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论文

超高速摄影仪转镜运转可靠性数值与实验分析

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摘要:

为探讨分析转镜运转可靠性的数值方法,运用Monte Carlo理论并结合ANSYS参量化设计语言,根据小样本原理和可靠性理论建立了转镜运转可靠性分析数学模型.对转镜运转可靠性进行了数值分析,并对数值分析结果进行了实验验证.数值分析结果表明:转镜的功能函数值远大于零,最大应力与转镜转速的线性相关系数达0.9,镜体密度的相关系数值为0.15,最大应力、应变、位移的偏斜度和峭度值均为正值,统计结果服从正态分布呈右偏态,在95%的置信度水平下,转镜可靠度为0.999.这说明在理想状态下转镜的运转可靠性满足要求,转镜的最大应力值取决于转镜转速,并且镜体的密度对转镜最大应力有较大影响.转镜运转可靠性试验中没有转镜出现破坏,表明转镜运转可靠性数值分析方法是正确的,为转镜的运转可靠性分析提供一种可行、高效的数值分析手段.

关键词:　超高速摄影仪转镜　运转可靠性分析　Monte Carlo方法　变异系数　转镜可靠性试验

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Numerical and Experimental Analysis on the Operational Reliability of Rotating Mirror for Ultra-high Speed Camera

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Abstract:

In order to explore a new method of calculating the operational reliability of rotating mirror by numerical analysis and experiment,a mathematic model of operational reliability of rotating mirror was established by the ANASYS parameter design language,based on the Monte Carlo method and the small sample theory.The result of numerical analysis shows that the value of performance function is further than the value of zero.The correlation coefficient of the maximum stress and the revolving speed of rotating mirror are 0.9,the correlation coefficient of the mirror body density with that is 0.15 and the skewness and kurtosis of the maximum stress,strain and displacement are positive.Meanwhile,the statistical results of the maximum stress,strain and displacement obey normal distribution and show right skewed state.The sample data is concentration appears around the mean value.In the confidence level of 95%,the reliability of rotating mirror is 0.999 9.It can be concluded that the operational reliability of rotating mirror can meet the performance requirement in theory.The maximum stress of rotating mirror is determined by the operational and the density of the mirror body.None of the ten rotating mirror is damaged in the reliability experiment of rotating mirror.The results obtained in the course of this investigation clearly demonstrate that the numerical analysis of operational reliability for rotating mirror is right,which can prove a new method of analyzing the operational reliability with higher practicable and efficient.

Keywords: Ultra-high speed camera rotating mirror　Operational reliability analysis　Monte Carlo method　Coefficient of variation Reliability experimental

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