应用光学 2007 28 (3): 245-249 ISSN: 1002-2082 CN: 61-1171/O4

光电工程

尾流散射光性质的一维小波变换分析

张建生[1,2],林书玉[1],苗润才[1],杨万民[1]

1. 陕西师范大学物理系, 西安 710062; 2. 西安工业大学数理系, 西安 710032

收稿日期 修回日期 网络版发布日期 2007-5-10 接受日期

摘要 船舶尾流具有特殊的声学、电学、磁学和光学特性。选用一维小波变换含离散小波变换、连续小波变换、小波包变换、复小波变换对测量的尾流光学性质进行了分析，其结果表明：不同条件下尾流散射光信号具有不同的自动阈值，经小波变换后保留的能量比例、小波系数置零比率不同，变换的小波系数染色模式、系数曲线、最大系数线区别明显。一维连续小波变换显示出细节信号具有一定周期性，说明在测量过程存在周期性的干扰因素。通过小波分解的各层细节信号，为在测量结果中消除或降低这些因素的影响指明了方向。一维连续小波变换结果显示，在不同压强下小波系数大小及分布、极大值分布都有明显区别。一维小波包变换的压缩信号保留了原始信号绝大部分的能量，选择的系数可作为不同压强下尾流气泡幕的特征系数，而一维复小波变换变换的模、模角以及系数随时间轴的分布，其相对大小都不相同。经小波分析，可以提取出散射光信号的共性，也可以直观地展示不同散射光信号的区别。

关键词 小波变换 尾流 气泡幕 光学信号

分类号 0439-34

One-dimensional wavelet transformation analysis on specialty of scattered light from ship wakes

ZHANG Jian-sheng[1,2],LIN Shu-yu[1],MIAO Run-cai[1],YANG Wan-min[1]

1. Physics Department, Shaanxi Normal University, Xi'an 710062, China;
2. Math-Physical Department, Xi'an Technological University, Xi'an710032, China

Abstract Ship wakes have special acoustic, electromagnetic and optical characteristics. One dimensional wavelet transformations, including dispersive wavelet, continuous wavelet, wavelet packet and complex continuous wavelet transformations, are used to analyze the scattered optical specialty of ship wakes (SOSSW). SOSSW under different conditions have distinct auto thresholds, different retained energy and zero setting ratio of the wavelet coefficient. The coloration modes, coefficient curves, and local maximal coefficient lines vary distinctly. The one dimensional disperse wavelet transformation reveals that the detailed signal holds particular periodicity. The analysis of the wavelet detailed semaphore demonstrates the way to eliminate or decrease the effects of these factors. Wavelet coefficients, its distributions and maximal lines differentiate obviously under different pressures according to the one dimensional continuous wavelet transformation. The compression signal of the one dimensional wavelet packet transformation retains the major energy of the original signal. The selected coefficients can act as a characteristic coefficient of the wake bubble curtain under different pressures. The relative magnitude of the mode, mode angle and coefficient distribution along time axis differ from each other based on the one dimensional complex continuous wavelet transformation. The common characteristics of the scattered light signal can be extracted and the difference of various scattered light signals can be directly observed through wavelet analysis, which is useful in wake identification.

Key words wavelet transformation wake bubble curtain optical signal

DOI:

通讯作者 张建生 zhangjsh@mail.xait.edu.cn