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信息科学

无零级衍射分量的高带宽离轴数字全息

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摘要: 提出了一种消除零级衍射分量对离轴数字全息影响的方法以提高离轴数字全息的有效空间带宽。该方法在大的物参光强比记录条件下, 用预先记录的参考光强对全息图进行归一化, 并做对数变换和一维离散希尔伯特变换去除零级衍射分量。然后, 通过指数变换恢复出物波光场, 从而实现无零级衍射分量的高带宽离轴数字全息。从理论上对方法原理进行了分析, 给出了基于有限脉冲响应的一维离散希尔伯特变换算法。最后, 通过实验对本文方法进行了验证, 并讨论了光强比对零级衍射分量抑制效果的影响。结果表明, 无论零级与一级衍射谱是否发生混叠, 当参考光强度比物光强度大5倍以上时, 采用本文方法均可以有效去除零级衍射分量的影响。

关键词: 傅里叶光学 离轴数字全息 零级衍射 对数变换 希尔伯特变换

High bandwidth off-axial digital holography without zero-order diffraction term

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Abstract: A recording method to suppress the zero-order diffraction term in an off-axial digital hologram and to improve its effective bandwidth is proposed. The method records the hologram on the condition that the reference intensity is more stronger than that of the object. Then, the recorded hologram is normalized by the recorded reference intensity beforehand. The natural logarithm operation and Hilbert transform are applied to the normal hologram to suppress the zero-order diffraction and the object complex field is recovered by an exponential operation. The theory of the method is analyzed. It shows that the logarithm operation can suppress the zero-order term and the Hilbert transform can filter the desired term. Finally, the experiments are performed to validate the method. The results show that the method can suppress the zero-order diffraction term efficiently even in the case of the strong spectral overlap between the zero-order term and the diffraction orders. The influence of the intensity ratio of the light of reference to that of object on the suppression efficient of zero-order diffraction term is analyzed. It shows that the zero-order term can be efficiently suppressed through the proposed method when the intensity ratio is above 5.

Keywords: Fourier optics off-axial digital holography zero-order diffraction logarithm operation Hilbert transform

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