Paper ID: 68973
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IAF HUMAN SPACEFLIGHT SYMPOSIUM (B3)
Interactive Presentations - IAF HUMAN SPACEFLIGHT SYMPOSIUM (IPB)

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THE USE OF VIRTUAL REALITY IN MICROGRAVITY ENVIRONMENTS FOR ASTRONAUT TRAINING

Abstract

On-board training (OBT) is a valuable training tool for the crew members on-board the International Space Station (ISS). OBTs are designed to complement ground training and provide rapid assistance in unforeseen complex circumstances or refresh knowledge and skills before execution. Virtual reality (VR) is an excellent medium for training complex tasks effectively and enables delivery of so called 'just-in-time' training as it shortens training time on the ground, which is a decisive advantage in the field of space exploration. VR-OBT, a joint DLR ESA technology demonstrator, explores this potential of VR for on-board training, during ISS increment 66 and 67.

A standalone VR headset relies on many sensors to accurately sense the environment and calculate the user's position and orientation therein. However, embedded sensors such as accelerometers, like those in Inertial Measurement Units (IMUs), do not function properly in microgravity as they are calibrated to 1g and expect this value. This causes problems and errors in displaying the intended training content, including unwanted drift, jitter, and flicker.

This work builds upon the experience and results gained during the development, testing and execution of VR-OBT during parabolic flights and on-board the ISS. The primary focus of this paper is to present the challenges that were encountered during the development of a VR application for use in microgravity and an in-depth analysis on the cause of unsatisfactory tracking performance. Consequently, potential solutions are presented. In conclusion, the findings that were obtained by testing some of the proposed corrections during a parabolic flight campaign and on-board the ISS showed promising results but at the same time highlighted persisting challenges, the overcoming of which is crucial to the feasibility of using VR applications in microgravity. This research is intended to provide a foundation for future investigation.