

本期目录 | 下期目录 | 过刊浏览 | 高级检索

[打印本页] [关闭]

微纳技术与精密机械

静止轨道对地观测光学系统外遮光罩设计

钱婧,董德平,孙胜利

中国科学院上海技术物理研究所

摘要：研究了午夜前后阳光照射对静止轨道三轴稳定对地观测光学系统的系统成像和系统热稳定性的影响。根据光学系统在静止轨道运行时的受照特点，分析了直射入光学系统的太阳光能量，推导出由外遮光罩高度，形状及不同太阳倾斜角确定的无量纲数阳光抑制比K，用以描述外遮光罩对视场外直射阳光的抑制能力并指导各种形状外遮光罩的高度设计。用Monte-Carlo方法编制通用程序计算了各种轮廓形状在不同太阳倾斜角下的抑制比K。在实例设计中取春秋分K=0.5作为设计依据，外遮光罩的高度为底部轮廓东西轴长的1.8倍，此时阳光由遮光罩底部轮廓进入光学系统的时间为3 h，设计结果满足卫星载荷尺寸要求。

关键词：静止轨道 对地观测光学系统 外遮光罩 阳光抑制比 Monte-Carlo方法

Design of outer baffle of earth observation optical system on geostationary orbit

QIAN Jing, DONG De-ping, SUN Sheng-li

Shanghai Institute of Technical Physics, Chinese Academy of Sciences

Abstract: The affects of direct sunlights before and after midnights on the imaging quality and thermal stability of an earth observation optical system on geostationary satellite in space were investigated. According to the characteristics of solar heat flux on the geostationary orbit, the energy density of direct sunlight projecting to the optical system was analyzed and a dimensionless parameter named sunlight inhibitory ratio determined by outer baffle's height, shape dimension and sun inclination was deduced. It was used to describe the inhibitory ability of outer baffle in the optical system for the direct sunlight and also used as a design principle for the height of outer baffle. The program based on Monte-Carlo method was compiled to solve the sunlight inhibitory ratio of different shape outer baffles in different sun inclination scenarios. In a real design, the sunlight inhibitory ratio was selected to be 0.5 at equinox and the final outer baffle height is about 1.8 times of the east-west axis length of the outer baffle's bottom side. This way, the incidence sunlight in the optical system from the baffle is three hours. The result satisfies the dimension requirements of satellite payloads.

Keywords: geostationary earth observation optical system outer baffle sunlight inhibitory ratio Monte-Carlo method

收稿日期 2012-10-17 修回日期 2012-12-24 网络版发布日期 2013-03-20

基金项目:

武器装备预研基金项目

通讯作者: 钱婧

作者简介: 钱婧(1982-), 女, 福建建瓯人, 博士研究生, 助理研究员, 主要从事空间遥感仪器热控技术方面的研究。

作者Email: hitqj@163.com

参考文献:

