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Low-bits encoding of wave-fields for data-size reduction in computer holography

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ABSTRACT

For the last few years, high-definition computer-generated holograms (CGHs), composed of more than billions pixels, have been expanding its scale, and the optical reconstruction has become clearer. In computer holography, light is treated as a digital data, but storing and transmission of the data are difficult because of its huge data-size.

We have two choices to store and transmit CGH data. One is to hold the fringe pattern. Alternatively, we can hold the sampled wave-field of the objects or 3D scene. The data-size of a fringe pattern is considerably smaller than that of the sampled wave-field. But, when a CGH data is held as the fringe pattern, reconstruction parameters of the CGH, such as the incident angle of illumination light, cannot be changed in the reconstruction system. In contrast, holding the sampled wave-field has several advantages in terms of versatility, but the data-size is commonly eight times larger than that of the fringe pattern encoded with 8 bits gray-level.

In this paper, we propose a technique of low-bits encoding of a wave-field to compact the data of high-definition CGHs. This technique uses nonlinear quantization algorithm that requires iterative optimization. However, encoding by the proposed technique is very fast, because we utilize the fact that the shape of amplitude histogram of a wave-field is almost independent of the type and scale of the wave-field, and thus the quantization parameters can be pre-computed. Actual high-definition CGHs created using the proposed low-bits encoding technique are demonstrated to confirm validity of the technique.

Keywords: Computer holography, Computer-generated hologram, quantization, encoding

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8 bit/sample, low-bits encoding, (this work)

64 bit/sample