

## Efficient generation of hologram news ticker using N-LUT method

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**Keywords :** 3D Display, Computer generated holography, Look-up table, News ticker

### Abstract

*In this paper, a new method to efficiently generate the holographic news ticker in holographic 3DTV or 3-D movies using N-LUT method is proposed. The proposed method is largely consisted of five steps: construction of the LUT for each character, extraction of characters in news ticker, generation and shift of the CGH pattern for news ticker using the LUT, composition of hologram pattern for 3-D video and news ticker and reconstruct the holographic 3D video with news ticker. From some simulation results confirmed the feasibility of the proposed method in fast generation of CGH patterns for holographic news ticker.*

### 1. Introduction

Recently, a lot of research works are actively being done on three-dimensional (3-D) imaging and display due to its high interests throughout the world [1-4]. Among them, the holographic method has been particularly regarded as one of the most attractive approaches for creating the most authentic illusion of observing volumetric objects. It is because the holographic technology can supply very high-quality images and accurate depth cues viewed by human eyes without any special observation devices [5-9].

There are two kinds of holographic 3-D imaging and display methods: optical holography and digital holography. In the optical holography, holograms of the real 3-D objects are optically recorded from wave interferences between the two intense laser beams with a high degree of coherence between them in a dark room. Therefore, this system must be kept to be very stable since even a very slight movement can destroy the interference fringes, in which both intensity and phase information of the 3-D objects are contained.

Another approach is the digital holography known as a computer-generated hologram (CGH) [5-7]. A CGH can be generated by computing the interference pattern produced by the object and reference beams by

using a computer simulation model of wave optics. Using this CGH pattern, an electro-holographic 3-D display system can be constructed.

So far, some approaches for generation of CGH patterns have been suggested. One of them is the ray-tracing method. However, this method has been suffered from the computational complexity, because it requires one by one calculation of the fringe pattern per image point per hologram sample. To overcome this problem, a look-up table (LUT) method was presented by M. Lucente [10]. But, in this method, In LUT method a great increase of computational speed in calculation of CGH patterns of the object images can be obtained. But its drawback is the huge memory size of the LUT required for storing all fringe patterns of the object image points. Recently, a novel look-up table (N-LUT) method to dramatically reduce the number of pre-calculated interference patterns required for generation of digital holograms was proposed [11-13]. In this method, a 3-D object image is approximated as a set of discretely sliced image planes with different depth, and only the fringe pattern of the center object point on each image plane is pre-calculated, so-called a principal fringe pattern (PFP) and stored in the N-LUT, so that the size of the N-LUT can be significantly reduced by comparing to that of the conventional LUT method.

On the other hand, news ticker is used to show breaking news or news headlines in conventional 2-D broadcasting system. For the case of the breaking news, the fast creation is need, because the information should be sent quickly. In addition, if holographic 3-D broadcasting system is started in the future, news ticker will remain. Therefore, holographic news ticker in holographic 3-D broadcasting system should be generated quickly. News ticker is consists of characters, simple logos and etc. Therefore, holographic news ticker could be efficiently generated using the characteristics of news ticker and LUT for each characters generated by N-

LUT.

To confirm the proposed method, moving car in front of the castle is used as a 3D video and the words 'HOLOGRAM CAPTION GENERATOR' is used as a news ticker. From this simulation results confirmed the feasibility of the proposed method in fast generation of CGH patterns for holographic news ticker.

### 2. News Ticker

A news ticker (sometimes referred to as a "crawler") is a small screen space on news television networks dedicated to presenting headlines or minor pieces of news. It may also refer to a long, thin scoreboard-style display seen around the front of some offices or public buildings. [14]



Fig. 1. News ticker

The presentation of headlines or other information in a news ticker has become a common element of many different news networks. The use of the ticker has been different on a number of different channels, financial news channels using two or more tickers progressing at different speeds, displaying stock prices and business headlines. Networks with a focus on sports often use a slightly different system, where scores and status of current and finished games are displaced one by one, along with minor sports highlights. News networks commonly use a setup in which news headlines are scrolled across the bottom half of the screen, though some variations have formed, such as CNN International presenting them without a scrolling effect.

