　　　　　　　　　　　　　　　　　　　　　　　　　　[打印本页]　[关闭]

论文

光束在尾流气泡中传输的复散射效应

孙春生[1,2],张晓晖[1],朱东华[1]

（1 海军工程大学 兵器工程系,武汉 430033）
（2 国防科技大学 光电科学与工程学院| 长沙 410073）

摘要：

为了了解光束在尾流气泡中的传输特性，为前向光尾流的探测提供理论依据，研究了光束在尾流中传输时传播方向上和横截面方向上的辐射强度分布特性.基于辐射传输方程的小角度近似解，得到了探测截面上的约化强度和漫射强度的表达式，其中漫射强度表征了复散射的强弱|针对典型的尾流气泡分布，通过数值计算分析了光束传输方向上的约化强度和漫射强度与接收视场角、光学厚度和光束大小的关系，也计算分析了光束横截面方向上的辐射强度随光束大小和横向距离的变化关系.结果表明，光束在尾流气泡中传输时复散射效应明显，且复散射的强弱与接收视场角、光束直径、光学厚度和横向距离密切相关.

关键词： 复散射　辐射传输方程　尾流　气泡

Multiple Scattering of Laser Beam Propagating in Ship Wakes

SUN Chun-sheng[1,2],ZHANG Xiao-hui[2]|ZHU Dong-hua[2]

(1 Department of Weaponry Engineering.,Naval University of Engineering,Wuhan 430033,China）
（2 College of Optoelectronic Science and Technology,National University of Defence Technology,Changsha 410073,China）

Abstract:

Intensity distributing characters on the axis of Gaussian beam propagating in ship wakes and on the cross-section vertical to the beam axis are investigated to understand the transferring property of laser beam in wakes and to provide the theoretic basis for detecting ship wakes by forward light beam attenuation.Based on the solution of the radiation transfer equation in the narrow angle approximation,the formulations for radiation intensity,which is divided into un-scattered intensity and scattered intensity denoting the extent of multiple scattering,detected by received section are derived.Given a typical bubbles' distributing function,numerical computations and analysis are given for the un-scattered intensity and scattered intensity on the beam axis relating to detector's view of field,optical depth,and beam size| similarly the numerical results are also presented for the radiation intensity on the cross-section vertical to the beam axis relating to transverse distance and beam size.The results show that the multiple scattering coming from laser beam propagating in ship wakes is obvious,and the extent of multiple scattering has a close connection with view of field,beam size,optical depth,and transverse distance.

Keywords: Multiple scattering　Radiative transfer equation　Wakes　Bubbles

通讯作者：孙春生

作者简介：

参考文献：

[1] TREVORROW M V,VAGE S,FARMER D M.Acoustical measurements of microbubbles within ship wakes［J］.J Acoust Soc Am,1994,95(4):1922-1930.

［2］PELTZER R D,GARRETT W D,SMITH P M.A remote sensing study of surface ship wake［J］.Int J Remote Sens,1987,8(3):689-704.

［3］ZHANG X,LEWIS M,BISSETT W P,et al.Optical influence of ship wakes［J］.Appl Opt,2004,43(15): 3122-3132.

［4］SU Li-ping,REN De-ming,QU Yan-chen,et al.Study of scattering properties by ship wakes［J］.Laser Journal,2007,28(1): 70-71.
苏丽萍,任德明,曲彦臣,等.舰船尾流散射特性的研究［J］.激光杂志,2007,28(1): 70-71.

［5］MINER E W,GRIFFIN O M,SKOP R A.Near-surface bubble motions in sea water［R］.NRL-MR-5756,1986.

［6］ZHANG X,LEWIS M,LEE M,et al.Volume scattering function of natural bubble populations［J］.Limnol Oceanogr,2002,47(5): 1273-1282.

［7］JI Yan-jun,MA Xiang,HE Jun-hua,et al.The influence of bubble on the transmitting of light in wake ［J］.Acta Photonica Sinica,2004,33(5): 626-628.
纪延俊,马祥,何俊华,等.尾流中气泡对光传播的影响［J］.光子学报,2004,33(5): 626-628.

［8］XIANG Jian-sheng,HE Jun-hua,CHEN Min,et al.Study of character of the forward scattered light of bubbles based on Mie's light scatteing theory［J］.Acta Photonica Sinica,2007,36(11): 2111-2114.
项建胜,何俊华,陈敏,等.基于Mie光散射理论的尾流气泡前向散射光特性研究［J］.光子学报,2007,36(11): 2111-2114.

