Paper ID: 51004
oral
student

IAF MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Gravity and Fundamental Physics (1)

Author: Mr. Florian Gautier
France, florian.gautier.borrallo@gmail.com

Mr. Elioenai Sitepu
Cranfield University, United Kingdom, elioenai.sitepu@cranfield.ac.uk
Ms. Carole Le Blay
France, carole.leblay@gmail.com
Mr. George Kersey
Cranfield University, United Kingdom, g.kersey32@gmail.com
Mr. Stuart Ogborne
Cranfield University, UK, United Kingdom, Stuart.Ogborne@cranfield.ac.uk
Mr. Daniyal Ahmad Durrani
Cranfield University, UK, United Kingdom, Daniyal-ahmad.Durrani@cranfield.ac.uk
Dr. Joan Pau Sanchez Cuartielles
Cranfield University, United Kingdom, jp.sanchez@cranfield.ac.uk
Dr. Luca Zanotti Fragonara
Cranfield University, UK, United Kingdom, l.zanottifragonara@cranfield.ac.uk
Dr. Jennifer Kingston
Cranfield University, United Kingdom, j.kingston@cranfield.ac.uk

DROP YOUR THESIS! 2018 RESULTS: 4.74 SECONDS OF MICROGRAVITY CONDITIONS TO ENABLE FUTURE CUBESAT LANDINGS ON ASTEROIDS

Abstract

The exploration of asteroids has seen an increasing interest for both scientific and exploitation purposes, with a growing number of asteroid missions recently launched by major space agencies. In this context, landing safely on the surface is the main challenge to obtain in-situ observations. However, prior knowledge of the targeted asteroid, i.e. ground-based Earth observations, is limited and this affects the chances of the spacecraft to safely reach its surface. Rather than risking the mothership, small landers can be used to scout the surface as Haybusa2 mission did. An alternative is CubeSats, a low cost solution for prospection. The weak gravitational field of asteroids may also allow for a ballistic landing, if enough energy is dissipated at touchdown. A low dissipation of energy at touchdown would however result in high uncertainties of the final landing location, or may even result into an escape trajectory. There is great uncertainty on the expected level of energy dissipation at touchdown, with a knock-on effect on the margins enforced to the choice of landing site. The Land3U team from the Astronautics and Space Engineering Course at Cranfield University performed an experiment with support of ESA Academy's "Drop Your Thesis!" programme. This experiment aimed to provide additional data on the engineering constraints relevant to land a CubeSat on the surface of an asteroid. It also attempted to bridge the disagreement between the coefficient restitutions measured by previous missions (Hayabusa Philae) and those from previous microgravity experiments. The experiment was performed in ZARM's Drop Tower, located in Bremen, during two Drop campaigns in November 2018 and February 2019. A total of 7 drops were carried out, each providing 4.74 seconds of microgravity under vacuum environment. The experiment measured the coefficient of restitution of a 1U mock-up, equipped with a 4kg mass, touching down on the simulated asteroid surface with an average velocity of 15 cm/s. The coefficient of restitution is equal to the ratio between the velocity before and after the impact. The campaign produced several successful drops in which multiple coefficients of restitution could be measured. The first two drops were not able to produce a rebound of the CubeSat due to the behaviour of the simulant during transition from 1g to 0g environment. This paper reviews the experiment set-up, the simulant behaviour and the result of estimated coefficient of restitution computed from velocity measurement by video tracking.