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STUDY ON MICROSATELLITE STRUCTURE TO MITIGATE MECHANICAL ENVIRONMENT

Abstract

This study aims to reduce mechanical environment in both out-of-plane and in-plane directions without consuming mass and volume, which are onboard resources of a 50kg class microsatellite (below, microsatellite). Microsatellites are exposed to severe mechanical environments during rocket launches and vibration tests. The mechanical environment damages components inside microsatellites and affects the satellite system. At the worst case, the system becomes unsustainable. Currently, many problems occur during vibration tests in the development of Japanese satellites. Against the mechanical environment, the most common countermeasure is to apply polyimide tape to fastening points of components mounted on microsatellites to attenuate vibration by converting vibration into heat through due to viscoelasticity of the tape's adhesive layer and friction between film and fastening points. Actually, this method mitigated in-plane vibration in MUSES-A. But experiments conducted during the development of SOLAR-1 showed that it was less effective for out-of-plane vibration. As a result, mechanical environmental countermeasures were attaching sound-absorbing materials, which is another damping method, to mountable locations.However, the materials are heavy and it can attach only to a limited number of locations inside a microsatellite because microsatellites have severe mass and volume constraints on their payloads.As mentioned above, there are currently only limited methods for damping vibration in in-plane and out-of-plane directions for the on-board resources. Hence, the mechanical environment of satellites must tolerate it. Therefore, countermeasures against the mechanical environment of onboard products increase development time and cost.Therefore, there is a need for a method that can attenuate vibration in out-of-plane and in-plane directions without consuming the onboard resources.Therefore, we have devised a method to greatly reduce the mechanical environment both out-of-plane and in-plane by microsatellite structures without using mass or volume.This method is to incorporate a damping systems as part of microsatellite structure. Most microsatellite structures are composed of composite materials, and the damping system was replaced as part of the composite material or incorporated inside the structural member without affecting the onboard resources.This method was experimentally confirmed that this method significantly mitigates the in-plane and out-of-plane mechanical environment compared to the conventional method and is therefore very effective.In this presentation, in addition to the above experiments, we will describe feasibility evaluations of the method by checking changes in stiffness and strength