Paper ID: 50255
oral
student

IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (A1)
Medical Care for Humans in Space (3)

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A SLIDING WINDOW REAL-TIME PROCESSING APPROACH FOR ANALYSIS OF HEART RATE VARIABILITY DURING SPACEFLIGHT

Abstract

The paradigm of technological disruption continues to pave the way for innovative technology that has the capacity to acquire comprehensive real-time physiological and environmental data and present endless opportunities to study physiological processes and mechanisms, aid clinical discovery and advance the field of preventative and corrective medicine both on Earth and during spaceflight. Missions of increased distance and duration, as well as ad-hoc emergency situations that render the space crew to remain in space for long periods of time with reduced number of team members necessitate deployment of comprehensive clinical-decision support systems aboard the space station, to preserve and maintain the well-being of the crew, and ensure successful execution of mission objectives and safe return to Earth. In prior work, we presented the use of Artemis, big-data analytics platform for real-time analysis of adaption to conditions of spaceflight, to assess the levels of stress imposed on the human body and identify the state of well-being and any deviation from the norm that becomes apparent prior to onset of clinical symptoms. Conventional methods of adaption assessment were limited to 5-minute windows of data, which were historically averaged to a single hourly and daily value. The capability of Artemis to support analysis of high-frequency, high-volume and high-velocity data present new opportunities for analysis of heart rate variability during spaceflight. As such, we propose the use of a 5-minute sliding window-based analysis of heart rate variability for assessment of adaption during spaceflight. This method would support investigation of stressor-induced responses (i.e. physical load, task activity, environmental) to help identify the exact onset of the highest strain of regulatory mechanisms and assess activity of various components of the autonomic nervous system. In addition, 5-minute sliding window analysis would provide more insight into recovery processes during periods of inactivity or rest. This approach will be demonstrated with the use of data acquired from terrestrial simulation studies and will be incorporated into future Space, Mars and Lunar missions, focusing on modernization of software systems for use on the International Space Station and beyond.