Design of flexure support of space compact reflector subassembly and dynamic analysis

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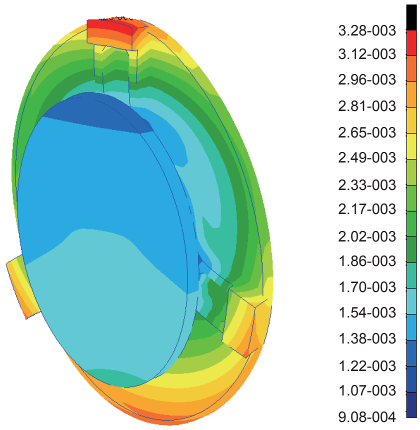

Rigid body displacement nephograrn of reflector subassembly under temperature variation

Overview: The reflector assembly of a telescopic week scan electro-optical tracking and pointing system for a space borne laser communication system is studied. There are many reflection links in the electro-optical tracking and pointing system, so the requirements for the surface figure and dynamic stiffness of the reflector assembly under the operating conditions are high. The surface figure of neck side grooving flexible support, neck side ring grooving flexible support and underside grooving flexible support with the same grooving width resisting microgravity and thermal environment change are contrasted, and the modes of the three flexible support structures are also analyzed, According to practical applications of space load, the structural stiffness advantage and surface figure of the three flexible support scheme have been evaluated. The analysis results show that the surface figure RMS of neck side grooving flexible support scheme resisting microgravity and thermal environment change can reach 2.05 nm and 8.88 nm, the fundamental frequency mode is 926.1 Hz and there is no dense frequency phenomenon in all modes. In the balance between the surface figure RMS and the higher stiffness resisting he vibration damage, the flexible design is most reasonable. On this basis, the parameterized design of the flexible support structure of the reflector is completed. To further verification of the dynamic stiffness of neck side grooving flexible support structure in space vibration environment, frequency response analysis and random vibration analysis of neck side grooving flexible support are have been done. The frequency response analysis results show that the magnification of the acceleration response is 2.86 times, the maximum stress is 96 MPa under the resonance which is less than the tensile strength limit of the material, the safety factor is 5.35; The frequency response analysis results show that the root mean square of the acceleration response of the reflector assembly is 11.14 g RMS, and the RMS of acceleration response is less than 3 times the input satisfying the 3σ criterion. The mean stress response of the flexible support under random vibration is 191 MPa which is also less than the tensile strength limit of the material, and the safety factor is 2.83. Finally the reliability of the stiffness of the flexible support structure is verified by a 0.2 g sinusoidal sweep test. The experimental results show that the primary natural frequency of the reflector components is 904.3 Hz, and the relative error with the modal analysis results is 2.4%, that is, the analysis results are basically accurate and reliable. So the flexible support design of reflector assembly is reliable to meet the requirements of the use.

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