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NON-INVASIVE INTRACRANIAL PRESSURE MONITORING IN ASTRONAUTS USING NEAR-INFRARED IMAGING AND MACHINE LEARNING

Abstract

Prolonged exposure to microgravity conditions in space missions leads to significant physiological changes in astronauts, including increased intracranial pressure (ICP), which poses risks to their health and mission success. Traditional methods for measuring ICP are invasive, posing additional risks and limitations in the space environment. This study introduces a novel, non-invasive approach to estimate ICP using near-infrared (NIR) imaging combined with machine learning algorithms. By analyzing changes in blood flow and vasodilatation captured through an NIR camera aboard the International Space Station (ISS), this project aims to develop an accurate, rapid, and scalable method for ICP monitoring. The NIR technology offers the advantages of being low-cost, compatible for bedside use, and suitable for continuous and autonomous monitoring. Generative adversarial networks (GANs) enhance image resolution, while machine learning models, including random forests, analyze the NIR spectroscopy signals to estimate ICP. This method's feasibility is underpinned by its potential for real-time monitoring without the risks associated with invasive procedures. Expected outcomes include the ability to non-invasively approximate ICP with high accuracy, revolutionizing astronaut health monitoring in long-duration space missions and paving the way for terrestrial applications in neurological care. The success of this approach could significantly enhance the safety, comfort, and medical care of astronauts, contributing to the viability of extended missions to the Moon, Mars, and beyond. This project underscores the intersection of space exploration and medical innovation, highlighting the critical role of advanced technologies in addressing the unique challenges of human health in space.