of Mental Health. He received his PhD in Human-Computer Interaction from the Mixed Reality Laboratory at the University of Nottingham, UK.

