IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Interactive Presentations - IAF MATERIALS AND STRUCTURES SYMPOSIUM (IP)

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SINGLE RING DEPLOYABLE TRUSS MECHANISM FOR SPACE ANTENNA

Abstract

Unfurlable antennas are one of the most desirable antennas in space industry, because of its compact stowed configuration and light weight. In this paper an Unfurlable peripheral ring type antenna truss which can support a flexible cable net is studied. This mechanism has n- number of basic deployable units (BDU) which can be repeated to get a closed loop. The links with in a BDU are connected using revolute joints. The BDUs are connected to each other using gear coupler so as to achieve a closed loop configuration. Initially we studied the loop by formulating a loop-closure equation and the solution reveals that the geometric constraints imposed on the loop by virtue of closing is not enough for synchronised deployment, i.e. the loop has more than one degrees of freedom (dofs). In order to constrain additional dofs a cable loop is implemented on each BDU which made the whole loop a single degree of freedom mechanism. Thus the mechanism can be driven using a single motor for stowing and deploying. A unique four joint hinge is designed which takes power from the gear coupler that connects two BDUs and deploys two auxiliary appendages out of the plane of the loop for supporting the flexible cable net. The paper also describes a full kinematic model to analyse the position, velocity and acceleration of the mechanism elements. Next the Equation of motion which describes the deployment dynamics is derived for the truss using Lagrange method. This is done by considering the cable loop used in BDUs an and friction on joints. Using this the relationship between control force and motion is derived and is verified by a prototype of the Unfurlable truss mechanism.