IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
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SHARJAH-SAT-1 STRUCTURAL DESIGN AND ANALYSIS

Abstract

Small-scale satellites' abilities have been developing rapidly in the past couple of years, permitting them to effectively carry out various intricate missions that once required substantial satellite platforms. One of the fundamental steps in the design phase of any satellite is structural analysis. It is crucial to carry out the structural numerical simulation and experimental testing on the structure of a CubeSat, as it gains acceleration significantly higher than the gravitational acceleration during launch. This can cause structural failure, and it must be assessed and prevented. Otherwise, it would cause grave damage to the satellite itself, any accompanying payload, and the launch vehicle carrying them.

This paper will present the structural design and analysis of the Sharjah-Sat-1 CubeSat, a 3U+ CubeSat. It is the first mission of the Sharjah Academy for Astronomy, Space Sciences, and Technology (SAASST) and University of Sharjah (UoS). It has a dual payload: (i) an improved X-ray Detector (iXRD) to observe bright X-ray sources and the Sun coronal holes and (ii) a system of two optical cameras for Earth

imaging. In addition, a star tracker is included to satisfy the pointing requirements. All the subsystems are tightly packed in the 3U+ structure requiring a careful determination of the element thicknesses. The structure has been subjected to two different analyses: modal analysis and quasi-static loading analysis. These analyses were conducted using the finite element analysis (FEA) software ANSYS. Modal analysis was performed on the CubeSat to determine the natural frequencies in two behaviors: free body and constrained behaviors. In addition, three different quasi-static analysis cases were conducted on the CubeSat structure in the positive X, Y, and Z-axes directions. The obtained FEA numerical results were evaluated thoroughly. It was later compared, validated, and verified through vibration testing to assure that Sharjah-Sat-1 can safely survive the different failure modes imposed by the mission environment conditions during its lifetime.