PoSSUM Evaluation of a Commercial Extravehicular Activity Space Suit in Lunar and Microgravity Environments

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Renewed calls for human space exploration missions to the Moon and Mars have led to the United States' commitment to return to the Moon by 2024. The commercial space sector is responding by developing new technologies to support the missions, with a heavy emphasis on transport vehicles. However, more and more private companies are innovating to create new and better intravehicular and extravehicular activity (IVA or EVA, respectively) space suits.

An EVA spacesuit prototype developed by Final Frontier Design (FFD based in Brooklyn, New York), was tested October 2019 in analogue lunar and microgravity environments at the headquarters of the Canadian Space Agency (CSA HQ located in St. Hubert, Québec, Canada), as part of Project PoSSUM, an international non-profit research and education organization. The CSA's indoor lunar yard, which is typically used to test rovers and autonomous technologies, was converted by PoSSUM into an analogue test site for human participants by installing a gravity-offset system designed by Kansas State University and modified for multi-axis use by PoSSUM. The gravity-offset system could be programmed to simulate lunar, Martian, or near weightless environments allowing a variety of suited tests to be carried out. Tests included traversals across flat, raised or sloped terrains, planetary geology sampling and characterization using prototype low-fidelity hand operated tools, and "EVA walks" to repair an instrument panel on a mock Quest joint Airlock of the space station, all the while monitoring suited participants' biometrics using CSA's wireless biomonitoring technologies.

Here, we describe in more detail each component of this unique international collaboration and analogue testing: 1) the FFD's EVA spacesuit and life support system, 2) the gravity offset system and infrastructure, 3) the CSA lunar yard, 4) the prototype planetary geology tools, 5) the Quest Joint Airlock and busy board, 6) CSA's biomonitoring technologies, and 7) the mission planning and crew roles. Results from the 2019 analogue campaign are presented and show that the EVA spacesuit has great potential with its unique low cost and mass, increased sizing capabilities, and effective thermal regulation system. Lesson's learned regarding hardware, software, and logistics will also be discussed, as well as PoSSUM's plans for its 2020 analogue campaign at CSA HQ as well as potential future campaigns on commercial reusable suborbital spacecraft.