International Conference on Spatial Cognition Rome, Italy • September 13-17, 2021

Submission 174

Embodied VR Flying Improves Spatial Orientation while Reducing Cybersickness

Ashu Adhikari [1], Bernhard E. Riecke [1], Abraham M. Hashemian [1], Thinh Nguyen-Vo [1, 2], Ernst Kruijff [3, 1], Markus von der Heyde [4, 1]

[1] *Simon Fraser University, School of Interactive Arts and Technology, Vancouver, BC, Canada*

[2] *Microsoft, Redmond, WA, USA*

[3] *Institute of Visual Computing, Bonn-Rhein-Sieg University of Applied Sciences, Germany*

[4] *vdH-IT, Germany*

Supporting low-cognitive-load spatial orientation while reducing motion sickness are key challenges for locomotion in virtual reality (VR) applications. For ground-based locomotion, we have physical walking as the “gold standard”, but for 3D (flying) there is no such equivalent. Here, we investigated if replacing the standard 2-thumbstick flight controllers with an embodied (leaning-based) flying interface (“HeadJoystick”) could help improve user experience and performance. To investigate this, we designed a gamified 3D (flying) navigational search paradigm where 22 participants (10 female) had 5 minutes to find 8 objects hidden in 16 boxes randomly positioned in a landmark-free 3D virtual environment presented immersively via HMD (HTC Vive). Virtual translation was controlled by either leaning (forward/backward, left/right, up/down) or using the Gamepad’s thumbsticks. Rotations were always performed by participants physically turning on their swivel chair.

Compared to using thumbsticks, leaning-based locomotion improved performance (more collected balls while reducing distances traveled) while also reducing motion sickness and mental task demand. Although HeadJoystick was rated as more physically fatiguing for long-term use, participants felt more engaged, enjoyed it more, and overall preferred it.

Together, this suggests that providing translational proprioceptive/vestibular cues using a seated leaning-based interface (HeadJoystick) can provide an effective, engaging, and no-additional-cost alternative to the conventional thumbstick-based flying interfaces, and help to improve spatial orientation and spatial updating in 3D space. Furthermore, HeadJoystick frees up user’s hands and to some degree their minds, so their hands can more easily be used for other tasks such as interaction or communication.

Keywords: *Locomotion Techniques, Virtual Reality, 3D Spatial Orientation, Motion Sickness, Leaning-based Locomotion Interfaces*

Presented by: Adhikari, Ashu

Presentation type: Talk

Topic/s:

- physical, virtual, and hybrid spaces

Submitter-ID: 126
Submitted by: Dr Bernhard E. **Riecke**
Independent contribution