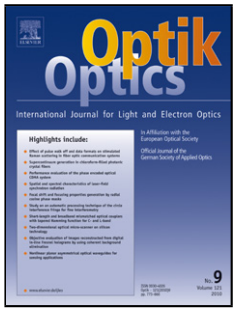

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Author: Peizhen Qiu

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<AT>The feasibility of automatic focusing in digital holography by using Fresnel transform as numerical holographic reconstruction algorithm

<AU>Peizhen Qiu* ##Email##qiupeizhen@126.com##/Email##
<AU>
<AFF>School of Science, Huzhou University, Huzhou 313000, China

Abstract Several automatic focusing approaches have been proposed in the past to compute the refocus distance in digital holography (DH) and digital holographic microscopy (DHM). Most of the automatic focusing approaches are in combination with the convolution or angular spectrum method as numerical reconstruction algorithms for digital hologram. Relatively little work has been done on the combination of detecting the focus distance by automatic focusing approaches with Fresnel transform based method for digital holographic reconstruction. In this letter, the feasibility and application of the Fresnel transform based method to perform a digital holographic reconstruction in automatic focusing in DH are studied. The numerical simulation and experimental results are given. The results validate that the Fresnel transform based reconstruction algorithm can also be effectively applied to automatic focusing in DH and DHM.
<KWD>Keywords: digital holography; Fresnel transform; automatic focusing.
<H1>1 Introduction

Digital holography (DH) permits the recording and numerical reconstruction of the object wave in both amplitude and phase [1-3]. In recent years, DH has been rapidly developed and widely applied in many fields, such as shape measurement [4,5], microscopy [6-8], particle detection[9,10], living cell tracking [11], encryption [12] and object recognition [13].

One of the most appealing aspects in DH is numerical focusing from a signal hologram, providing an automatic approach to retrieve the focus distance without mechanical realignment [14]. Many approaches have been proposed to detect refocus distance in DH, which are based on amplitude analysis[15], intensity gradient[16], Fresnelet-sparsity criterion [17], sparsity measurement[18], two off-axis illumination beams[19], correlation coefficient method[20], weighted spectral analysis[21], spectral l_1 norms [22] and so on[23-25].

However, most of the proposed automatic focusing approaches are in combination with convolution or angular spectrum method as numerical reconstruction algorithms for digital hologram reconstruction. i.e, firstly, a sequence of reconstructed images of the recorded object corresponding to different reconstruction distances is obtained by using convolution or angular spectrum method. And then, the one with the best image quality which corresponds to the optimal reconstruction distance is selected by using a certain focus criterion. In contrast to the Fresnel transform method, the use of convolution or angular spectrum reconstruction method provide significant advantages in holographic reconstruction and focusing. They maintains the pixel resolution of the reconstructed image, preserve a constant image scale [26,27]. Therefore, most of literatures on the