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AUGMENTED AND VIRTUAL REALITY APPLICATIONS FOR HUMAN SPACEFLIGHT AND EXPLORATION ACTIVITIES: THE ESA-EAC XR LAB

Abstract

National agencies and private entities are currently advocating for human and robotic missions beyond Low Earth Orbit (LEO) to the Moon and, ultimately, to Mars. Within the European Space Agency (ESA), the European Astronaut Centre (EAC) located in Cologne, is the centre of excellence for astronaut training, operations and space medicine with more than 30 years of experience in supporting human spaceflight. The centre is currently supporting International Space Station (ISS) missions, but it is preparing for upcoming exploration challenges and locations using and testing novel technologies. The ESA-EAC XR Lab was established in 2015 and explores new tools in the domain of Augmented (AR), Virtual (VR) and Mixed Reality (MR) applications for human spaceflight and exploration activities. The ESA-EAC XR Lab supports applications of immersive technologies benefiting astronauts as well as ISS instructors, industries, researchers and operators. Today, the portfolio of the ESA-EAC XR Lab activities cover human spaceflight missions in Low Earth Orbit (LEO), such as ISS robotics and layout familiarization for astronauts, and procedure viewing and support for real-time operations with MR. Moreover, upcoming exploration missions are also part of the portfolio. In particular, a highly realistic VR environment of planetary bodies such as Moon or Mars for upcoming robotic missions and outreach activities, virtual collaborative design review of human factors with high quality simulation of weightlessness in VR for the new Lunar Gateway Program in collaboration with astronauts and industries, and VR architectural visualisation for the newly planned LUNA analogue facilities. The roadmap of future activities includes VR spacewalks familiarization for astronauts, virtual rover operations, human anatomy training and AR telemedicine support for ISS flight surgeons. The present paper provides an overview of the ESA-EAC XR Lab and how it is exploiting AR, VR and MR technologies to address new exploration challenges related to LEO and beyond.