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## 论文

### 20×非制冷型红外变焦光学系统设计

刘峰<sup>1</sup>,徐熙平<sup>1,2</sup>,段洁<sup>1,2</sup>,孙向阳<sup>1</sup>,任宇芬<sup>3</sup>

(1 长春理工大学 光电工程学院 航天技术研究所,长春 130022)

(2 长春理工大学 吉林省光电测控仪器工程技术研究中心,长春 130022)

(3 郑州轻工业学院 技术与物理系,郑州 450002)

#### 摘要:

针对长波用160×120元非制冷焦平面阵列探测器,设计了8~12 μm波段折射式红外连续变焦光学系统.该系统具有相对孔径大,F数为1.1,变倍比高,变焦凸轮曲线平滑等特点.系统使用锗和硫化锌两种普通红外材料,通过引入非球面校正系统轴外像差,在中焦时采用平滑换根提高了变倍比,通过对凸轮曲线的优化设计,有效地控制了变焦过程中光轴漂移.系统在空间频率为17 lp/mm处,全焦距范围内调制传递函数均在0.55以上,接近衍射极限|系统在接收半径为17.5 μm的探测器敏感元内,能量集中度大于78%,表明该系统具有良好的成像质量.

关键词: 光学设计 连续变焦 动态光学 像移补偿

### Design of 20× | Uncooled Thermal Infrared Continuous-zoom Lenses

LIU Feng<sup>1</sup>, XU Xi-ping<sup>1,2</sup>, DUAN Jie<sup>1,2</sup>, SUN Xiang-yang<sup>1</sup>, REN Yu-fen<sup>3</sup>

(1 Institute of Aerospace Technology, College of Optoelectronic Engineering, Changchun University of Science and Technology, Changchun 130022, China)

(2 Research Center of Opto-electrical Measurement and Control Instrument Engineering, Changchun University of Science and Technology, Changchun

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### 本文作者相关文章

刘峰

徐熙平

段洁

孙向阳

任宇芬

130022, China)

(3 Department of Technology and  
Physics, Zhengzhou University of Light  
Industry, Zhengzhou 450002, China)

Abstract:

8~12  $\mu\text{m}$  infrared (IR) hybrid refractive continuous zoom lenses are designed, based on long-wave 160 $\times$ 120 element uncooled thermal IR focal plane arrays (FPA) detector. The continuous zoom system has a large relative aperture, the  $F\#=1.1$ , high zoom ratio, smooth curve of zoom. Two common infrared materials of Ge and ZnS are used in this optical system. To correct off axis aberration, aspheric surface is accepted, zoom ratio can be improved by solving compensated curves at the middle equivalent focal length, and the optimum design of cam curve has brought the optical axis drift under control in the process of zoom. The modulation transfer function (MTF) is above 0.55 in all focal lengths at the spatial frequency of 17 lp/mm and approaches the diffraction limit. The energy permeance ratio is greater than 78% within the detector sensor limits smaller than 17.5 $\mu\text{m}$ , which shows that the optical system has good imaging quality.

Keywords: Optical design Continuous-zoom  
Dynamic optical theory Image shifting  
Compensation

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