应用光学 2009, 30(5) 853-858 DOI: ISSN: 1002-2082 CN: 61-1171/O4

论文

非制冷长波红外热像仪折衍混合双视场光学系统设计

白瑜[1,2];杨建峰[1];薛彬[1];阮萍[1];马小龙[1];田海霞[3];王楠茜[4]

1.中国科学院西安光学精密机械研究所，陕西西安710119；2.中国科学院研究生院，北京100039；
3.中国空空导弹研究院，河南洛阳471009；4.西安应用光学研究所，陕西西安710065

摘要：

根据衍射光学元件具有大的负向色散特性，将衍射光学元件应用于红外双视场光学系统中，根据傅里叶光学分析衍射光学元件(DOE)的消色差，列表对比折射透镜与衍射光学透镜的特性，并给出变倍比为4:1可用作非制冷红外热像仪的光学系统的具体设计实例。系统采用切入式变焦方式，在短焦时切入2片透镜实现宽视场，通过引入二元面和非球面提高了成像质量。设计结果表明：在空间频率11lp/mm处，短焦距40mm时，各个视场的MTF值均大于0.6；长焦距160mm时，各个视场的MTF值均大于0.7，宽视场和窄视场都具有较好的成像质量。

关键词： 红外光学系统；光学设计；双视场

Design of refractive/diffractive dual FOV optical system for uncooled LWIR thermal imager

BAI Yu[1,2]; YANG Jian-feng[1]; XUE Bin[1]; RUAN Ping[1]; MA Xiao-long[1]; TIAN Hai-xia[3]; WANG Nan-xi[4]

1. Xi'an Institute of Optics and Precision Mechanics, CAS, Xi'an 710119, China;
2. Graduate School of CAS, Beijing 100039, China;
3. China Airborne Missile Academy, Luoyang 471009, China;
4. Xi'an Institute of Applied Optics, Xi'an 710065, China

Abstract:

Because of the large negative dispersive characteristic of diffractive optical elements, they are applied to infrared dual-FOV systems. The fundamental principle of chromatic aberration for diffractive optical elements is analyzed according to Fourier optics. The characteristic of refractive lens and diffractive optical lens is compared. A sample design of a optical system with zoom ratio 4∶1 which can be used in uncooled infrared thermal imager is presented. The manner of zoom is accomplished by exchanging two lenses into the wide FOV system configuration. The binary surface and aspheric surface is used to improve the image quality. The design result shows that when spatial frequency is 11lp/mm and the short focus is 40mm, the MTF value of each FOV is bigger then 0.6; when the long focus of 160mm, the MTF value of each FOV is bigger then 0.7; and both the wide-FOV and narrow-FOV have high image quality.

Keywords: infrared optical system optical design dual field of view

收稿日期 修回日期 网络版发布日期

DOI:

基金项目:

通讯作者: 白瑜（1982-），男，山西原平市人，硕士研究生，主要从事光学设计、红外光学和二元光学研究工作。

作者简介:

参考文献：

［1］白瑜，杨建峰，阮萍.长波红外连续变焦光学系统设计［J］.光电技术应用，2008,23(5)：15-17.
BAI Yu,YANG Jian-feng,RUAN Ping.Design of LWIR continuous zoom optical system［J］.Electro-optic Technology Application, 2008，23(5)：15-17.(in Chinese with an English abstract)
［2］田海霞，杨建峰，马小龙. 可见光变焦距电视光学系统设计［J］.光子学报，2008,37(9)：1797-1799.
TIAN Hai-xia, YANG Jian-feng,MA Xiao-long.Design for visible video zoom optical system［J］. Acta

Photonica Sinica, 2008,37(9)：1797-1799. (in Chinese with an English abstract)
［3］任德清，RAUSCHER B J.红外双视场透镜系统的光学设计［J］.红外技术,1998,20（3）:19-22.
REN De-qin,RAUSCHER B J.The optical design of infrared dual field lenses［J］.Infrared Technology,1998，20（3）：19-22. (in Chinese with an English abstract)
［4］金国藩，严瑛白，邬敏贤.二元光学［M］.北京：国防工业出版社，1998.
JIN Guo-fan,YAN Ying-bai,WU Min-xian.Binary optics［M］.Beijing:National Defense Inderstry Press,1998.(in Chinese)
［5］王学新，焦明印. 红外光学系统无热化设计方法的研究［J］.应用光学,2009,30(1):129-133.
WANG Xue-xin,JIAO Ming-yin. Athermalization design for infrared optical system［J］.Journal of Applied Optics，2009,30(1):129-133. (in Chinese with an English abstract)
［6］白瑜，杨建峰，马小龙,等.长波红外光学系统无热化设计［J］.红外技术，2008，30(10)：583-585.
BAI Yu,YANG Jian-feng,MA Xiao-long,et al. Athermalization of long-wavwlength infrared optical system［J］. Infrared Technology，2008，30(10)：583-585. (in Chinese with an English abstract)
［7］陈潇，杨建峰，白瑜.长波红外大相对孔径光学系统设计［J］.红外技术，2009,31(4):193-195.
CHEN Xiao, YANG Jian-feng, BAI Yu.Design of a long-wavelength low F/# infrared optical system［J］. Infrared Technology，2009,31(4):193-195. (in Chinese with an English abstract)
［8］白瑜，杨建峰，马小龙,等.8～12μm波段折/衍混合红外连续变焦光学系统［J］.红外技术,2008,30(9):505-508.
BAI Yu,YANG Jian-feng,MA Xiao-long,et al. Diffrative/refractive infrared continous zoom system in 8μm～12μm［J］. Infrared Technology，2008,30(9):505-508. (in Chinese with an English abstract)
［9］孙强.红外折射/衍射光学系统研究［D］.天津：南开大学，2003：30-40.
SUN Qiang.The research of infrared diffrative/refractive optical system［D］.Nankai University, 2003:30-40. (in Chinese)
［10］ZHANG J P,WANG L J,ZHANG X.Design of dual-fov refractive/diffractive LWIR optical system［J］. SPIE,2007,6722:1117-1122.

本刊中的类似文章

文章评论 (请注意:本站实行文责自负, 请不要发表与学术无关的内容!评论内容不代表本站观点.)

反馈人		邮箱地址	
反馈标题		验证码	3588