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USING THE METHOD OF LOCI IN VIRTUAL REALITY TO REDUCE ROBOTIC OPERATIONS TRAINING TIME FOR ASTRONAUTS

Abstract

The European Astronaut Centre (EAC), in Germany, trains and supports astronauts for their space missions on board the International Space Station (ISS). As part of their preparations, future ISS crew members must train to safely use the Mobile Servicing System (MSS). The MSS includes the Space Station Remote Manipulator System (SSRMS–also known as Canadarm2, a 17m-long robotic arm), which occasionally needs to be piloted from inside the station.

Astronauts may need to complete various operations with the SSRMS, such as capturing a free-flying Cygnus cargo vehicle, or moving other astronauts during spacewalks. Using the arm is a highly specialized skill, because there are only limited means for the operator to monitor the arm's surroundings, and mistakes can cause crew injuries and severe damage to hardware. Moreover, predicting the arm's motion is error prone, since the arm has seven revolving joints, while the operator only has two hands.

Until now, instructors have prepared astronauts to face these challenges through lengthy training with replicas of the arm commanding interface and an interactive 3D simulation of its movements. With this training system, it takes around 20 hours of one-on-one training to acquire a first level of proficiency. The system is also used to train some of the ground personnel, so that they can support the crew in orbit. Unfortunately, such volumes of students require a lot of time from the instructor-team. With the aim of lowering the training time, the eXtended Reality Laboratory of EAC and the NASA CX-2 Robotics operation team launched a Joint Investigation into Virtual reality for Education (JIVE).

JIVE changes the training paradigm, from being purely simulation-based to one which presents knowledge in a purposely built interactive museum environment in Virtual Reality (VR). The virtual training rooms utilize the method of loci, a memory enhancement technique which makes use of spatial memory. The rooms are deliberately very different from each other. Some have claustrophobic qualities, some are brightly lit, and others are in open spaces, to create a strong anchor for teaching content. In addition, the inherent stereoscopy of VR allows a more efficient presentation of spatially demanding knowledge, such as 3D coordinate frames or clearance monitoring. These techniques allow in just 10 hours of training to achieve the same proficiency level as the non-VR training did in 20.

This paper presents the innovative pedagogy of JIVE enabled by VR and its use for ISS training.