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MATERIALS AND STRUCTURES SYMPOSIUM (C2)
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THE DESIGN AND TESTING OF DEPLOYMENT MECHANISMS AND STRUCTURE OF TWIN NANO-SATELLITE, STUDSAT-2.

Abstract

This paper presents the different mechanisms used for the double deployment of solar panels, deployment of drag sail and antenna, along with the optimized structural design of the twin nanosatellite , STUDSAT-2. STUDSAT (STUDentSATellite) is a project undertaken by a group of students pursuing undergraduate engineering courses from INDIA. The mission of the satellite is to capture images of the earth with a resolution of less than 40 meters, along with the demonstration of inter-satellite communication between the two satellites STUDSAT-2A and STUDSAT-2B. The objective also includes testing of an indigenously developed drag sail mechanism for de-orbiting and an inter satellite separation mechanism. These nano-satellites are designed for the dimension 300*300*150 mm weighing 5 kg and 4.5 kg each.

One of the major problems faced by nano-satellites is the power generation for the on-board components. Since the area available for harvesting solar power is relatively less, a double deployment mechanism is used to increase the surface area without changing the dimensions of the satellite, thus increasing the net power output. The main disadvantage of incorporating a conventional double deployment mechanism is the mechanical shocks that are developed during the deployment. These shocks disrupt the orientation of the satellite. This paper explores the possibility of using a sliding panel double deployment mechanism and a damping mechanism to address the above mentioned issues. The sliding panel double deployment mechanism probes the different possible arrangements incorporating a variable mass moment of inertia system to decrease the final angular velocity, thus significantly reducing the shocks. The necessary equations and a detailed plot of the angle turned, angular velocity and angular acceleration as a function of time have been included.

The antennas used for the communication are stacked inside the structure during the launch. A suitable mechanism is designed for their deployment in the orbit. The drag sail consists of thin kapton sheets that are attached to pre-stressed metallic strips. A suitable system is designed for stacking and deployment of the same. All the components involved are analysed for static and dynamic loads to validate the design.

The mass of the STUDSAT-2 is constrained to 10 kg approximately, hence the structure has been optimized to reduce the mass from the previous designs. A detailed static and dynamic analysis is

conducted on the optimized structure to assess the structural integrity of the design.