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FALLING FROM THE EDGE OF SPACE – AN INNOVATIVE APPROACH TO MICROGRAVITY RESEARCH

Abstract

There are a number of methods by which private companies and research institutions test their experiments for use in a Space Environment. The type of stimuli and number of environmental conditions used in conjunction with one another scale with the cost of such a test. The costliest of the conditions one would wish to simulate is microgravity, as the act of removing gravity forces the experiment to be falling aligned with the gravity vector for a significant period of time, for any meaningful exposure to this condition. Current solutions involve vertical drop tests, such as the Bremen drop tower, operated by ESA, which can achieve microgravity conditions for 4.6s (ZARM FABmbH , 2012). Parabolic flights can subject payloads to a microgravity environment of around 30s over several successive manoeuvres, and Sounding rockets, such as NASA's Black Brant system, can achieve microgravity for around 10-12 minutes, at a cost of $2 Million dollars. (NASA Goddard Spaceflight Center) These systems, whilst effective, are limited in operation frequency and expensive to set up and operate, hence they are significantly oversubscribed and have extensive waiting lists. (National Research Council of Canada, 1988) This paper presents a new, innovative and novel approach to microgravity research. By using a high-altitude payload, falling at terminal velocity from an altitude of 30km, research institutions will be able to perform microgravity experiments of up to 4 minutes, and the lack of launch infrastructure required to launch these vehicles means that launch capability is worldwide, with minimal set-up time required. The demonstration of this launch manoeuvre is performed using Stratonauts LTD STRATO-X launch vehicle, a flight-proven research platform capable of lofting payloads to over 32km. Test flights with 9-degree of freedom sensors are used in the determination of the fidelity of the microgravity environment generated, as well as several key experiments in microfluidics are performed to test the effectiveness of such a system. As the payload is subjected to Near-Space conditions also, the Near-Space platform is one of the few options in the world to simulate a payload through the entire stimuli of flight parameters available, and whilst competing with Suborbital launchers, offers Microgravity capability at a fraction of the cost. Further testing will be conducted aboard five high altitude balloon flights in June 2020 to determine the consistency of the subjected environment, and to further strengthen the case for versatile drop-testing in the future.