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

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DEVELOPMENT OF MORPHING DEPLOYABLES FOR SPACE APPLICATIONS

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 is under continual development and advances in high strength fibres have pushed the limitations of these structures. This has led to their application in deploying large-aperture antennas, reflectors, solar sails and more recent large-scale inflatable spacecraft such as 'Transhab' and Genesis I and II. There is ongoing research into increasing the range of capabilities of these structures by enhancing the stiffness of the deployed structure. This can be achieved by combining the inflatable material with folding structural components, such as tape springs, or by using rigidizable coatings. However, the lower stiffness and inherent flexibility of these inflatable structures also allows the structure to be morphed and controlled, which can be advantageous for a wide variety of applications. Initial research has previously been performed into integrating Shape Memory Alloys (SMA) with inflatable wings for Unmanned Aerial Vehicles (UAV) allowing airfoil optimization for various flight regimes. The aim of this work is to investigate the integration of shape memory alloys into inflatable structures for space applications. The article outlines ongoing research work at the University of Southampton into the field of morphing inflatable structures. Various commercially available shape memory alloys have been purchased and initially investigated to determine fundamental parameters such as maximum achievable force, power required, controllability and repeatability of the motion. Such an initial investigation is a necessity in order to optimize their integration with the inflatable structure. The inflatable structures consist of simple tubes allowing the maximum possible deflections to be determined from a simple geometry. Methods of integration and possible configurations are then discussed before the final construction of the test specimens. These specimens are used to determine the important system parameters such as the deflections achievable for various power inputs, and the controllability of the deflection through the morphing phase of the SMA's. The paper presents these results and concludes with an assessment of the potential performance of these structures.