2.3.9. Future Engineering

Generic Technologies

Future Engineering

GT17-868SF – Maturation of extended reality solutions for space environments

Budget: 900 k€ - **Duration**: 18 months - **Current / Targeted TRL:** 3 / 7 - **TD** 8

Objective:
To develop solutions to overcome the limitations of commercial off-the-shelf Extended Reality headsets for their usage in Space environments.

Description:
In recent years, Extended Reality (XR) technology has shown great potential for various applications on-orbit, including astronaut training, science, maintenance and operations.

Some Commercial Off-The-Shelf (COTS) XR devices have recently introduced different experimental “Travel Modes” that were tested during a Parabolic Flight Campaign in 2025. Results showed robust localization and tracking when relying on visual cues only (no inertial sensors were used). As a result, a Meta Quest 3 headset is planned to be delivered to the ISS in 2026 for further testing. However, some other challenges still remain, like the lack of a non-invasive solution integrated in the visor of spacesuits, environmental challenges (e.g. radiation hardening, thermal management, power and battery constraints, dust and particle contamination, device durability, etc.), limited bandwidths, weight and balance distribution affected by lower-zero-G conditions, psychological effects of using XR in Space, among others.

The present activity must address the remaining challenges by proposing XR solutions with higher maturity for (1) Intra-Extravehicular Activities (IVA/EVA) in microgravity (e.g. Launch & Entry, International Space Station) and (2) Moon / Mars environments. These XR solutions shall propose non-invasive projection systems, adapted in the visor of spacesuits to allow Mixed Reality interactions. This technology could support astronaut operations in Space by providing navigation assistance, scientific site identification, procedure guidance, equipment troubleshooting, teleoperation of robotic devices, immersive training for countermeasure, virtual mapping, data visualization or enhanced collaboration between astronauts and ground personnel, among others.

The following tasks are foreseen in this activity:
- Define specifications and guidelines for XR hardware used in space and extraterrestrial environments and develop strategies to ensure their technological maturity and readiness.
- Create a non-invasive Mixed Reality solution integrated in the visor of spacesuits.
- Create a roadmap to address the upcoming challenges, environments and use cases of using XR in Space environments.

Deliverables: Flight Model, Report, Software

Application/Need Date: Intra-Extravehicular Activities (IVA/EVA), Moon / Mars environments. TRL 7 by 2028
Mission Classification: alpha, beta, gamma, delta

THAG Roadmap: Not relevant to any Harmonisation topic.