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Kinoform Optimisation Using Gerchberg- Saxton Iterative Algorithm

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Abstract : Computer Generated Holography (CGH) is employed to create digitally defined coherent wavefronts. A CGH can be created by using different techniques such as by using a detour-phase technique or by direct phase modulation to create a kinoform. The detour-phase technique was one of the first techniques that was used to generate holograms digitally. The disadvantage of this technique is that the reconstructed image often has poor quality due to the limited dynamic range it is possible to record using a medium with reasonable spatial resolution.. The kinoform (phase-only hologram) is an alternative technique. In this method, the phase of the original wavefront is recorded but the amplitude is constrained to be constant. The original object does not need to exist physically and so the kinoform can be used to reconstruct an almost arbitrary wavefront. However, the image reconstructed by this technique contains high levels of noise and is not identical to the reference image. To improve the reconstruction quality of the kinoform, iterative techniques such as the Gerchberg-Saxton algorithm (GS) are employed. In this paper the GS algorithm is described for the optimisation of a kinoform used for the reconstruction of a complex wavefront. Iterations of the GS algorithm are applied to determine the phase at a plane (with known amplitude distribution which is often taken as uniform), that satisfies given phase and amplitude constraints in a corresponding Fourier plane. The GS algorithm can be used in this way to enhance the reconstruction quality of the kinoform. Different images are employed as the reference object and their kinoform is synthesised using the GS algorithm. The quality of the reconstructed images is quantified to demonstrate the enhanced reconstruction quality achieved by using this method.

Keywords : computer generated holography, digital holography, Gerchberg-Saxton algorithm, kinoform
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