

Fast Generation Method for Computer-Generated Hologram Animation with Hidden Surface Removal Using Ray Tracing Method.

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1. Introduction

A computer-generated hologram(CGH) is an ideal three-dimensional(3D) display technology. CGHs are calculated by simulating wave propagation from 3D objects using a computer.

In CGH, hidden surface removal is essential to display realistic 3D images. The calculation method of CGH using ray tracing method provides various rendering techniques including the hidden surface removal[1]. In this method, a hologram plane is divided into elementary holograms to realize continuous parallax. However it takes huge time to calculate CGH fringe patterns. Therefore, reduction of computational complexity is required to calculate CGH animation with many frames. In this paper, a fast calculation algorithm of hidden surface removal for CGH animation using ray tracing method is proposed.

2. Proposed Method

CGH animation scenes consist static and moving objects. However, conventional method[1] calculates light waves from all of the objects whether moving or not.

In this proposed method, wave propagation from static and moving objects is calculated independently. The light waves from the static objects are called Base-frame. To realize the hidden surface removal, light waves from the moving objects are added to the Base-frame and light waves from hidden surface are subtracted in each animation frame. Light waves on a hologram plane u_1 are calculated by

$$u_1 = u_0 + \sum_{i=1}^N S_i - \sum_{i=1}^N B_i, \quad (1)$$

where u_0 represents the light waves of Base frame, N is the number of the point light sources of moving objects, S_i is light waves from moving objects, and B_i is light waves from hidden surface of S_i (Fig.1). By using this method, computational complexity is able to be reduced.

In this algorithm, so as to determine whether calculates or not, depth value of all static and moving objects is compared. After this process, the foremost point light source in each ray is determined and the light wave calculated from the point is added to u_0 . Thereby, appropriate hidden surface removal is able to be performed.

3. Experiment

To confirm the hidden surface removal, the animation with many frames was calculated using the scene arranged a

moving blue plane surface and static orange sphere in front of a static checker-board. To verify reconstructed images, the full-color electro-holographic display was used[2]. These reconstructed images are Fig.2. It turned out that the blue plane surface hid the checker-board. Moreover, to conduct this experiment, the calculation speed of 90-frames CGH animation became about 9-times as fast as the conventional method. Consequently, appropriate hidden surface removal and reduction of calculation time was confirmed.

4. Conclusion

In this paper, the fast calculation algorithm of hidden surface removal in animation using ray tracing method was proposed. The experiment by the proposed method showed that hidden surface removal about the moving plane surface was conducted correctly and proved effective in the fast calculation for CGH animation. In future, there is meaning in reducing calculation time in terms of making CGH animation.

References

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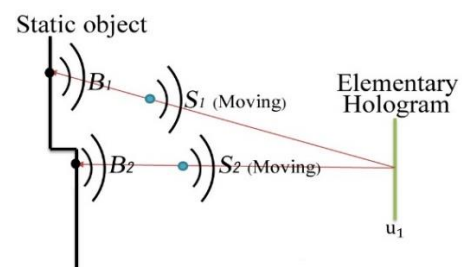


Fig.1 Calculation algorithm



Fig.2 Optical reconstructed image