Paper ID: 78574
student

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

Author: Mr. Ryohei Orii
The Graduate Universty for Advanced Studies[SOKENDAI], Japan, orii.ryohei@ac.jaxa.jp

Mr. Takeru Nakamura
The Graduate Universty for Advanced Studies (SOKENDAI), Japan, cstk15082@g.nihon-u.ac.jp
Prof. Yasuyuki Miyazaki
JAXA/ISAS, Japan, miyazaki.yasuyuki@jaxa.jp

A PROPOSAL FOR A LIGHTWEIGHT DEPLOYABLE LARGE MEMBRANE DIPOLE ARRAY ANTENNA

Abstract

Deployable structures consisting of membrane surfaces can be stowed and lightweight, enabling the construction of large-scale structures in a single launch. The usefulness of this structural style has been strongly recognized since its demonstration by IKAROS. In addition, it is now important to add value beyond storage and deployment. We have been studying the application of such a structural style to large deployable antennas to improve their stowability and lightweight. To realize a large membrane antenna, it is necessary to satisfy both the requirements specific to space structure engineering, such as stowability and lightweight, and those specific to antenna engineering, such as gain and directivity. On the other hand, the simplicity of fabrication is an important point in realizing large membrane antennas, but it does not seem to have received much attention. For example, a typical concept for a large membrane antenna is to use two layers, with a patch antenna mounted on the first layer and a GND on the second layer. This method is easy to store, lightweight, and has a high antenna gain, so it can satisfy both requirements. However, to ensure stable antenna performance, the distance between the two layers must be strictly controlled, which requires the insertion of a large number of spacers between the layers. In addition, wiring for the feed between the two layers is required, and the handling of this wiring is difficult. If dipole antennas are mounted instead of patch antennas, only a minimum of one membrane surface is required. Although the gain of the dipole antenna is lower than that of the patch antenna, the gain can be improved by placing the reflector-mounted membrane surfaces at a distance from each other. This method requires no wiring between the two layers and is easy to fabricate. The objective of this research is to confirm the usefulness of the concept of a large membrane surface antenna implemented with a dipole antenna with a reflector. To this end, storage efficiency, areal density, radiation pattern, and ease of fabrication are quantified numerically and experimentally, and compared with typical concepts.