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现代应用光学

相移干涉测量中相移误差的自修正

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摘要： 分析了相移干涉测量过程中相移误差产生的原因，研究了基于迭代最小二乘算法的相移误差修正法，实现了任意两幅干涉图间相对移相量的计算和自适应校正。基于光、机、电、算四系统，实现任意步长的3幅以上干涉图像的采集，用迭代最小二乘法计算任意两幅干涉图间的相对移相量，然后将其闭环反馈至硬件相移系统，自动修正相移步长为给定量的特征相移值，从而完成干涉仪相移误差的自修正。 构建了相移误差自校正系统，通过实际干涉测量验证了算法的正确性和相移误差自修正系统的可行性。结果表明，自适应修正后相移量相对误差<5%，面形RMS测量重复性<λ/1 000，实现了高精度、高效率的相移误差自适应修正。

关键词： 相移干涉测量 相移量计算 相移误差 误差自修正

Self-correction of phase step error in phase shifting interferometry measurement

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Abstract: The reasons for the phase shifting errors in a phase shifting interferometric measurement were analyzed, and a method to correct the phase shifting errors was researched based on the least square method. The calculation and correction for the relative phase step amount between arbitrary two interferograms were implemented. With the combination of optical, mechanical, electrical and calculating subsystems, more than three step interferometric images with arbitrary intervals were achieved. Then, the iterative least-square algorithm was used to calculate the relative phase step amount between arbitrary two interferograms. The phase shift error was feedbacked to the hardware system and the phase step interval was corrected in self-adaption until the phase step interval was equal to the characteristic value of the phase shift. A phase shift error correction system based on iterative least-square algorithm was constructed to achieve phase step error self-correction on a phase shifting interferometry. The real measurement of optical surface was conducted to verify the correction of algorithm and the feasibility of phase step error self-correction system. The results show that the relative phase step error is less than 5%， and the root mean square error（RMS） for measurement repeatability of the optical surface is less than λ/1 000 with the help of the proposed phase step self-correction process.

Keywords: phase shifting interferometry phase step calculation phase shift error error self-correction

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