光学精密工程 » 2015, **Vol. 23** » Issue (6): 1587-1597 DOI: 10.3788/OPE.20152306.1587

光学自由曲面研抛机床的综合误差建模与补偿

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Comprehensive error modeling and compensation for optical free-form surface polishing machine tool

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全文: PDF (2360 KB) RICH HTML NEW

输出: BibTeX | EndNote (RIS)

摘要 为提高光学自由曲面的加工精度,本文基于多体系统理论建立了五轴数控研抛机床综合误差模型.采用直接测量方式对各轴的移动误差和转角误差进行重复测量与分析,发现不同进给速度和测量间距对移动误差和转角误差没有显著影响.把误差数据代入综合误差模型中,得出研抛机床综合误差在*x*轴、*y*轴和*z*轴轴向上的移动误差和转角误差分量的变化规律,进而获知线性位移误差是影响综合误差最主要的因素.依据综合误差模型进行补偿实验,补偿后*x*轴、*y*轴和*z*轴的线性位移误差分别下降88%、89%和84%,补偿效果显著.实验结果证明本文所提出的综合误差建模及补偿方法具有较高的精度和较好的鲁棒性.

关键词 : 光学自由曲面, 五轴研抛机床, 多体系统, 综合误差模型, 误差补偿

Abstract : To improve the machining accuracy of an optical free-form surface, an integrated error model for five-axis polishing machine tool was established based on multi-body system theory. The movement error and rotation error of every axis were measured and analyzed by direct and repetitive measurement model, and it shows that the feed speed and measurement spacing have no significant influence on the movement and rotation errors. By taking the error data into the integrated error model, the variation rule of movement and rotation errors which are the components in the three axes of *x*, *y* and *z* from the integrated error of polishing machine tool was obtained. According to the above analysis, the main influence factor of integrated error is linear displacement errors. The compensation experiment was conducted based on integrated error model. The linear displacement errors of the three axes of *x*, *y* and *z* have been compensated obviously and they are decreased by 88%, 89% and 84% respectively. The experiment results indicate that the integrated error model and compensation method have high accuracy and excellent robustness.

Key words : optical free-form surface five-axis polishing machine multi-body system comprehensive error modeling error compensation

收稿日期: 2015-02-14

中图分类号: TQ171.68
TG659

基金资助:国家973重点基础研究发展计划资助项目(No.2011CB706702)

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引用本文:

张恩忠, 赵继, 冀世军, 林洁琼, 李刚. 光学自由曲面研抛机床的综合误差建模与补偿[J]. 光学精密工程, 2015, 23(6): 1587-1597. ZHANG En-zhong, ZHAO Ji, JI Shi-jun, LIN Jie-qiong, LI Gang. Comprehensive error modeling and compensation for optical free-form surface polishing machine tool. Editorial Office of Optics and Precision Engineering, 2015, 23(6): 1587-1597.

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