SPACE POWER SYMPOSIUM (C3)
Space Power Technologies and Techniques (2)

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A STUDY OF BEAM DIRECTION VARIATION OF LARGE DEPLOYABLE REFLECTOR ANTENNA ON ORBIT

Abstract

Large satellite antenna will be manufactured by large structure and material so that reflector antenna or array antenna. For these large antennas, thermal distortion error is serious problem on orbit beam direction error, distortion of beam shape and increasing side-lobe level. This paper study the beam direction error caused by thermal distortion of reflector using Engineering test satellite VIII (ETS-VIII). The experimental result of the pattern measurement and the error correction of beam direction are described-here. ETS-VIII was launched at December 2006. Many communication technologies are experimented and evaluated the performances. This Satellite is equipped with transmitting and receiving antennas for land mobile communications. First, we show the outline of its antenna constructed by large deployable reflector (LDR), physical size is about 17m x 19m and phased array feed, number of elements is 31. Reflector is offset parabola and equivalent aperture diameter is about 13m. Parameters of transmitting and receiving reflectors are same. Tx and Rx feeds constructed by S band phased array system are arranged at defocus points, 900 mm offset to reflector surface direction from focus point, respectively. The reflectors are constructed by the metal mesh surface and the deployable truss structure, and stowed at lunch and deploy on orbit. Next we describe the measurement of radiation patterns of this antenna on orbit. Antenna patterns are measured by moving the satellite attitude with one dimension (cross scanning), and receiving the CW signal on the earth station from the transmitting antenna. During these experiments, we recognize the received signal level at earth station form satellite is varied and its cycle is a day. We think these daily variation will be caused by variation of beam direction of that antenna results from thermal distortion of reflector. Next, we discuss the verification of this daily variation of receiving level in detail and the experimental results of correction of the beam direction shift using phased array function. Form experiment, the angle of beam shift can be specified and then the beam direction shift can be corrected by prediction of beam direction. From these discussions, we make sure that the beam direction error can be corrected for future large satellite antenna. Finally, we describe the plan of next study and experimental plans prediction of reflector shape and correction of array weights using REV (rotating element electric vector) method.