- [1] KARSTEN S, SUMITA C, KURT G, et al.. Design and manufacture of a lightweight reflective baffle for the BepiColombo laser altimeter [J]. Optical Engineering, 2007, 46(4): 043003-1-11.
- [2] PIERFRANCESCO B, FABIO P. Baffling system for the Wide Angle Camera (WAC) of ROSETTA mission [J]. SPIE, 2000, 4093, 79-88.
- [3] FEINBERG L, COHEN L, DEAN B, et al.. Space telescope design considerations [J]. Optical Engineering, 2012, 51(1): 011006-2-9.
- [4] 杨林, 李达, 崔天刚, 等. 空间太阳望远镜在紫外波段成像检测中的杂散光测量和消除 [J]. 光学精密工程, 2011, 19(7): 1456-1463.
- [5] YANG L, LI D, CUI T G, et al.. Measurement and elimination of stray light from space solar telescopes for imaging test at UV band [J]. Opt. Precision Eng., 2011, 19(7): 1456-1463. (in Chinese)
- [6] 蒋范明, 陈凡胜. 地球同步轨道随动可展开遮光罩技术研究 [J]. 红外技术, 2012, 34(2): 73-77.
- [7] JIANG F M, CHEN F SH. Deployable and rotatable baffle servo system for remote sensor in space [J]. Infrared Technology, 2012, 34(2): 73-77. (in Chinese)
- [8] 邹刚毅, 樊学武. 离轴三反射望远镜遮光罩设计与杂光分析 [J]. 光子学报, 2009, 38(3): 605-609.
- [9] ZOU G Y, FAN X W. Baffle design and stray light analysis of the off-axis three-mirror telescope [J]. Acta Photonica Sinica, 2009, 38(3): 605-609. (in Chinese)
- [10] 廖志波, 伏锐敏, 宗肖颖. 星敏感器反射式遮光罩的设计 [J]. 红外与激光工程, 2011, 40(1): 66-69.
- [11] LIAO ZH B, FU R M, ZONG X Y. Design of specular baffle of star sensor [J]. Infrared and Laser Engineering, 2011, 40(1): 66-69. (in Chinese)
- [12] 颜昌翔, 许杰, 彭岩. 离轴三反空间光学望远系统的杂散光抑制 [J]. 光学精密工程, 2010, 18(2): 289-293.
- [13] YAN C X, XU J, PENG Y. Stray light suppression of three-mirror off-axis space optical telescope [J]. Opt. Precision Eng., 2010, 18(2): 289-293. (in Chinese)
- [14] 贾学智, 金光, 张雷. 空间相机外遮光罩结构与优化 [J]. 光学精密工程, 2008, 16(8): 1560-1565.
- [15] JIA X ZH, JIN G, ZHANG L. Design and optimization of lightweight outer baffle for space camera [J]. Opt. Precision Eng., 2008, 16(8): 1456-1463. (in Chinese)
- [16] DU B L, LI L, HUANG Y F. Stray light analysis of an on-axis three-reflection space optical system [J]. Chinese Optics Letters, 2010, 8(6): 569-572.
- [17] EDWARD S. Thermal design of retro-reflective stray light fore-baffles for space-borne optical systems [J]. SPIE, 2001, 4198, 82-95.
- [18] GOES I-M DataBook. National Aeronautics and Space Administration Goddard Space Flight Center [M]. Goddard Space Flight Center, 1996.
- [19] 游思梁, 王淦泉, 陈桂林. 基于Matlab的FY-4星载扫描辐射计午夜太阳入侵模拟 [J]. 上海航天, 2006, 23(5): 1-2.
- [20] YOU S L, WANG G Q, CHEN G L. Midnight solar intrusion simulation of imager in FY-4 Satellite based on matlab [J].

Aerospace Shanghai, 2006, 23(5): 1-2. (in Chinese) [14]游思梁. 太阳辐射对地球同步卫星扫描成像辐射计性能的影响[J]. 红外, 2006,27(9): 39-43. YOU S L. Effect of solar radiation on performance of scanning imaging radiometer on board geostationary satellite [J]. Infrared, 2006,27(9): 39-43. (in Chinese) [15]叶荣,尹球,匡定波,等. FY-4大气垂直探测仪扫描镜的太阳入侵研究[J]. 红外与毫米波学报, 2011,30(5): 433-437. YE R, YIN Q, KUANG D B, et al.. Effect of solar intrusion on scanning mirror of atmosphere vertical sounder onboard the FY-4 geostationary satellite [J]. Journal of Infrared and Millimeter Waves, 2011,30(5): 433-437. (in Chinese)

本刊中的类似文章

1. 陶小平 罗霄 薛栋林.地球静止轨道面阵凝视成像系统分时积分抑振技术[J]. 光学精密工程, 2013,21(8): 2169-2179
2. 贾学志,金光,张雷.空间相机外遮光罩结构设计优化[J]. 光学精密工程, 2008,16(8): 1560-1566
3. 赵立新.阳光直射对外遮光罩辐射加热的分析与计算[J]. 光学精密工程, 1997,5(1): 28-34
4. 赵立新.阳光直射对外遮光罩辐射加热的分析与计算[J]. 光学精密工程, 1997,5(1): 28-34
5. 赵立新.空间光学传感器外遮光罩的地球反照辐射的随机模拟计算[J]. 光学精密工程, 1996,4(4): 16-22

Copyright by 光学精密工程