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DEPLOYMENT MOTION CONTROL RESEARCH OF DEPLOYABLE TRUSS ANTENNA

Abstract

Large spatial deployable antenna structure which is composed of tetrahedral truss unit, have many advantages such as small stowed volume, high structure stiffness, being flexible configuration etc. This antenna is drived by rotational springs, which are placed in middle joints of each activator struts. Deployable dynamic analysis result of deployable truss antenna shown that the velocity and acceleration of antenna during deployment were relatively large. This cause that the impact force between the antenna and the satellite is large and may destroy the whole satellite system. So it is necessary to control the deployment motion of this kind of antenna structure. At first, the basic truss element and deployable machine of deployable truss antenna were introduced and a 2m test prototype was designed and manufactured. Deployable dynamic analysis theory was proposed, which based on Moore-Penrose generalized inverse matrix. For this deployable truss antenna, a new control method of deployment process was proposed. Corresponding open-loop deployment active control system was designed for this kind of antenna. In this control system, a piece of control cable was placed around several joints of antenna. While antenna deployed, control cable were released slowly by servo motor. After controlment, an active force was introduced to dynamics equation of antenna model and the deployable dynamic of antenna was analyzed. The corresponding control test for the 2m antenna test prototype was finished. By the programmable controller, the speed of servo motor was controlled. Then the control cable is released in the designed speed. The antenna were deployed without controlment and other four differnet designed speeds.Using the non-contact measurement system, the velocity and acceleration of antenna joints were measured during deployment. The test result shown that the velocity and acceleration of the antenna nodes, also the maximum impact force to the satellite were reduced efficiently after controlment. The research result shows the capabilities of this active control method.