光学精密工程 » 2016, Vol. 24 » Issue (1): 143-151 DOI: 10.3788/OPE.20162401.0143

电容传感器线性度标定平台

张德福*, 葛川, 李显凌, 倪明阳, 郭抗

中国科学院 长春光学精密机械与物理研究所 应用光学国家重点实验室 超精密光学工程研究中心, 吉林 长春 130033

Linearity calibration platform of capacitive sensors

ZHANG De-fu*, GE Chuan, LI Xian-ling, NI Ming-yang, GUO Kang

Engineering Research Center of Extreme Precision Optics, State Key Laboratory of Applied Optics, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, Changchun 130033, China

摘要 图/表 参考文献(0) 相关文章 (8)

全文: PDF (2564 KB) RICH HTML NEW

输出: BibTeX | EndNote (RIS)

摘要

设计了一种电容位移传感器在线标定平台,用于位移的高精度调节和检测。该平台的运动对称中心轴、测量光路的对称中心轴和传感器的传感轴共轴,故从测量原理上减小了阿贝误差。标定平台具有z/tip/tilt调节功能,保证了传感器的传感面和被测面板的被测面之间的装调对准。介绍了标定平台的组成和标定方法的原理,采用对称平行四边形机构实现了微位移调节,基于柔度矩阵法(CMM)分析了导向机构的输出柔度和行程。试验测得动平台行程为735.162 μm,和有限元法(FEM)、CMM计算结果的误差分别为7.410%和4.633%,满足行程误差要求。经过标定补偿后,传感器的线性度由0.014 21%提高至0.006 231%。实验结果显示,该线性度标定方法精度高,标定后的传感器满足位移精密调节机构使用要求。

关键词 : 电容传感器, 线性度标定, 标定平台, 柔度矩阵

Abstract :

An on-line linearity calibration platform for capacitive displacement sensors is proposed to implement the high-precision adjustment and the measurement of displacement. The symmetry axis for movement, the measuring axis of an interferometer and the measuring axis of a sensor are collinear in the platform, so that the Abbe error is decreased in principle. For the *z*/tip/tilt adjustment function in the platform, the alignment between the sensor and the target surface is realized. The composition and principle of the calibration method are introduced and the micro-displacement is adjusted by a symmetrical parallelogram mechanism. Then, the output compliance and stroke of the guiding mechanism are analyzed based on Compliance Matrix Method(CMM). The experiment result demonstrates that the stroke of the calibration platform is 735.162 μm and the errors are 7.410% and 4.633% comparing with that of the Finite Element Method(FEM) and CMM, respectively, which meet the requirement of the stroke. Moreover, the sensor linearity is improved from 0.014 21% to 0.006 231% after calibration calculation. The linearity calibration method has high-precision and it satisfies the requirement of fine displacement adjustment of the mechanism.

Key words : capacitive sensor linearity calibration calibration platform compliance matrix

收稿日期: 2015-04-03

中图分类号: TP212.12

基金资助:

国家自然科学基金资助项目(No.61504142);国家科技重大专项基金资助项目(No.2009ZX02205)

作者简介: 张德福(1983-),男,吉林长春人,博士,助理研究员,2007年、2012年于哈尔滨工程大学分别获得学士、博士学位,主要从事光学元件位移调节机构设计和精密检测方面的研究。E-mail:zhangdf@sklao.ac.cn;葛川(1985-),男,辽宁丹东人,硕士,助理研究员,2008年、2011年于西安电子科技大学分别获得学士、硕士学位,主要从事微位移检测和精密控制方面的研究。E-mail:gechmail@163.com

引用本文:

张德福, 葛川, 李显凌, 倪明阳, 郭抗. 电容传感器线性度标定平台[J]. 光学精密工程, 2016, 24(1): 143-151. ZHANG De-fu, GE Chuan, LI Xian-ling, NI Ming-yang, GUO Kang. Linearity calibration platform of capacitive sensors. Editorial Office of Optics and Precision Engineering, 2016, 24(1): 143-151.

链接本文:

http://www.eope.net/CN/10.3788/OPE.20162401.0143 或 http://www.eope.net/CN/Y2016/V24/I1/143

服务

把本文推荐给朋友

加入我的书架

加入引用管理器

E-mail Alert

RSS

作者相关文章

张德福

葛川

李显凌

倪明阳

郭抗