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

Author: Dr. Jungang Yang
Xi'an Institute of Space Radio Technology, China, yangjungang2004@aliyun.com

Dr. Yong Xiao
Xi'an Institute of Space Radio Technology, China, xiao.yong@126.com
Mr. Xiaoping Wan
Xi'an Institute of Space Radio Technology, China, 13669194798@163.com
Dr. Zhihua Zhao
Tsinghua University, China, zhaozh@tsinghua.edu.cn
Dr. yesen fan
Xi'an Institute of Space Radio Technology, China, fanyesen@126.com
Mr. yonggang fang
Xi'an Institute of Space Radio Technology, China, 5419407@qq.com

SCIENTIFIC PROBLEMS AND ENGINEER RESOLVENT DURING DEVELOPMENT OF LARGE DEPLOYABLE MESH ANTENNA

Abstract

Tiantong1-1 is the first Chinese satellite for mobile communication in synchronous orbit. Benefited from the usage of large mesh deployable antenna, the communication capacity of the satellite has been greatly expanded, which miniaturized the ground handheld communication terminal and realized mobile communication in the Chinese land and the surrounding sea areas. Tiantong1-1 is the "Chinese version of maritime satellite," making people can communicate in places such as Gobi, mountains, and sea, where no ground base station signals are covered. The satellite was successfully launched and then is functioning correctly. In order to achieve high gain and high coverage, the Large Deployable Antenna (LDA) with the aperture more than 10 meters is the key payload of the satellite.

The LDA is a complex antenna structure with the most significant technological leapfrogging. It is difficult to realize in engineering. There are many challenges need to be broken through during the development process of LDA, for instance, reliable locking and releasing, reliable deployment and verification, deployment indication, electrical performance realization, in orbit surface accuracy maintenance. Those challenges involve many aspects of the structure, mechanism, material, control and testing and other interdisciplinary problems. We think the three most critical problems during the development of the LDA are: (1) the ability of deployment after entering the orbit, (2) controllability when the coupling vibration of the satellite and (3) good performance of signal receiving and receiving. They are referred to as "reliable deployment, reliable control, and reliable electrical performance" for short. From the mechanical point of view, they are related to three mechanical problems. First, the development process of LDA is a complicated, flexible multi-body dynamics process; and obtaining the deploying process dynamic characteristics requires the use of flexible multi-body dynamics method. Second, the LDA has typical ultra-low modal characteristics and how to accurately track modal information identification to achieve the attitude control of the whole satellite during flying is a typical super low modal structural dynamics problem. Third, the electrical performance of LDA mainly resolved by the surface accuracy and the surface design is a typical statically indeterminate nonlinear tension cable net system pretension optimization design problem.

In this paper, we introduced and summarized the scientific problems and engineering solutions of the above three aspects of the development, the control, and the surface accuracy, based on successful development of LDA.