That is, news ticker is used to show breaking news or news headlines. For the case of the breaking news, the fast creation is need, because the information should be sent quickly. In addition, if holographic 3-D broadcasting system is started in the future, news ticker will remain. Therefore, holographic news ticker in holographic 3-D broadcasting system should be generated quickly. News ticker is consists of

characters, simple logos and etc. Therefore, holographic news ticker could be efficiently generated using the characteristics of news ticker and LUT for each characters generated by N-LUT.

### 3. Proposed method

Figure 2 shows an overall block-diagram of the proposed method to generate hologram news ticker of holographic 3DTV or 3-D movies using newly proposed look-up table method. The proposed method is largely consisted of five steps: construction of the LUT for each character, extraction of characters in news ticker, generation and shift of the CGH pattern for news ticker using the LUT for each character and composition of hologram pattern for 3-D video and hologram pattern for news ticker. First, the LUT is constructed for the each character. Secondly, the character is extracted from the news ticker. And then, the hologram pattern of each character is generated and shifted by the amount of the shift of news ticker. Finally, the hologram pattern of news ticker is composed by the hologram pattern of 3-D video image.

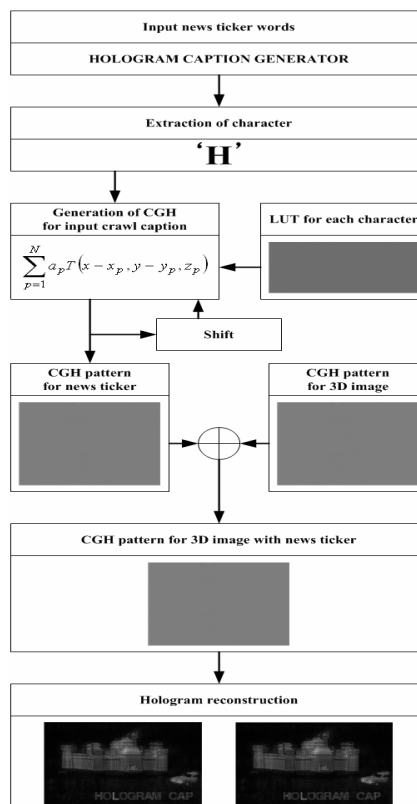


Fig. 2. Block diagram of the proposed method for generation of holographic news ticker

### 4. Experiment and Result

In this paper, 200 frames of 3-D video images are computationally generated for the test 3-D video, in which each frame has a resolution of 320×240 pixels. Figure 3 shows four frames of the intensity and depth images for test 3-D videos. These 3-D video images show the sequential front views of a 3-D scene with a car moving in front of the fixed castle. And the generated news ticker ‘HOLOGRAM CAPTION GENERATOR’ is used. CGH patterns with 1000×1000 pixels are generated using the intensity and depth data of the test 3-D videos. Each pixel size of the CGH pattern is given by  $5\mu m \times 5\mu m$ . Then, these CGH patterns of proposed method are digitally reconstructed and the results are shown in Fig. 4.

