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NEUROVESTIBULAR RESPONSE TO VIRTUAL REALITY SENSORY PRESENTATION IN MIXED-GRAVITATIONAL CONDITIONS

Abstract

The environmental conditions of long-duration spaceflight (e.g., high stress, sleep disregulation, prolonged isolation and confinement) increase the risk of adverse cognitive or behavioral events which may compromise mission safety and success. Effective countermeasures are necessary to promote individual behavioral health and performance by providing increased sensory stimulation, offering novelty, preventing boredom, reducing stress, and increasing attention.

Previous studies have investigated the application of Virtual Reality (VR) stimulation to promote stress management and mitigate against adverse cognitive/behavioral events in isolated, confined, extreme (ICE) environments (e.g., Anderson, Stankovic et al. 2022, Lyons et al. 2020). VR also offers tremendous potential for on-board and just-in-time training and operational applications as well. However, while VR systems have been extensively studied on the ground under 1G conditions, little work has explored the impact of altered gravity on neurovestibular response to VR exposure.

This paper presents preliminary data from a parabolic flight characterizing the effects of VR-based sensory stimulation in reduced gravity (e.g., Lunar gravity, Martian gravity, and microgravity). We assess the viability of VR as an effective tool for use in reduced gravity environments by investigating the psychophysiological, neurovestibular, and subjective experiential impacts of the presentation of VR stimulation under various gravity conditions. In-flight investigation will be followed up by laboratory testing further exploring the impacts of gravity frame mis-match (e.g., zero gravity visual scene presented in a 1G laboratory environment). The goal of this work is to generate design and usage recommendations for VR systems in long-duration spaceflight.