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# INITIAL GEOMETRY CONFIGURATION OPTIMIZATION OF SPACE INFLATABLE MEMBRANE REFLECTOR

**Abstract**

For large deployable inflatable space reflector made by membrane, analysis and control of the shape precision are key technologies. There are five main factors concerned with the shape and precision of membrane reflector, include initial geometry configuration of membrane piecesinflation pressureboundary conditions, material properties, cutting pattern and manufacture method. Membrane pieces to make inflatable parabolic reflector need to carefully design to guarantee the reflector surface precision under work condition.

In this paper, shape optimization model based on genetic algorithm method is developed to define the initial geometry configuration of reflector membrane pieces, where the effects of inflation pressureboundary conditions, material properties are included. The shape optimization model is integrated by two processes. The first is FEA process, where geometrical nonlinear FEA model is introduced to predict the stress and deformation of membrane reflector surface under specified boundary condition, the input and output variables are respectively initial geometry configuration data and reflector surface shape error. The second process is a developed optimization code based on genetic algorithm, where the input variable is surface error which carried out from the analysis process, and through optimization code a series of new initial geometry configuration data is calculated. Then, the new initial geometry configuration data from optimization code is introduced to update the analysis process, after the cycling iteration, the optimized initial geometry configuration data is obtained, which can be made the membrane reflector close to designed surface shape under specified work condition.

For verification the optimization method and results, a 6m diameter inflatable membrane parabolic reflector model made by Kapton HN membrane is developed. The reflector surface shape is tested by non-contact photographic measurement. Boundary tension force is also measured. Test results are presented to compare with predicted results from FEA and optimization process. As is shown from the comparison, the FEA analysis result is correct and the surface precision can be obviously improved with this optimization method. The optimization method and result can be applied to adjust and control the surface shape precision of inflatable membrane parabolic reflector.