Representation and synthesis of computer-generated holograms

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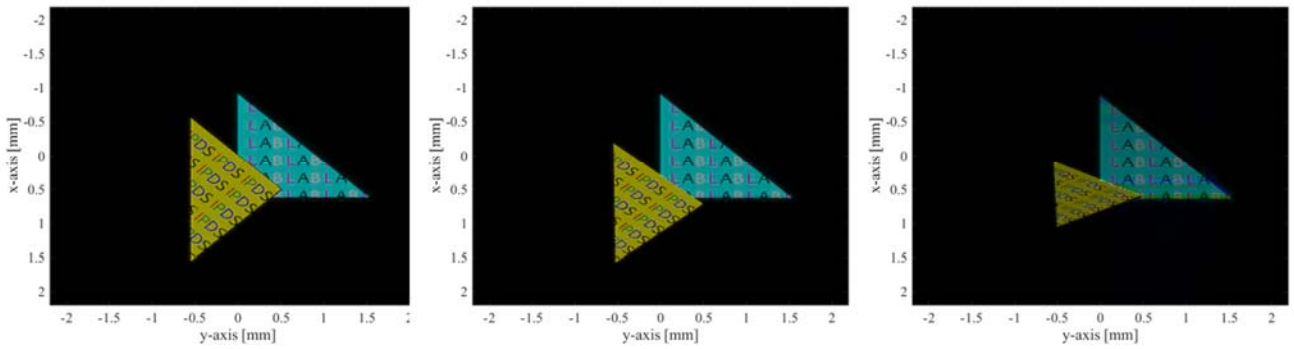
The comptuational algorithm of polygon computer-generated holograms (CGHs) is overviewed based on our recent research results[1-3] and several issues related to computational algorithms are discussed. The issues are categorized into the representaton theory of three-dimensional objects with various surface textures and the efficient algorithm for the calculation of the field representation. In this talk, the texturing, backgroud insersion, and occlusion process of the polygon CGH represetation are described. In particular, the mathematical formulation of exact occlusion expression is addressed and its numerical computation results are visualized and compared. In Fig. 1, the change in numerical reconstruction results of the proposed method with a variation in the tilt angle of the front triangle is shown. We changed tilt angle of the front triangle from 0 degree to 60 degree in Fig. 1(a)-(c). In comparison with the conventional projective occlusion method, their difference would be stark when the front triangle is slanted sharply. The approximate projective occlusion algorthm is faster and more efficient than the exact occlusion method.



(a) (b) (c)

Fig. 1. Change of numerical reconstruction of the proposed method by tilt angle of the front triangle (a) 0 degree (b) 30 degree (c) 60 degree

In the polygon CGH, the phase regularization is also an interesting problem. Without phase regularization, the dark line defects are observed in the boundaries of elementray triangular facets. The physical origin and algorithmic treatment for this problem are discussed.

On the ohter hand, the fast calculation of the CGH, even though it is approximate, is desirable if the fast approximate calculation does not significantly deteriorate the holographic image quality. Our own research results realted to this problem is introduced. The first is the reconfiguration algorithm of bandlimited wide-viewing angle CGH that is targeted to model CGH for different observation positions and the second is the accelerated fast CGH calculation exploting the sparisity property of the polygon CGH.

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References

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