

光电信息获取与处理

干涉条纹图像处理的相位解包新方法

万文博;苏俊宏;杨利红;徐均琪

西安工业大学光电工程学院,陕西西安710032

摘要:

干涉图的处理是光干涉计量中的关键技术。采用泰曼-格林型干涉系统,建立被测物与干涉相位之间的数学模型,通过MATLAB软件,实现对被测参数的自动化测量。基于二维快速傅里叶方法的基本原理,提出一种新的相位解包算法——菱形种子算法,通过识别1个种子点,然后依次向相邻4点扩展,再把这4个点作为第二批种子点,依次向各自的4点邻域扩展,以菱形轨迹遍历所有的有效信息点,以到达整幅图像相位解包的目的。采用该算法测量薄膜样片的厚度,测试结果与ZYGO测试结果比较,PV误差为0.0364λ,RMS最大误差为0.003λ,证明该算法虽然处理的是单幅干涉图,但可以得到高精度的相位分布。

关键词: 干涉图 二维快速傅里叶法 相位解包 薄膜测试

APhase unwrapping algorism for image processing of interferogram

WAN Wen-bo;SU Jun-hong;YANG Li-hong;XU Jun-qi

School of Optoelectronics Engineering, Xi'an Technological University, Xi'an 710032, China

Abstract:

Interferogram processing is one of main techniques in optical interferometry metrology. Modern interferometry for thin-film thickness has the advantages of non-contact, high accuracy and great field of view, etc. Taking advantage of Twyman-Green interferometer, the relationship between interferogram and measured object parameter can be determined by mathematical model, thus the thickness of measured object is measured automatically. A new algorism of phase unwrapping for measuring the material object is proposed based on the FFT method, an algorism of diamond phase unwrapping. This algorism identifies a seed point, seed points spread to four points nearby the fist seed point, the four points will serve as the second group of seed points, these seed points will spread to four points nearby the second group of seed points in turn and pass through all of the effective information points by a diamond path. Seed points will eventually bring about the phase unwrapping in the entire image. In this paper, the thin-film thickness is determined by the method, setting the results of this method against results from ZYGO, the PV error and RMS maximum error are 0.0364λ and 0.002λ respectively. Although single interferogram was processed in this study, a phase distribution with high accuracy was achieved.

Keywords: interferogram 2-D FFT phase unwrapping measurement of thin-film thickness

收稿日期 修回日期 网络版发布日期

DOI:

基金项目:

通讯作者: 万文博(1983-), 男, 陕西西安人, 硕士研究生, 主要从事光学检测及仪器设计方面的研究。

作者简介:

作者Email: wwbohpe@eyou.com

参考文献:

[1] 帅高龙,苏俊宏,杨利红,等.基于FFT的薄膜厚度干涉测量新方法 [J].光学与光电技术, 2009,7(1):55-57. SHUAI Gao-long,SU Jun-hong,YANG Li-hong,et al.Interferometric measurement method of thin film thickness based on FFT [J]. Optics and Optoelectronic Technology,2009,7(1):55-57. (in Chinese with an English abstract) [2] 石一磊,苏俊宏,杨利红,等.基于相位偏移干涉术的薄膜厚度测量方法 [J].应用光学, 2009,30(1):76-83. SHI Yi-lei,SU Jun-hong,YANG Li-hong,et al.Measuring thin-film thickness with phase-shift interferometry [J]. Journal of Applied Optics,2009,30(1):76-83. (in Chinese with an English abstract) [3] 葛锦蔓,苏俊宏.干涉图处理技术在膜厚测量中的应用 [J].红外与激光工程, 2009,38(S):213-

扩展功能

本文信息

- ▶ Supporting info
- ▶ PDF(2015KB)
- ▶ [HTML全文]
- ▶ 参考文献[PDF]
- ▶ 参考文献

服务与反馈

- ▶ 把本文推荐给朋友
- ▶ 加入我的书架
- ▶ 加入引用管理器
- ▶ 引用本文
- ▶ Email Alert
- ▶ 文章反馈
- ▶ 浏览反馈信息

本文关键词相关文章

- ▶ 干涉图
- ▶ 二维快速傅里叶法
- ▶ 相位解包
- ▶ 薄膜测试

本文作者相关文章

PubMed

216. GE Jin-man, SU Jun-hong. Measurement application of thin film thickness for image processing of interferogram [J]. *Infrared and Laser Engineering*, 2009, 38(S): 213-216. (in Chinese with an English abstract) [4] 葛锦蔓, 苏俊宏. 薄膜厚度测量的干涉图处理技术 [J]. *中国激光*, 2009, 36(2): 1-5. GE Jin-man, SU Jun-hong. Interferometric processing technology of thin film thickness [J]. *Chinese Journal of Lasers*, 2009, 36(2): 1-5. (in Chinese with an English abstract) [5] CARBALLO G F, FIEGUTH P W. Probabilistic cost functions for network flow phase unwrapping [J]. *IEEE Trans. Geosci. Remote Sens.*, 2000, 38(5): 2192-2201. [6] 刘保伟. InSAR最小二乘相位解缠算法 [J]. *空间电子技术*, 2008, 1(12): 17-22. LIU Bao-wei. InSAR phase unwrapping algorithm [J]. *Space Electronic Technology*, 2008, 1(12): 17-22. (in Chinese with an English abstract) [7] 黄柏圣, 许家栋. 基于短时傅里叶变换的干涉相位解缠方法 [J]. *现代雷达*, 2009(9): 55-58. HUANG Bai-sheng, XU Jia-dong. InSAR phase unwrapping algorithm based on two-dimensional windowed Fourier transform [J]. *Modern Radar*, 2009(9): 55-58. (in Chinese with an English abstract) [8] 何勇, 朱日宏, 陈磊. 基于区域生长理论的波面解包算法研究 [J]. *光学技术*, 2006(4): 594-597. HE Yong, ZHU Ri-hong, CHEN Lei. Research of wave unwrapping algorithm based on the region growing theory [J]. *Optical Technique*, 2006(4): 594-597. (in Chinese with an English abstract) [9] 葛锦蔓. 干涉法测量膜厚及干涉图处理技术研究 [D]. 西安: 西安工业大学, 2010. GE Jin-man. Test measurement technology and instruments [D]. Xi'an: Xi'an Technological University, 2010. (in Chinese)(下转第178页)

本刊中的类似文章

1. 石一磊; 苏俊宏; 杨利红; 徐均琪. 基于相位偏移干涉术的薄膜厚度测量方法[J]. *应用光学*, 2009, 30(1): 76-79
2. 刘勺斌; 杨洪波. 一种用于光机热集成分析的新方法——干涉图插值法[J]. *应用光学*, 2007, 28(5): 553-558
3. 葛锦蔓, 苏俊宏. 干涉图的预处理技术研究[J]. *应用光学*, 2009, 30(6): 992-995
4. 张跃国, 张记龙, 王志斌, 田二明, 李晓, 王相如. Wollaston棱镜阵列中子棱镜结构角误差分析[J]. *应用光学*, 2011, 32(1): 80-84

---

Copyright by 应用光学