

## 论文

### 液体对微振动的放大效应

苗润才, 王文成, 许佳婷, 谢甜

陕西师范大学 物理学与信息技术学院, 西安 710062

#### 摘要:

根据表面波声光效应的原理, 实验上建立了固体表面微振动的激光衍射测量系统. 当激光斜入射到微振动引起的液体表面波上, 观察到了清晰、反衬度非常高的衍射图样. 利用MATLAB软件对拍摄的衍射图样进行扫描, 得到了衍射光斑的光强分布图, 并根据衍射图样宽度与表面波振幅的解析关系式, 求出了液体表面波的振幅, 其大小在微米量级. 改变样品池中液体的深度, 测得不同深度下液体表面波的振幅, 给出了表面波振幅与液体深度之间的解析关系, 并发现了液体对微振动的放大效应. 利用液体对微振动的放大效应, 求出了固体表面微振动的振幅, 实现了固体表面微振动的探测.

关键词: 微振动 振动放大 衍射 液体深度

## Amplification Effect of Micro Vibration in Water

MIAO Run-cai, WANG Wen-cheng, XU Jia-ting, XIE Tian

Institute of Physics and Information Technology, Shaanxi Normal University, Xi'an 710062, China

#### Abstract:

According to the acousto-optic effect, a measurement system of the vibration in the solid surface was built by laser diffraction. When the laser beam illuminated obliquely to the liquid surface wave caused by the vibration, the clear and very high diffraction pattern was observed. The diffraction pattern was scanned by use of MATLAB software. The light intensity distribution of the diffraction pattern was received. Based on the analytical relationship between the diffraction pattern width and the amplitude of the surface wave, the amplitude was obtained. And its size was in microns category. When the depth of the sample pool was changed, the surface wave amplitude was given. The relationship between liquid depth and the amplitude was provided. And the amplification effect concerning the vibration of the liquid was found. Then the vibration amplitude in the solid surface was got. Therefore the micro vibration in the solid surface was achieved.

Keywords: Micro vibrations Vibration large Diffraction Liquid depth

收稿日期 2012-04-09 修回日期 2012-06-01 网络版发布日期

DOI: 10.3788/gzxb20124110.1205





#### 基金项目:

陕西省重大科技创新专项资金(No.2010ZKC01-18)和陕西省自然科学基金(No.2010JM1003)资助

通讯作者: 王文成(1984-), 男, 硕士研究生, 主要研究方向为液体表面波的光学检测. Email: wangwencheng2012@163.com

#### 作者简介:

#### 参考文献:

- [1] MIAO Run-cai, YANG Zong-li, ZHU Jing-tao. Visualization of low-frequency liquid surface acoustic waves by means of optical diffraction[J]. Applied Physics Letters, 2002, 80(17): 3033-3035. 
- [2] BARTER J D. Surface strain modulation of insoluble surface film properties[J]. Physics of Fluids, 1994, 6(8): 2606-2612. 
- [3] KLIPSTEIN W M, RADNICH J S, LAMOREAUX S K. Thermally excited liquid surface waves and their study through the quasielastic scattering of light[J]. American Journal of Physics, 1996, 64(6): 758-765. 
- [4] BARTER J D. Imaging surface-wave analyzer for liquid surfaces [J]. Applied Optics, 1997, 36(12): 2630-2635. 

## 扩展功能

### 本文信息

- ▶ Supporting info
- ▶ PDF(1468KB)
- ▶ HTML
- ▶ 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

