

## 论文

### 单幅条纹图相位解调的小波分析方法

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摘要:

相位解调是条纹相位分析的关键问题. 本文提出一种应用小波频率估计联合频率导数对变形条纹进行瞬时频率分析, 从中提取参考基频, 从而依靠单一变形条纹实现相位解调的方法. 首先, 理论上证明了当变形条纹瞬时频率空间导数等于零, 该空间点的瞬时频率等于参考基频频率; 其次, 引入Gabor小波提取变形条纹的瞬时频率空间分布, 利用变形条纹瞬时频率的空间导数分布识别提取参考基频, 从而实现相位解调. 利用该方法进行了三维形貌测量的实验, 结果表明该方法在实现相位解调中效果良好.

关键词: 光学测量 条纹传感 小波变换 瞬时频率估计 频率导数 相位解调

## Phase Demodulation Using a Single Deformed Fringe Pattern by Wavelet Analysis

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Abstract:

To realize phase demodulation using a single deformed fringe pattern in 3D fringe sensing, a method is proposed. In the method, instantaneous frequency estimation of wavelet transform is applied to the deformed fringe pattern, and derivative frequency is used to directly extract the fundamental spectrum of the original fringe pattern from the instantaneous spectrum of its deformed fringe pattern. Firstly, theoretical analysis shows that if the instantaneous frequency at a certain position of the deformed fringe pattern is equal to the fundamental frequency of its original fringe pattern, the derivative frequency at such position is zero. Secondly, the instantaneous spectrum of the deformed fringe pattern is experimentally estimated by Gabor wavelet transform. Finally, the fundamental spectrum of the original fringe pattern is identified and obtained from the above instantaneous spectrum. It means that a single deformed fringe pattern is enough to realize phase demodulation. Experimental results of 3D shape measurement show the good effect of the proposed method in phase modulation.

Keywords: Optical measurement Fringe sensing Gabor wavelet transform Instantaneous frequency estimation Derivative frequency Phase demodulation

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