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IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures II - Development and Verification (Deployable and Dimensionally Stable Structures) (2)

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DESIGN AND TESTING OF TPA-1 CUBESAT PAYLOADS: DEPLOYABLE BOOM, IMAGERS AND DRAGSAIL

Abstract

In this paper we discuss the design and testing of a deployable boom and tuna-can-sized dragsail payloads for an upcoming 3U CubeSat mission, which is planned for launch in 2023 Q1. The deployable boom will extend two cameras that are mounted at the tip to a maximum distance of 2m from the satellite. These two cameras will be pointed back towards the satellite in a stereoscopic configuration to generate 3D point cloud as a technology demonstration for future applications in pose estimation and condition assessment. The major challenge faced in this design is the need to electrically connect the cameras at the tip of the boom. We first discuss the considered methods of solving the problem, which are cocoiling a ribbon cable with the boom or accommodating for a separate cable spool and managing the cable deployment. Then, the design and layout of the full deployer mechanism will be discussed, which will be followed by the results of the deployment and retraction testing and vibration testing. Potential further applications of the boom system will be discussed. With the exponential increase in CubeSat launches in recent decades it is imperative that institutes and companies take the responsible step to deorbit their dead satellites. Even if the natural orbit decay of satellites from low Earth orbit is relatively low, the number of launches continues to increase, so it is important to deorbit the satellite as soon as possible. With this in mind, the second payload is a tuna-can-sized dragsail that will be mounted to the +Z face of the satellite and will deploy a $1m^2$ sail at the end of the satellite's life, providing a 16-fold increase in drag area for a tumbling CubeSat. Dragsails have been deployed from CubeSats in the past, but this latest venture offers a compact design that is positioned outside of the normal CubeSat volume, and hence leaves the internal volume of the satellite free for payloads. The sail is deployed by releasing the strain energy of four cocoiled tape spring booms, which are connected to the corners of the sail. We verify the design through repeated deployment tests and summarise the results.