

Ground-Based Preparatory Activities (11)  
Testing Facilities, Designing and Testing (3)

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RESEARCH ON MODAL TESTING METHOD OF MEMBRANE ANTENNA IN VACUUM  
ENVIRONMENT

**Abstract**

The planar membrane structure has good application prospects in large spacecraft membrane antenna, solar sail and baffle because it has the advantages of low quality and small folding volume. The modal characteristics of planar membrane structure directly decide or to a large extent affect the surface accuracy maintenance and vibration control of the structure. The correctness of modal analysis needs to be verified by ground tests. As the membrane structure is light and flexible, air has an important influence on its modal analysis results, which increases the mass and changes the damping characteristics of the structure. In order to obtain the modal characteristics of planar membrane structure more accurately, it is necessary to carry out modal tests in vacuum environment. In this paper, a modal testing system for the membrane antenna is designed and built, which is suitable for vacuum environment. The system uses special step excitation device composed of electromagnet exciter. In this device, special tooling is designed, through which the excitation point position, excitation displacement and excitation force can be flexibly selected so as to excite the required mode shapes. This step excitation device does not produce any additional mass to the membrane antenna so that the accuracy of modal test results can be ensured. By analyzing and processing the collected signals of two laser vibrometers, the modal frequencies and mode shapes of the membrane antenna in vacuum environment can be obtained. By comparing the theoretical simulation results, the modal test results in atmospheric environment and the test results in this paper, not only the effectiveness and feasibility of the testing system is verified, but also the specific influence of air on the modal test results is analyzed. The research content in this paper lays a solid technical foundation for the product characteristics investigation and design improvement of the membrane antenna, which is of great engineering significance.