Paper ID: 79032
student

IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (A1)
Medicine in Space and Extreme Environments (4)

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# AN ARTIFICIAL INTELLIGENCE METHOD FOR AUTONOMOUS MONITORING OF THE RETINA FOR MEDICAL APPLICATIONS IN SPACE AND EXTREME ENVIRONMENTS

**Abstract**

Over two-thirds of astronauts on long-duration human spaceflight missions experience Spaceflight Associated Neuro-ocular Syndrome (SANS). In many cases, SANS can result in changes to the inner surface of the eye, called the retina. Any potential changes in-flight are monitored as part of routine space medicine operations. However, this medical monitoring requires specialized diagnostic equipment, clinical specialists, real-time communication, and extensive training. These requirements, though feasible with missions to Low Earth Orbit, create operational challenges with proposed exploration class missions to the Moon or Mars, where communications delays limit the feasibility of tele-operated systems, and the years of medical training required to diagnose with competency limits the level of training that can be provided to astronauts. To address these challenges, the method described herein uses artificial intelligence (AI) algorithms to aid astronauts, without years of specialist medical training, to identify regions of interest in their retinas, in real time during spaceflight without a connection to ground operations or the Internet, to determine the presence of SANS. This system was trained, validated, and tested using clinical data and ground analog data collected from isolated, confined, extreme (ICE) environments. Spaceflight data from a recent International Space Station (ISS) technology demonstration was also used to guide the system architecture. Preliminary results show 93% weighted average precision and 84% weighted average recall in determining presence of SANS. Altogether, the results of this method suggest that AI applications on small, lightweight, mobile retinal imaging devices could be used to support (1) astronauts with SANS monitoring throughout the time course of a long duration, exploration class mission without the need for extensive specialist medical training, (2) non-expert clinicians on Earth in detecting similar changes to

the eye, for the purpose of disease screening, and (3) space medicine operations decision-making on the use of potential in-flight SANS countermeasures during future ISS and Artemis program missions.