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# 离轴三反空间相机主三镜共基准一体化结构

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# Integrated primary and tertiary mirror components from common base line of off-axis TMA space camera

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摘要 图/表 参考文献 相关文章 (15)

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**摘要** 针对采用离轴三反(TMA)光学系统的空间相机中光学系统主镜和三镜的轴向位置接近的特点,提出了主三镜共基准一体化结构来提高光机结构的精度和稳定性.利用一块高刚度、高度轻量化整体背板替代分离的主镜和三镜背板,以实现主镜和三镜光学加工、检测和装调的基准统一.由于此整体背板同时也是主框架的组成部分, 故降低了结构整体重量,提升了光机结构动/静态刚度.对采用主三镜共基准一体化结构的空间相机进行干涉检测,结果表明主镜和三镜的各视场镜面面形最大分别为0.024λ和0.013λ,均满足光学公差要求.对铝结构样机进行了多入多出(MIMO)自由模态测试,测得一阶模态频率为48 Hz,对应原理样机一阶约束模态频率114 Hz,满足结构刚度要求.在离子束光学精加工过程中,通过分时对主镜和三镜进行加工,省去了主镜和三镜分离结构加工用的散热时间,加工效率提高了约50%.主、三镜共基准一体化结构的应用提高了离轴TMA空间相机的性能和光学精加工效率,为高分辨力宽视场空间相机的光机结构设计提供了参考.

**关键词** : 离轴三反空间相机, 主镜, 三镜, 共基准, 一体化结构, 干涉检测, 模态测试, 离子束加工

**Abstract** : As axial locations of two mirrors in a space camera with off-axis Three Mirror Anastigmatic(TMA) optical system are closed, this paper proposes a integrated structure combined primary and tertiary mirrors to improve the precision and stability of the opto-mechanical structure. A high-stiffness and ultra-lightweighted integrated support plate was applied as the replacement of separated primary and tertiary mirror support plates to achieve the unification of optical machining, detection and adjustment base lines. The integrated support plate was also a constituent part of the main support frame, so that the entire weight was reduced and the dynamic/static stiffness of the opto-mechanical structure was enhanced. The interference detection of the space camera with the integrated structure was performed. The results indicate that maximum surface shapes of primary mirror and tertiary mirror are 0.024λ (rms) and 0.013λ(rms), respectively, and both meet optical tolerance requirement. The MIMO(multi-input multi-output)free modal test was performed for an aluminum structure prototype, and the results show that the first mode is 48 Hz, which corresponds to the first constrained mode of 114 Hz for the principle prototype and meets the structural stiffness requirement. During ion beam fine optical machining process, the time sharing was used to machine the primary mirror and the tertiary mirror, and the machining efficiency is improved by about 50% for omitting the heat dissipation time. It concludes that the application of integrated structure for primary mirror and tertiary mirror improves the performance and optical machining efficiency of the space camera, and provides a reference for opto-mechanical structure design of high resolution and wide field of view space cameras.

**Key words** : off-axis Three Mirror Anastigmatic(TMA) space camera primary mirror tertiary mirror common base line integrated structure interference detection modal test ion beam machining

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