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EXPERIMENTAL INVESTIGATION AND NUMERICAL ANALYSIS OF A CUBESAT – DEPLOYER SYSTEM

Abstract

CubeSats are a specific typology of nanosatellite, based on the concept of a unit, which measures 10x10x10 cm. Over the past decade, these satellites have gained increasing popularity, thanks to their modularisation and standardisation. These characteristics allowed fast and low-cost access to space for small companies and universities. In this framework, the S5Lab (Sapienza Space System and Space Surveillance Laboratory) from the Sapienza University of Rome, has launched 5 different CubeSats in the past 7 years. Throughout the process of developing these satellites, the laboratory team has gained a valuable understanding of what contributes to successful satellite production, and various lessons learned have been identified and analyzed at various phases of the project. Between all the phases of nanosatellite development, the testing phase is a crucial step. Its primary objective is to ensure that the satellite is correctly functioning and that can survive the launch and space environment. To clear these operational phases, environmental test campaigns are carried out, typically comprising Vibration testing and Thermal Vacuum testing. With specific reference to the vibrational testing of CubeSats, the dynamic characterization of the releasing system is one of the key factors for space launch clearance. Therefore, the identification of the dynamic behaviour of the CubeSat relies on a deep knowledge of how the deployer releasing system, represented by a spring mounted on the bottom part of the deployer, couples with the CubeSat itself. As such, the determination of the modal characteristics of the CubeSat is of crucial importance to understand if it can withstand the vibration environment during launch and deployment. Therefore, a comprehensive understanding of the modal characteristics of the CubeSat - deployer spring system is essential in ensuring the successful operations of the CubeSat. In this paper, the effects of the deployer configuration on the modal properties of the whole system are numerically and experimentally investigated. With reference to a 1U CubeSat, the effects of the rigidity of the releasing spring are analyzed by considering two spring configurations, that is a rigid (blocked conditions) and normal operating spring values. The modal parameters and the dynamic responses obtained from the sine and random tests, carried out at the Structural Dynamics Laboratory of the University of Rome "La Sapienza", are compared with the numerical predictions obtained from the corresponding finite element analysis.