홀로그램 프린팅 광학소자에 대한 균일도 분석 방법

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Uniformity Analysis Method for Hologram Printing Optical Elements

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요 약

In order to maintain the quality of the hologram similar to that of the master hologram, the uniformity of the amount of light irradiated must be secured. In this paper, the uniformity of the amount of light irradiated is analyzed to perform at high speed while maintaining the quality of the cloned hologram in the technology of replicating the generated master hologram.

Ⅰ. 서 론

In the process of producing a hologram, hologram reproduction technology that generates a large number of duplicated holograms from a master hologram has become a very important technology. In particular, the technology to replicate the hologram at high speed while maintaining the quality of the master hologram is important. In order to maintain the quality of the duplicated hologram similar to that of the master hologram, the uniformity of the amount of light irradiated must be secured. In this paper, the uniformity of the amount of light irradiated is analyzed to perform at high speed while maintaining the quality of the duplicated hologram in the technology of replicating the generated master hologram[1-2].

In hologram cloning technology, a laser is generally used as a light source. In this case, the profile of the laser light source may be assumed to be a Gaussian distribution having an average of 0 and a variance of σ2. The definition of the Gaussian profile is as follows.

$$\left| A_0 \exp\left\{ -\frac{1}{2}\left(\frac{x^2+y^2}{\sigma^2}\right)\right\}\right|^2 \tag{1}$$

Here, A0 is the intensity of the light source, and x and y are location information. Distribution thereof may be changed by adjusting σ2 in the Gaussian profile.

Ⅱ. 본론

In order to measure the light uniformity of a duplicated hologram, four uniformity measurement methods (2) were used in this paper, and their average values were used as a measure of uniformity performance.

$$U_{CoV} = \left(1 - \frac{\sigma_L}{\overline{L}}\right) \times 100,$$

$$U_{MAX} = \frac{MIN}{MAX} \times 100,$$

$$U_{Mean} = 1 - \frac{\left(\frac{MAX - MIN}{2}\right)}{Mean} \times 100,$$

$$U_{Dev} = 1 - \frac{(MAX - MIN)}{Mean} \times 100,$$

$$U_{Avg} = \frac{1}{4}\left(U_{CoV} + U_{MAX} + U_{Mean} + U_{Dev}\right) \tag{2}$$

In order to analyze the light uniformity of the hologram replicated in hologram cloning technology, simulations were performed under the following experimental parameter conditions in this paper.

표 1. 실험 파라미터 조건

Spot 크기	100 mm × 100 mm
가우시안 프로파일에서 σ^2	1
광원의 세기	10 mW
픽셀 크기	100 µm
마스터 홀로그램 크기	200 mm × 200 mm
Spot간의 간격	0.1 mm ~ 75.1 mm

The simulation results performed under the experimental parameter conditions shown in Table 1 are shown in Fig. 3.

Figure 1 is a setup for luminance measurement. This setup checks the average value with the maximum/minimum value through the luminance value for each 12 point and measures the uniformity.

그림 1. 휘도 측정 셋업

Figure 2 shows the holographic optical element recorded for the measurement. The laser used is a green laser and has a wavelength of 532nm laser.

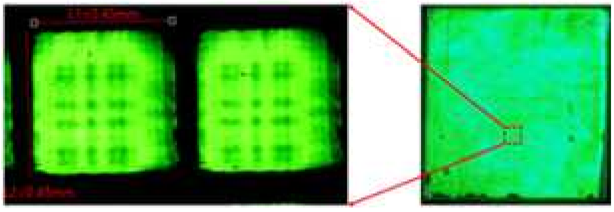

그림 2. 기록이 완료 된 홀로그램 광학 소자

Ⅲ. 결론

As shown in Figure 3, replicating at 0.1 mm spot intervals showed the best results.

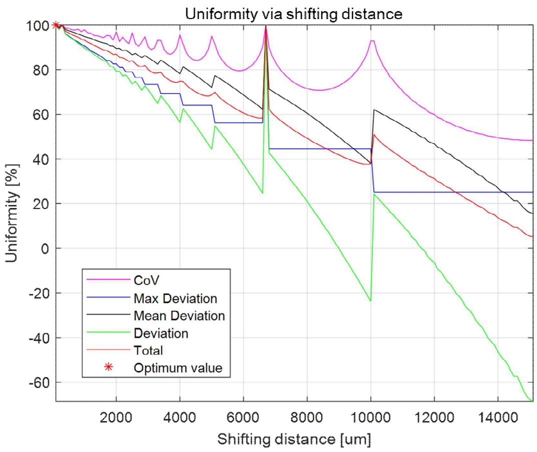

그림 3. 홀로그램 복제를 위한 빛 균일도 분석 결과

However, because the spot spacing is tight, it takes a lot of time to duplicate the hologram. On the other hand, when the spot spacing is 6.7 mm, the uniformity performance is similar to the performance under the 0.1 mm condition. In addition, since the spot spacing is 67 times wider, the hologram replication speed is also faster. Therefore, under such experimental parameter conditions, a spot spacing of 6.7 mm can be said to be the optimal condition.

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