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INCONGRUENT BODY MOVEMENT AFFECTS TELEOPERATION PERFORMANCE

Abstract

Robotics and teleoperation are essential technologies for space exploration. Due to the hostile conditions in space as well as on the Lunar and Martian surfaces, future space missions will require efficient remote teleoperation systems that could be controlled from an orbiting station or a Lunar/Martian module. Hence, it is crucial to gain a comprehensive understanding of how hazardous environments, such as degraded visual environments or altered gravity, affect astronauts' teleoperation performance. The literature shows that internal graviceptive vestibular and somatosensory representations – of body position and gravity - participate, via multisensory integration, in visuo-motor tasks. In this study, we evaluate if graviception modulated via a motion platform movement affects operators' teleoperation performance of a drone in virtual reality under normal and degraded visual conditions. Furthermore, we investigate how different kinds of teleoperation interfaces could improve operators' performance under these conditions. We compared participants teleoperation performance and mental workload under different view perspectives (first-person-perspective vs third-person-perspective) and attitude display types (fixed wing vs fixed horizon) visual conditions, while operators' body were either stationary or in motion under congruent and incongruent conditions with respect to drone movement. Preliminary results showed that body movement tends to increase operators' perceived mental demand and task difficulty as well as their frustration levels with no observable difference between the congruent and incongruent conditions. However, when body movements were incongruent with respect to the drone's movement, operators were less precise and made more teleoperation errors (collisions). Overall, our results suggest that teleoperators' movement impacts their performance as well as their perceived mental workload. While further investigation and analysis are required to evaluate how the different types of visual interfaces could mitigate the observed phenomena, our findings provide a starting point for investigating the relationships between body movement and teleoperation performance, which could lead to increased safety in space-related activities.