［9］ISHIMARU A.Wave propagation and scattering in random media［M］.HUANG Run-heng,ZHOU Shi-jian,transl.Beijing:Science Press,1986.
石丸 A.随机介质中波的传播和散射［M］.黄润恒，周诗健，译.北京：科学出版社，1986.

［10］SUN Chun-sheng,ZHANG Xiao-hui,ZHU Dong-hua.Energy distributing properties of light scattered by ship far wakes［J］.Acta Optica Sinaca,2008,28(10):2006-2009.
孙春生,张晓晖,朱东华.舰船远程尾流的散射光能量分布特性［J］.光学学报,2008,28(10):2006-2009.

［11］FANTE R L.Propagation of electromagnetic waves through turbulent plasma using transport theory ［J］.IEEE Trans Antennas Propag,1973,21(9): 750-755.

［12］ZARDECKI A,DEEPAK A.Forward multiple scattering corrections as a function of detector field of view［J］.Appl Opt,1983,22(19): 2970-2976.

［13］BOHREN C F,HUFFMAN D R.Absorption and scattering of light by small particles［M］.New York:Wiley,1983.

［14］TREVORROW M V.Boundary scattering limitation of fish detection in shallow waters［J］.Fisheries Research,1998,35: 127-135.

［15］JI Bang-jie,LIU Ji-fang,DENG Zhong-fang.Optimized Guassian Fitting Algorithm for scattered light's spatial spectrum intensity distribution of wake bubbles based on theory of wavelets［J］.Acta Photonica Sinica,2007,36(10): 1520-1524.
冀邦杰，刘继芳，邓仲芳.基于小波分析的气泡光散射空间谱强度分布的高斯拟和算法优化［J］.光子学报,2007,36(10): 1520-1524.

本刊中的类似文章

1．袁军行 陈良益.尾流的全息成像方法研究 [J]. 光子学报, 2009,38(3): 636-640

2．张建生;林书玉;苗润才;杨万民.

小波分析在气泡幕散射光信号处理中的应用

[J]. 光子学报, 2007,36(3): 557-564

3．邓仲芳;刘继芳;李增荣.利用后向散射光空间谱强度分布探测尾流气泡的实验研究[J]. 光子学报, 2006,35(8): 1216-1220

4．李增荣;刘继芳;邓仲芳.尾流后向散射光功率衰减特性研究[J]. 光子学报, 2006,35(9): 1417-1420

5．张建生;何俊华;冀邦杰;陈良益.尾流光学信号的处理方法[J]. 光子学报, 2005,34(8): 1274-1277

6．赵晓飞;何俊华;韦明智;陈良益.一种基于图像处理技术获取尾流特性的新方法[J]. 光子学报, 2006,35(3): 443-446

7．陈敏;何俊华;纪延俊;阎亚东;陈良益.基于互相关的气泡速度的测量方法研究[J]. 光子学报, 2005,34(8): 1253-1256

8．纪延俊;何俊华;郑黎;陈良益.应用短时Fourier变换对尾流光学信号分析[J]. 光子学报, 2004,33(12): 1533-1536

9．纪延俊;何俊华;董晓娜;郑黎;陈良益.尾流气泡幕散射光的性质[J]. 光子学报, 2004,33(8): 1018-1020

10．纪延俊;马祥;何俊华;郑黎;陈良益.尾流中气泡对光传播的影响[J]. 光子学报, 2004,33(5): 626-628

11．李建民 宋元军 王蕴芬 王增波 杨富 李崇香 冯浩 孟旭东.动态气泡直径的远场干涉测量方法[J]. 光子学报, 2008,37(6): 1229-1232

12．孙春生,张晓晖,朱东华.气泡数密度对尾流光束衰减测量的影响[J]. 光子学报, 2009,38(6): 1516-1519

13．顾建农 张志宏 张晓晖.舰船远场尾流气泡分布特性的数值模拟[J]. 光子学报, 2007,36(8): 1504-1509

14．冀邦杰 刘继芳 邓仲芳.基于小波分析的气泡光散射空间谱强度分布的高斯拟合算法优化[J]. 光子学报,

2007,36(8): 1520-1524

15．陈敏 何俊华 陈良益 .互相关测速的误差综合分析[J]. 光子学报, 2007,36(10): 1914-1919

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		邮箱地址	
反馈标题		验证码	1562