Paper ID: 73197
oral
student

29th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Generic Technologies for Small/Micro Platforms (6A)

Author: Ms. Emanuela Gaglio
Scuola Superiore Meridionale, Italy

Mr. Riccardo Guida
University of Naples "Federico II", Italy
Dr. Anselmo Cecere
Università degli Studi di Napoli "Federico II", Italy
Mr. Stefano Mungiguerra
Università degli Studi di Napoli "Federico II", Italy
Prof. Raffaele Savino
University of Naples "Federico II", Italy

ASSESSMENT OF A DEPLOYABLE AERODYNAMIC CONTROL SYSTEM FOR MICROSATELLITES RECOVERY

Abstract

In the last decades, deployable re-entry systems have represented a research topic of increasing interest among scientists and engineers interested in the development of Entry, Descent, and Landing (EDL) technologies. The rationale is to reduce capsules ballistic coefficient $B = \frac{m}{SC_D}$ without exceeding volumetric constraints of current and future space launchers fairings. As a result, heat flux, deceleration, and stagnation pressure peaks are sensibly mitigated, promoting the employment of lightweight Thermal Protection Systems (TPS) materials. Since backshells are no longer required and the new configurations make the traditional RCS-based attitude control systems difficult to be implemented, alternative Guidance, Navigation, and Control systems should be implemented. University of Naples Federico II fits in this context with a number of research projects in this field. In the current study, a re-entry satellite based on a 16U CubeSat is equipped with an umbrella-like, deployable heat shield, supposed to be open immediately before the re-entry phase. To enhance the landing site precision targeting, a proper number of flaps embedded at the end of the aeroshell are actuated during the descent. In this scenario, the current work is focused on a preliminary system design and study of the aerodynamic control system based on flaps. A mechanic concept design of the microsatellite has been undertaken to highlight the different mechanisms needed for flap deflections and heat shield deployment. A system analysis has been performed for the assessment of relevant sub-systems required to perform a typical orbital mission profile. A preliminary mass budget led to the definition of the nominal re-entry trajectory from which a relevant flight condition has been chosen to investigate the effectiveness of aerodynamic control system based on flaps. This condition, Mach 15 and altitude 66 km, is the one close to the expected peaks of deceleration and stagnation pressure. The analyses have been carried in different configurations of the re-entry system: aeroshell, aeroshell with undeflected flap, and aeroshell with deflected flaps. Aerothermodynamic viscous turbulent simulations have been performed, allowing one to highlight the influence of both angle of attack and different flaps' deflections. The results will be useful for design of microsatellites with re-entry, landing and payload recovery capabilities.