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

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OPTIMIZATION METHOD ON CONTROLLING THERMAL DEFORMATION OF LARGE SPACE DEPLOYABLE TRUSS STRUCTURES

Abstract

Large space deployable truss structure can be used on large solar arrays and space antennas. As the main support structure, it plays a great role in the whole structure. With the development of spaceflight mission, the dimensions of deployment structures increase more and more large, but ground simulation test of full scale model becomes difficult, and cost of the thermal vacuum simulation test is still very expensive. Therefore, it's very important to analyze thermal control design, simulate the temperature field and thermal deformation of deployable truss structures in-orbit. In the deep low space environment, spacecraft structures are exposed to solar radiation, heat from earth albedo and infrared-radiation, undergo large changes in temperature. In this paper, based on the small deformation theory, thermal-structure analysis of 50-meters long truss structure was studied. After preliminary calculation of 5 6 cycles, one long beam of the truss can't reach heat balance by using original surface thermal control coating. And large thermal deformation was found on the top of the truss, it cannot meet the requirements. In order to minimize the thermal deformation, principles of adjusting thermal control coatings were established: (1) three beams reach heat balance as soon as possible; (2) after heat balance, make the temperature differences minimum, which locate on the three beams at the same section along the truss. Thermo-structural FEA model of 50-meters long truss was established, thermal control coating of one long beam was adjust, transient temperature-curve of six cycles was achieved. And it was found that the beam can reach heat balance. Then according to the above principle (2), continue adjusting the thermal control coatings of the beam, until temperature differences of the three beams was minimal. It was discovered that the thermal deformation of the whole truss was corresponding to the smallest value. These results may provide some reasonable references and advices for the thermal design and the thermal analysis of large space deployable truss structures.