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BRAIN OXYGENATION THROUGH FUNCTIONAL NEAR-INFRARED SPECTROSCOPY (FNIRS) MEASUREMENTS IN SPACE – METHODS FROM THE ARCHITECTURAL PROPERTIES' IMPACT ON STRESS AND COGNITION (APISC) STUDY – IN THE ISS

Abstract

During the implementation of the Architectural Properties' Impact on Stress and Cognition (APISC) study in the ISS, functional Near-Infrared Spectroscopy (fNIRS) was utilized to evaluate brain oxygenation levels in different Areas of Interest (AOIs), during repeated measures of cognitive assessments in different locations of the International Space Station. The aim of this ongoing study is to identify potential differences in oxygenation levels in the brain, for similar performance in tasks, across locations. The cognitive tasks crew completes in different locations are Reaction Time (Psychomotor Vigilance Task), Working Memory (n-back), and Executive Function (OpenMATB). The equipment utilized was the Photon NIRS cap, with twelve normal and four short-distance, dual-wavelength sources (760 and 850 nm), and 10 detectors with an area 7.5 squared millimeters. Based on the tasks, AOIs associated with Attention, Working Memory, Perception, Motor Control and Executive function were considered. Those AOIs were limited, due to number of available optodes and also criteria of best fit for crew in orbit. Based on the limited selection of AOIs, a specific montage was selected. The crew self-administered the assessment. Thus they fitted the fNIRS equipment on their own. Placement and repeatability are evaluated using 3D reconstructions of the fitting, using photogrammetry, showcasing consistency of fit through sessions, and between space use and ground use. Implementation of the method itself is a point for discussion. Since this is one of the first times that fNIRS has been implemented in orbit, the focus is data referring to the performance of the methodology during a short-duration mission to the ISS (two-week) with 8 sessions spread over the mission. The used metrics include skull coupling index per channel, and signal quality for the selected montage, per channel. The analyses include differences between earth and space performance. This presentation does not delve into results, but rather on the methodologies and technical demonstration of the technique.