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IMPLEMENTATION OF EXPERIMENTAL MICROGRAVITY UNIT 2.0 FOR LOW-COST AND ACCESSIBLE MICROGRAVITY EXPERIMENTATION

Abstract

Microgravity experimentation is a requirement for industry and researchers looking to develop solutions to current issues of long-term space travel. However, microgravity experimentation remains an expensive endeavour and is often reserved for research groups with significant financial backing.

In 2020, the UWA Aerospace team from the University of Western Australia proposed an overview of a low-cost, Experimental Microgravity Unit (EMU) to provide a solution to the high-cost barrier faced by microgravity researchers. EMU was designed to be an inverted rocket and was carried to a specified altitude by a helium-filled high-altitude balloon. Once this altitude was attained, the line connecting EMU to the high-altitude balloon was severed and it underwent freefall for up to 40 seconds, providing a microgravity like environment for a 2 kg payload.

EMU was only limited to one test and experimental data from this test was never obtained due to unforeseen weather conditions. A working inverted-rocket prototype was not developed for full-scale implementation.

This paper aims to further this research and provide a full-scale implementation of the newly developed EMU 2.0 by UWA Aerospace. The operation of EMU 2.0 in conjunction with a high-altitude balloon is identical to the process above. However, EMU 2.0 has a range of improvements from its predecessor. It features a low-cost, easy to manufacture composite fuselage; custom build flight computer and radio; a 2-stage supersonic recovery mechanism with an active guidance mechanism; and a custom-built cold gas ejection system. The team has also applied high level Computational Fluid Dynamics to simulate the aerodynamics of the rocket and optimise the freefall time. All components on EMU 2.0 have been designed and built by UWA Aerospace to ensure a high turnover rate and low production costs.

The project remains relevant two years onwards from the initial paper. It has the potential to make the barrier of entry to perform microgravity experimentation much lower and accelerate the global participation in space research, especially in countries with underdeveloped space economies. The first altitude

drop of 1 km will occur in April and subsequent 10 km and 30 km tests will occur in May and July respectively.