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

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DESIGN AND BUCKLING ANALYSIS FOR SUPPORT RIBS OF INFLATABLE ANTENNA REFLECTOR

Abstract

Ultra-light mass, high storage efficiency and reliable deployment are the keys to promote the active applications of space inflatable structures in deployable antenna. In this paper, a novel concept of offset-fed parabolic inflatable antenna reflector is proposed at first. The major components of inflatable antenna reflector include central hub, support rib, inflatable torus, tension system and reflector surface. Surface accuracy is mainly maintained by the support ribs stretched by tension system. A typical support rib of inflatable antenna reflector is then chosen to design its initial shape using a proposed inverse iterative method. Next, the buckling load and buckling mode of support rib are obtained based on an eigenvalue buckling analysis. Finally, the buckling strain and patterns are tested using a non-contact digital image correlation (DIC) technology. The results reveal the typical local buckling characteristics in the rib buckling modes. These local buckles mainly occur in the top area of rib near the left clamped edge and in the bottom of rib near the right terminal edge. According to these results, three useful strategies are proposed to control the buckling of support ribs so as to improve the stability of structure and sustain a high precision reflector. The first is to add the constraints from the reflector surface along the bottom edge of support rib. The second is to resist the local buckles using some transverse constrains which is perpendicular to the rib at the local buckling positions. The third is to change the transfer paths of tension in the support rib by adjusting and optimizing the positions and quantities of suspended ropes in tension system. Our results are of great benefit to the design and shape control of inflatable antenna reflector.