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

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STUDY ON A CALIBRATION METHOD FOR SHAPE CONTROL PARAMETERS OF A SELF-SENSING REFLECTOR ANTENNA EQUIPPED WITH SURFACE ADJUSTMENT MECHANISMS

Abstract

In this study, a novel method for an on-orbit calibration of shape control parameters is developed and verified. The she control parameters relate control inputs for shape control and changes in the antenna gains caused by intentional deformations. In this reflector antenna system, the intentional deformations are added to the reflector surface by using the surface adjustment mechanisms, and the corresponding changes in the antenna gains are measured. Then the control inputs for the shape correction of the deformed reflector are directly determined from the information on changes in the antenna gains without any iterations by using the calibrated shape control parameters. Surface adjustment mechanisms, which are primarily used to control the reflector shape, are also used to calibrate the shape control parameters. In the developed method, the shape control parameters of a reflector antenna are calibrated from the changes in the strengths of received radio waves caused by intentional deformations added by using surface adjustment mechanisms. The calibration are carried out as follows; First, deformations that are twice as large as the intentional deformations originally used are added to the surface of the reflector antenna and some of the control parameters are calibrated from the corresponding changes in antenna gains. Next, the some modes of the intentional deformations are simultaneously added to the reflector and the other parameters are calibrated. These calibration method are derived from the relations between surface errors of the reflector and antenna gains. Some numerical simulations are performed to investigate the feasibility of the developed method. In these simulations, a reflector antenna equipped with surface adjustment mechanisms is employed and it is assumed that the reflector is deformed by disturbances. The reflector surface is additionally deformed by using the surface adjustment mechanisms, and the changes in the gains are analyzed. The shape control parameters are calibrated by using the developed method. The control inputs are calculated using the parameters, and the original deformation due to the disturbance is corrected. The results of these simulations show that the parameters are calibrated accurately, and the deformation of the antenna reflector is corrected properly by the developed method. The results clearly indicate that the developed method is an effective means of controlling the shape of a reflector antenna equipped with surface adjustment mechanisms.