Generic Technologies

Future Engineering

GT17-869SF – Facility-less setup for enhanced virtual presence

Budget: 900 k€ - **Duration**: 24 months - **Current / Targeted TRL:** 3 / 6 - **TD** 8

Objective:
To develop a self-contained system using Extended Reality and interactive devices to allow space personnel to train and operate remotely and safely through immersive digital environments.
Description:
Virtual Presence refers to the sense of realism or immersion when interacting with a digital environment without being physically present. Human-machine interfaces and interaction technologies have evolved to evoke this feeling in users by leveraging familiar and intuitive cues. Virtual Presence is particularly advantageous in applications where interactions or complex visualizations are required from remote and safe locations. Virtual Presence can be used generically across a wide range of space use cases because it enables immersive interaction with complex systems or environments, making it valuable not only for astronaut training but also for robotic operations, telemaintenance, mission planning, payload integration, and expert support—any scenario where safe, intuitive, and effective human involvement is needed without physical presence.

The utilization of Extended Reality (XR) technologies in such space applications has attracted significant attention for their potential to enhance user interaction, improving usability, and enabling more natural interactions. However, as space exploration and missions become increasingly complex, the need for higher levels of immersion and efficient human-computer interaction has grown.

Virtual and Augmented Reality headsets and glasses are maturing with commercial off-the-shelf solutions, usually offering visual, aural and vestibular feedback. However, such stimuli are often insufficient for achieving higher levels of Virtual Presence in areas like training, where kinesthetics or force feedback are also crucial to feel object shapes, inertias or outer-Earth gravities. Therefore, the combination of XR technologies with other interaction devices like motion platforms, exoskeletons, haptic, tactile or neural devices, could potentially offer a more immersive, multimodal, scalable and embodied training experience.

The following tasks are foreseen in this activity:
- Define specifications and guidelines for XR interaction devices in space applications and outline the development of a multimodal framework to ensure their technological maturity and readiness.
- Design a self-contained, immersive hardware setup for training and teleoperation, tailored to specific space use cases, integrating XR technologies and interaction devices.
- Integrate the hardware solutions with a multimodal software framework capable of hosting multiple users while monitoring and orchestrating the XR and interaction devices.
- Collect and analyse learning analytics to develop custom training or teleoperation programs and provide personalized feedback to users.

Deliverables: Engineering Model, Report, Software

Application/Need Date: All missions. TRL6 by 2028 **Mission Classification:** alpha, beta, gamma, delta

THAG Roadmap: Not relevant to any Harmonisation topic.