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MULTISENSORY REAL-TIME SPACE TELEROBOTICS

Abstract

This paper will introduce the concept behind and preliminary results from an experiment whose goal is the analysis and improvement of real-time telerobotic control of robotic assets for future human exploration endeavours. A new approach to real-time space telerobotics will be presented, namely "Multisensory Real-time Space Telerobotics" - MRST in short, in order to improve perceptual functions in operators and surpass sensorimotor perturbations caused by microgravity conditions. It is hypothesised that telerobotic operations, under microgravity conditions can be improved by offering enhanced sources of sensory information to the operator (astronaut): combined visual, auditory and somatosensory stimuli (vestibular, proprioceptive and cutaneous).

Enhanced versus restricted sensory experiences will be characterised and compared, i.e. combined visual, auditory and somatosensory stimuli versus combined visual and somatosensory stimuli, in an operator's (astronaut's) performance during real-time telerobotic operations in microgravity. Specifically, the experiment will evaluate cognitive and physical responses – sustained attention/cognitive load, physical load and efficiency and efficacy – for a number of astronaut subjects.

Data collection measurements will involve the following while the astronaut performs the teleoperations tasks: 1) Neurophysiological: The recording of electroencephalographic activity of the brain; 2) Physiological: the recording of metabolic response via a physical activity monitor; 3) Performance data (efficacy, efficiency and safety factors) via video recording.

The full experiment is targeted for mid-to-late 2019 using astronaut subjects while they are controlling a remote rover on Earth in an analogue site from the International Space Station. This paper will summarise preliminary results from ground testing carried out in preparation for the 'real' experiment on orbit.

This activity is expected to provide indications about the mechanisms involved in brain multisensory integration under microgravity and define the 'optimum' human-robot interface for future space telerobotic operations, in order to improve human performance and thus reduce overall mission costs.