- ▶ 微振动
- ▶ 振动放大
- ▶ 衍射
- ▶ 液体深度

### 本文作者相关文章

- ▶ 苗润才
- ▶ 王文成
- ▶ 许佳婷
- ▶ 谢甜

- [5] MIAO Run-cai, Li Fang-ju, DONG Jun. Diffraction effect of thin laser beam from liquid surface waves at low-frequency[J]. Acta Photonica Sinica, 2007, 36(5): 877-880. 苗润才, 李芳菊, 董军. 低频声表面波对细激光束的衍射效应[J]. 光子学报, 2007, 36(5): 877-880.
- [6] WEISBUCH G, GARBAY F. Light scattering by surface tension waves[J]. American Journal of Physics, 1979, 47(4): 355-356. [crossref](#)
- [7] MIAO Run-cai, LUO Dao-bin, ZHU Fen, et al. Characters of laser diffraction fringes from liquid surface waves at low-frequency[J]. Acta Photonica Sinica, 2007, 36(11): 2134-2137. 苗润才, 罗道斌, 朱峰, 等. 低频液体表面波激光衍射条纹的特征[J]. 光子学报, 2007, 36(11): 2134-2137.
- [8] MIAO Run-cai, YANG Zong-li. Physical properties of liquid surface wave and its optical diffraction [J]. Acta Physica Sinica, 1996, 45(9): 1521-1525. 苗润才, 杨宗立. 液体表面波物理特性及其光学效应的研究 [J]. 物理学报, 1996, 45(9): 1521-1525.
- [9] MIAO Run-cai, SHI Jian, ZHAO Xiao-feng. Determination of the attenuation coefficient of surface acoustic wave by means of the light interference[J]. Acta Photonica Sinica, 2005, 34(3): 382-385. 苗润才, 时坚, 赵晓凤. 干涉法测量低频表面波的衰减系数[J]. 光子学报, 2005, 34(3): 382-385.
- [10] LEE P Y, BARTER J D, BEACH K L, et al. Recent advance in ocean-surface characterization by a scanning-laser slope gauge. San Diego: Society of Photo-optical Instrumentation Engineers, 1992, 7(92): 234-244.
- [11] HAYIR A. Ocean depth effects on tsunami amplitudes used in source models in linearized shallow-water wave theory[J]. Ocean Engineering, 2004, 31(3): 353-361. [crossref](#)
- [12] TODOROVSKA M I, TRIFUNAC M D. Generation of tsunamis by a slowly spreading uplift of the sea floor[J]. Soil Dynamics and Earthquake Engineering, 2001, 21(2): 151-167. [crossref](#)
- [13] TODOROVSKA M I, HAYIR A, TRIFUNAC M D. A note on tsunami amplitudes above submarine slides and slumps[J]. Soil Dynamics and Earthquake Engineering, 2002, 22(2): 129-141. [crossref](#)
- [14] TRIFUNAC M D, HAYIR A, TODOROVSKA M I. A note on the effects of nonuniform spreading velocity of submarine slumps and slides on the near-field tsunami amplitudes[J]. Soil Dynamics and Earthquake Engineering, 2002, 22(3): 167-180. [crossref](#)
- [15] BELZONS M, GUAZZELLI E, PARODI O. Gravity waves on a rough bottom: experimental evidence of one-dimensional localization [J]. Journal of Fluid Mechanics, 1988, 186(1): 539-558. [crossref](#)
- [16] JEONG T S, KIM J E, PARK H Y. Experimental measurement of water wave band gaps[J]. Applied Physics Letters, 2004, 85(9): 1645. [crossref](#)
- [17] MIAO Run-cai, ZHAO Xiao-feng, SHI Jian. Modulated interference of reflected light from liquid wave at tens Hertz frequencies[J]. Optics Communications, 2006, 259(2): 592-597. [crossref](#)

#### 本刊中的类似文章

1. 杨静 werone09.锥形光栅衍射特性分析[J]. 光子学报, 0,0(0): 0-0
2. 石天真,张耀举.聚焦光在单轴晶体中的感应磁化[J]. 光子学报, 2011,40(4): 565-568
3. 汪敏;胡小方;伍小平;袁清习;黄万霞;朱佩平.同步辐射X射线衍射增强CT方法研究[J]. 光子学报, 2006,35(10): 1597-1601
4. 颜树华.

#### 加权杨-顾算法研究

[J]. 光子学报, 2007,36(3): 530-535

5. 王爱荣;翟凤潇;王素莲;黄明举.新型双染料敏化的宽带光聚物全息特性研究[J]. 光子学报, 2006,35(2): 244-247
6. 李建龙;傅克祥;朱建华;张丽娟;曾阳素.用光栅的正负一级能量之比测体积相位全息光栅参量[J]. 光子学报, 2006,35(2): 239-243
7. 邹其徽;吕百达.等衍射长度超短脉冲贝塞耳-高斯光束的传输特性[J]. 光子学报, 2006,35(5): 746-749
8. 王刚;王石语;蔡德芳;文建国;过振.声光调Q衍射效率对脉宽压缩的影响研究[J]. 光子学报, 2006,35(1): 13-15
9. 苗润才 李芳菊 董军 祁建霞.低频声表面波对细激光束的衍射效应[J]. 光子学报, 2007,36(5): 877-880
10. 肖勇 唐道广 陈珂 成建群 黄明举.紫光至红光敏感的多波长复用全息存储材料[J]. 光子学报, 2009,38(3): 630-635
11. 王建永;李庆武;赵长青.旋转体时域有限差分法的另一推导方法和单向波方程吸收边界条件[J]. 光子学报, 2007,36(1): 148-151
12. 张洁;黄尚廉;闫许;伍艺;张智海.反射镜平动式光栅光调制器的光学特性分析[J]. 光子学报, 2006,35(6): 824-827
13. 马延琴 杜惊雷 陈铭勇 .大面积拼接光栅的远场衍射分析[J]. 光子学报, 2007,36(4): 742-745
14. 翟凤潇;王素莲;殷琼;李若平;路海;孙彩霞;黄明举<sup>2, \*\*</sup>.一种核黄素敏化的宽带全息记录材料[J]. 光子学报, 2007,36(3): 498-502
15. 任秀云 蔡春伟 王翥 国承山.横向剪切干涉法共路测量LCSLM的相位调制特性[J]. 光子学报, 2007,36(5):

文章评论 (请注意:本站实行文责自负, 请不要发表与学术无关的内容!评论内容不代表本站观点.)

反馈人	<input type="text"/>	邮箱地址	<input type="text"/>
反馈标题	<input type="text"/>	验证码	<input type="text"/> 6106
反馈内容	<input type="text"/>		