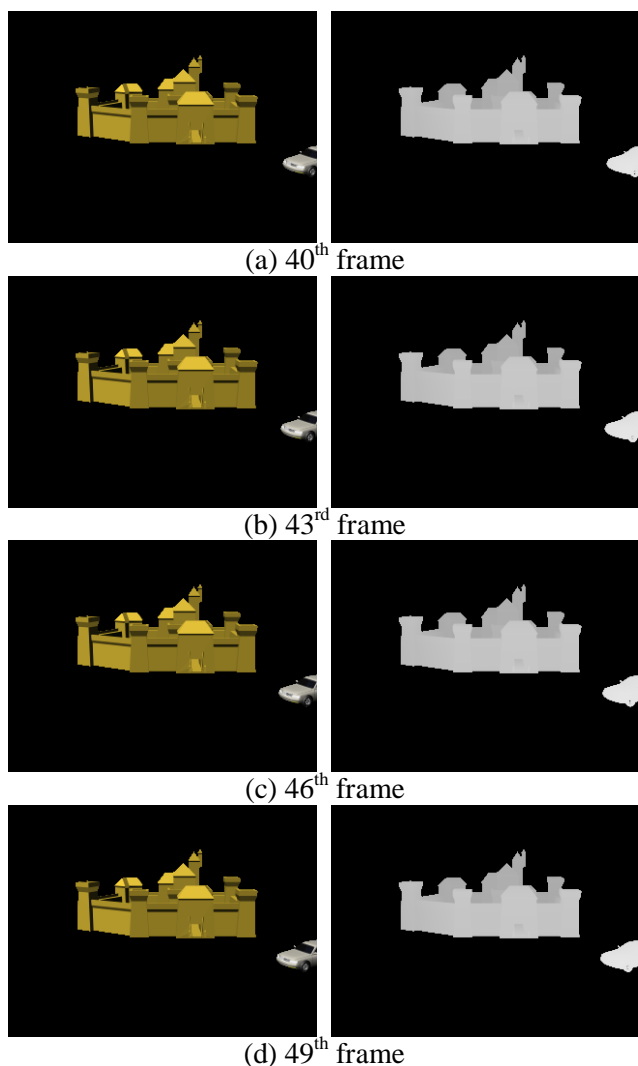


Fig. 3. Four frames of the intensity and depth images for test 3-D videos

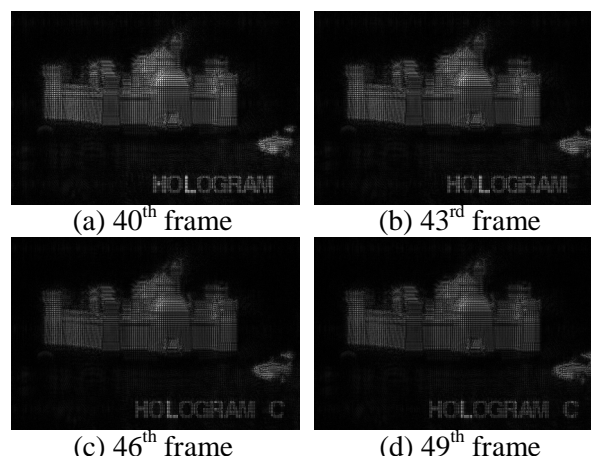


Fig. 4. Computationally reconstructed 3-D video images

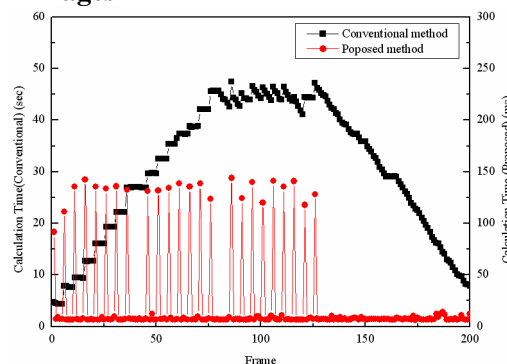


Fig. 5. Comparison results between conventional and proposed methods in terms of the number of the calculation time for one frame

Figure 6 shows the calculation time of hologram pattern for news ticker at each frame with the conventional and proposed methods. As you can see in Fig. 3, the proposed method has much less time for calculation time of one frame compared to that of the conventional method. Hence, the average calculation times for one frame are estimated to be 30.63 seconds and 4.45 milliseconds in the conventional and proposed method. These results reveal that the average calculation time for one frame in the proposed method can be reduced by 0.01% compared to the conventional N-LUT method.

### 5. Conclusion

In this paper, a new method for efficient generation of hologram pattern for news ticker for hologram 3DTV system has been proposed using the LUT of each character generated by N-LUT method. By using the characteristic of N-LUT method, reconstructed news ticker can be shifted by the amount of the shift

of news ticker. Thus only one generation is needed for one character, and then the calculation time of hologram news ticker is dramatically reduced. Good experimental results with 3-D test moving pictures and news ticker finally confirmed the feasibility of the proposed method in fast generation of CGH patterns for hologram news ticker.

## 6. Acknowledgement

This research was supported by the MKE (Ministry of Knowledge Economy), Korea, under the ITRC (Information Technology Research Center) support program supervised by the IITA (Institute of Information Technology Assessment) (IITA-2009-C1090-0902-0018).

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