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现代应用光学

Shack-Hartmann波前传感器检测大口径圆对称非球面反射镜

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摘要： 针对大口径非球面反射镜在研磨阶段后期其面形与理想面形存在较大偏差,且表面粗糙度较大、反射率较低,采用轮廓仪和普通干涉仪检测无法满足测试要求等问题,提出采用动态范围大且精度高的Shack-Hartmann波前传感器来检测大口径非球面反射镜。研究分析了Shack-Hartmann波前传感器检测系统的原理及系统误差并编写了相应的数据处理软件。为了验证该方法的可行性,对已经加工完成的350 mm口径旋转对称双曲面面形进行了检测,测量得到的面形误差PV值、RMS值分别为0.388λ、0.043λ(λ=632.8 nm);与干涉测量的标准结果进行了对比,得到的面形偏差PV值、RMS值分别为0.014λ和0.001λ。对比结果表明, Shack-Hartmann波前传感器的测量结果正确可靠,从而验证了Shack-Hartmann波前传感器检测大口径非球面反射镜的可行性。

关键词： Shack-Hartmann波前传感器 轮廓仪 非球面反射镜 大口径反射镜 相对测量

Test of rotationally symmetric aspheric surface using Shack-Hartmann wavefront sensor

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Abstract: As the surface shape of a reflection mirror is different from the target shape at the end stage of the grinding process, and the profilometers and common interferometers can not measure the surface error exactly, this paper proposed a method to measure the large aperture aspheric surface by using a Shack-Hartmann Wavefront Sensor (SHWS) with a large dynamic range and high precision. The principle of the measuring system for SHWS was researched, its measuring errors were analyzed and a corresponding data processing software was compiled. Using a simulation reference file, a hyperboloid reflection mirror with a diameter of 350 mm was tested by the SHWS. Results indicate that the PV and RMS of the surface error are 0.388λ and 0.043λ, respectively (λ=632.8 nm). In order to testify the measurement result, the mirror is also measured by an interferometer with a null compensator. Comparing the two testing results, the PV and RMS of the deviation are 0.014λ and 0.001λ, respectively, which proves the feasibility of measuring large aperture aspheric surfaces by SHWSs.

Keywords: Shack-Hartmann wavefront sensor profilometer aspheric mirror large aperture mirror relative measurement

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