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Space Structures II - Development and Verification (Deployable and Dimensionally Stable Structures) (2)

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PARAMETRIC STUDY OF FLEXIBLE SOLAR ARRAY BASED ON ORTHOGONAL METHOD

Abstract

The interest of using space flexible solar arrays for both Low Earth Orbit(LEO) and Geosynchronous Earth Orbit(GEO) satellites is today clearly identified(high power/mass ratio, low costs etc.). But to take advantage of these characteristics, the implementation of a flexible substrate is required and new concepts of low mass deployable support structures have to be developed. This paper puts forward a new concept of flexible solar array, which includes lenticular tube, polyimide membrane and triple junction solar cells. Parametric studies are performed on a generic flexible solar array designs to identify parameters of interest. The FEA software, ABAQUS, was used to perform the structural analysis to simulate the stiffness of solar array and the buckling of tube. The studies are presented a full-scale solar array including inertia relief and geometric nonlinearity. The numerical analysis procedures to introduce pre-stress into planar membrane were presented firstly, and the pre-stress introduction effects on a triangular planar film reflect-array were evaluated as a typical example. There are many factors which affect the stiffness of solar array, and they are coupling with each other. Therefore, orthogonal method including four factors, such as membrane's tensile force, membrane's thickness, lenticular tube's sectional dimension and lenticular tube's thickness, has been used in the numerical analysis. Through the Variance Analysis of Orthogonal experiment, the main factors affecting the stiffness of solar array have been achieved, and the structural parameters have been optimized.