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BRAIM IN SPACE: A TECHNOLOGY DEMONSTRATOR TO STUDY BRAIN ARTERIES IN MICROGRAVITY BY LEVERAGING SPACE PLATFORMS FOR ADVANCED MEDICAL RESEARCH

Abstract

Recent advancements in simplified methodologies have facilitated terrestrial laboratories to extend their research capabilities into space, presenting new opportunities for scientific exploration and commercial ventures. The utilization of space resources holds great promise, particularly in the domain of preserving human health beyond Earth's boundaries. Unlike traditional terrestrial observations that often require prolonged durations to detect physiological effects, controlled environments in space offer accelerated insights into therapeutic or adverse impacts, thus expediting medical research. The accessibility of commercial services, such as ICE Cubes at the International Space Station (ISS), has democratized access to space, making Low Earth Orbit (LEO) and lunar exploration more feasible and cost-effective for a diverse range of stakeholders. The Indian Space Research Organisation (ISRO) has introduced the PS4-OP concept, repurposing the spent fourth stage of the Polar Satellite Launch Vehicle (PSLV) for in-orbit scientific experimentation for a duration of up to six months instead of contributing to space debris. Equipped with standardized interfaces and essential functionalities, the PS4 platform serves as a versatile space laboratory for validating specific experiments related to human physiology requiring microgravity conditions and radiation exposure in a pressurized volume, and thereby assessing potential risks to astronauts. Through the interdisciplinary BRAIM (BRain Artery In Microgravity) experiment, the research team at ISAE-SUPAERO is focused on assessing feasibility of astronauts for space travel by engineering a 3U CubeSat technology demonstrator planned to be housed within the PSLV PS4 Orbital platform for medical research. For the proposed research within the PS4-OP, the ISAE team is presently involved in the CubeSat's mission design and analysis - from selection of orbit, thermal environment, external loads and disposal planning. As a collaboration with the Indian Institute of Space Science and Technology (IIST), this endeavor not only validates crucial advancements for society but also aligns with the objectives of Human Spaceflight Programme through investigation of hemodynamics in brain arteries to assess the impact of microgravity on vascular flow which is crucial for astronaut health. Additionally, the study would explore the effects of radiation on implantable devices like stents, vital for assessing their suitability in space conditions.