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光电工程

空间光学遥感器主反射镜轻量化及支撑设计

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摘要 为了得到某空间光学遥感器主反射镜合理的结构及支撑方式，检验新型光学材料SiC的光学性能，尤其是应用于空间光学系统的可行性，通过建立该空间光学遥感器主反射镜组件的虚拟样机，采用有限元仿真的方法，分析主反射镜在背部采取不同形式轻量化情况下的质量及质心位置。建立几种主反射镜的有限元模型，采用合理的MPC约束边界条件，用有限元方法分析主反射镜在加工、测试状态下自身重力作用对反射面面形精度的影响。经过仿真比较及轻量化优化设计，得到一种主反射镜及支撑的合理化结构，轻量化率达到75.6%，反射镜面RMS值为12.53nm，Pv值为54.52nm。最后的分析结果表明：质量、刚度及反射镜面精度均满足工程要求。

关键词 主反射镜 轻量化 有限元法 MPC
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Design and analysis of lightweight structure and support for primary mirror of space optic remote sensor

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Abstract In order to achieve a proper structure and support for the primary mirror used in the space optic remote sensor and test the optical performance of a new optic material (SiC), 3D solid models were built for the primary mirror subassemblies. The mass and the center-of-mass of the primary mirror are analyzed for the different lightweight structures used on the backside of the mirror with the finite-element simulation method. Several finite-element models of the primary mirror were built with appropriate MPC boundary constraint. The effect of the mirror weight on its surface form accuracy during the fabrication and testing process is analyzed with finite-element method. The optimal structure for the mirror and its support were achieved through the comparison of simulation results and optimized lightweight design. The optimized weight reaches 75.6% of the original value, the RMS of the mirror surface is 12.53nm and the Pv value is 54.52nm. The result shows that the weight, stiffness and surface accuracy of the primary mirror meet the engineering requirement.

Key words primary mirror lightweight finite-element method MPC

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