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

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DEVELOPMENT OF INFLATABLE STRUCTURES AT THE UNIVERSITY OF SOUTHAMPTON

Abstract

Inflatable technology has been used in Aerospace applications over many decades and in fact some concepts were initially proposed in the 1930's. The ability to inflate large structures with a low mass and stored volume has always been appealing to the aerospace industry and specifically the space industry where efficient deployable structures are continually required. Inflatable technology for space applications is under continual development and advances in high strength fibres and rigidizable materials have pushed the limitations of these structures. This has lead to their application in deploying large-aperture antennas, reflectors, solar sails and NASA's recent large-scale inflatable spacecraft 'TransHab'. However, many significant advantages can be achieved by combining inflatable structures with structural stiffeners such as tape springs. These advantages include control of the deployment path of the structure while it is inflating (a past weakness of inflatable structure designs), an increased stiffness of the structure once deployed and a reduction in the required inflation volume. Such structures have been previously constructed at the Jet Propulsion Laboratory focusing on large scale booms. However, due to the high efficiency of these designs they are also appealing to small satellite systems. This article outlines ongoing research work performed at the University of Southampton into the field of small satellite hybrid inflatable structures. Inflatable booms have been constructed and combined with tape spring reinforcements to create simple hybrid structures. These structures have been subjected to bending tests and compared directly to an equivalent inflatable tube without tape spring reinforcement. This enables the stiffness benefits to be determined with respect to the added mass of the tape springs. Corresponding theoretical models have also been developed based on both beam bending theory and finite element analysis. These models simulate the deflection of the hybrid structures for different inflation pressures allowing a direct correlation between theoretical and experimental data. The paper presents these results along with the initial performance parameters of the systems tested. The paper concludes with an outline of the future work to be performed at the University of Southampton.