

## 光学系统弥散斑参数的测试

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## Measurement of defocused spot parameters of optical system

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摘要

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**摘要** 采用CCD显微成像系统对光学系统弥散斑参数进行定量测量,并设计了弥散斑参数的评价算法。首先,给出了弥散斑参数的定义,分析了弥散斑所形成的能量等高线构成的闭合的连通区域,对占总能量80%的区域计算其弥散斑直径。然后,对该区域的边界点进行椭圆拟合,得到弥散斑圆度。提出的方法通过对光学系统在像平面所成的星点像的能量分布的分析,在弥散斑圆度测试中引入了椭圆拟合,减少了CCD噪声和测试环境中的杂光等随机因素对测试结果的影响,提高了测试结果的置信度。实验结果显示:弥散斑直径测试重复性为0.18 μm,弥散斑圆度测试重复性为1.65%。提出的方法实现了弥散斑参数的定量测试,满足航天项目中光学系统成像质量控制要求。

**关键词**: 光学系统, 弥散斑参数, CCD显微测量系统, 能量等高线, 区域填充, 椭圆拟合

**Abstract**: Defocused spot parameters of an optical system were measured by a testing system with CCD microscopic imaging quantitatively, and an evaluating method for the defocused spot parameters was designed. Firstly, the definitions of the defocused spot parameters including the diameter and the roundness were given. The connected region shaped by the energy contour of the defocused spots was analyzed, and the diameter equal to the area which is 80% of the total energy of the defocused spots was calculated. Then, the boundary of the region was fitted as an ellipse and the roundness of defocused spot was obtained. The method introduces the ellipse fit into the defocused spot roundness measurement through analysis of the energy distribution of star point image on image plane, so that the effects of CCD noise and stray light in test environment on the measuring results are reduced and the confidence of the test results is improved. The experimental results show that the repeatability of the diameter is 0.18 μm and that of the roundness is 1.65%. The method meets the needs of the optical systems in space projects for the imaging quality control.

**Key words**: optical system defocused spot parameter CCD microscopic system energy contour region filling ellipse fitting

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