

论文

水下低频声信号的激光探测及波的衰减

苗润才, 王玉明, 孟峰, 马静

陕西师范大学 物理学与信息技术学院, 西安 710062

摘要:

为了探测几十赫兹的低频水下声信号,建立了水下低频声信号的光学探测系统,得到了稳定、清晰的衍射图样.得到了衍射图样的宽度与声源距离的变化关系,声源距离越小,衍射图样越宽.当水下声波传至水表面后,实验上得到了表面声波的衰减特性,理论上得到了衍射图样的角宽度和液体表面波振幅的解析关系式.发现表面波振幅的衰减随距离是指数型衰减.并研究了衰减系数随频率的变化,频率不同衰减系数也不同,而且频率越大,衰减系数越小.

关键词: 水下声源 低频波 液体表面 衰减系数

Detection of Underwater Low-frequency Acoustic Signal and Wave Attenuation

MIAO Run-cai, WANG Yu-ming, MENG Feng, MA Jing

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

Abstract:

A simple measurement system is developed to study the optical effect of the low-frequency liquid surface wave which excited by underwater acoustic source. The high stability and clear diffraction pattern was observed experimentally. The relationship between diffraction patterns divergence angle and the distance of the acoustic signal was derived. Furthermore, with the increase of distance, the diffraction patterns divergence angle will decrease. The damping characters of the liquid surface wave was theoretically obtained when underwater acoustic wave spread to the liquid surface. The analytical expression between diffraction patterns divergence angle and the liquid surface wave amplitude was theoretically derived. It was found that the surface wave amplitude is exponent attenuation with the change of the horizontal distance. The attenuation coefficients is dependent on the frequency of liquid surface acoustic wave, and the greater frequency, the smaller attenuation coefficient.

Keywords: Underwater acoustic source Low-frequency wave Liquid surface Attenuation coefficient

收稿日期 2012-11-27 修回日期 2013-01-15 网络版发布日期

DOI: 10.3788/gzxb20134204.0432

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: 王玉明(1987-),男,硕士研究生,主要研究方向为低频水下声信号的光学探测. Email: wangyumingx@126.com

作者简介:

参考文献:

- [1] ZHANG Ya-ni, MIAO Run-cai. The detection of surface acoustic wave by laser and its new ideas [J]. *Laser Journal*, 2006, 27(2): 6-8. 张亚妮, 苗润才. 表面波的激光检测技术 [J]. *激光杂志*, 2006, 27(2): 6-8.

扩展功能

本文信息

- ▶ Supporting info
- ▶ [PDF\(1672KB\)](#)
- ▶ [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

- ▶ 水下声源
- ▶ 低频波
- ▶ 液体表面
- ▶ 衰减系数

本文作者相关文章

[2] DEVOLDER S, WEVERS M, de MEESTER D. Thin layer thickness measurements based on the acoustic-optic technique

[J]. *Applied Physics Letter*, 1996, 68(12): 1732-1734.

[3] BRIER R, LEROY O, DEVOLDER S. Surface roughness determination using the acoustic-optic technique: theory and experiment

[J]. *Applied Physics Letter*, 1997, 75(5): 599-601.

[4] YAMANAKA K, CHO H. Precise velocity measurement of surface acoustic wave on bearing ball

[J]. *Applied Physics Letter*, 2000, 76(19): 2797-2799.

[5] WEISBCH, GARBAY F. Light scattering by surface tension waves

[J]. *American Journal of Physics*, 1979, 47(4): 355-356.

[6] BARTER J D, LEE PHY. Real-time wave amplitude spectrum analyzer for air-liquid interfaces

[J]. *Applied Physics Letter*, 1994, 64(15): 1896-1898.

[7] 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.


[8] MIAO Run-cai, YANG Zong-li, ZHU Jing-tao, *et al.* Visualization of low-frequency liquid surface acoustic waves by means of optical diffraction

[J]. *Applied Physics Letter*, 2002, 80(17): 3033-3035.

[9] DONG Jun, QI Jian-xia, MIAO Run-cai. Measurement of the damping of liquid surface wave by diffraction

[J]. *American Journal of Physics*, 2007, 37(3B): 1129-1133.

[10] ZHU Feng, MIAO Run-cai, XU Chun-long, *et al.* Measurement of the dispersion relation of capillary waves by laser diffraction

[J]. *American Journal of Physics*, 2007, 75(10): 896-898. 

[11] MIAO Run-cai, SHI Jian, ZHAO Xiao-feng. Determination of the attenuation coefficient of surface acoustic wave by means of light interference

[J]. *Acta Photonica Sinica*, 2005, 34(3): 382-385. 苗润才,时坚,赵晓凤.干涉法测量低频液体表面波的衰减系数

[J]. *光子学报*, 2005, 34(3): 382-385.

[12] LUO Dao-bin, MIAO Run-cai, LIU Xiang-lian, *et al.* Study on diffraction and damping characteristics of low frequency liquid surface waves

[J]. *Laser Technology*, 2007, 31(6): 584-586. 罗道斌,苗润才,刘香莲,等.低频液体表面波的光衍射及衰减特性的研究

[J]. *激光技术*, 2007, 31(6): 584-586.

[13] LEE M S, BOURGEOIS B S, HSIEH S T, *et al.* A laser sensing scheme for detection of underwater acoustic signals

[J]. *IEEE Conference Publications*, 1988: 253-257.

[14] ANTONELLI L T, FLETCHER A. BLACKMON. Experimental detection and reception performance for uplink underwater acoustic communication using a remote, in-air, acoustic-

[15] LAGUTION J P, CHUNIN B A, CHUNIN S A. Research of dispersion of laser radiation in the water environment

[J]. *Information Optics*, 2010, 19(1): 50-53.

本刊中的类似文章

1. 苗润才, 2; 时坚2; 赵晓凤2. 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
2. 张翹. 高光谱水体吸收-衰减测量仪AC-S数据处理技术[J]. *光子学报*, 2010, 39(sup1): 59-63
3. 王春林, 伍剑, 林金桐. 双外腔反射半导体激光器中低频波动的研究[J]. *光子学报*, 2003, 32(8): 917-920
4. 苗润才, 朱京涛, 杨宗立. 液体表面的遮光效应及其应用[J]. *光子学报*, 2002, 31(4): 489-491
5. 程树英, 黄见洪, 林文雄, 张戈, 黄祥金, 黄呈辉, 沈鸿元. 用直接法测量血液的衰减系数 μ_t 存在的问题[J]. *光子学报*, 2001, 30(9): 1045-1049
6. 孙晶华, 孙秋华, 崔三烈, 阮顺龄. 改善水下影象衬度方法的研究[J]. *光子学报*, 1996, 25(11): 1003-1007
7. 夏涛, 李小兵, 郭江涛, 张睿, 茅昕. 光纤分布式测温系统中基于迭代法的高准确度温度解调算法[J]. *光子学报*, 2012, 41(7): 831-835

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" value="9397"/>
反馈内容	<input type="text"/>		

Copyright 2008 by 光子学报