Realistic Computer Generated Holograms Using Orthographic Ray-Sampling Plane

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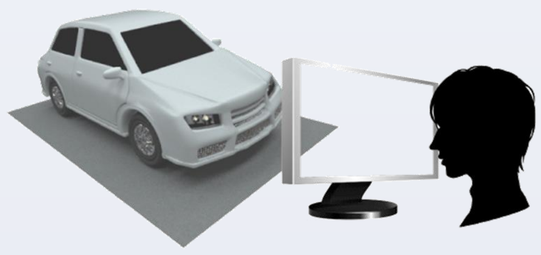
1. Introduction

Objective

Computer generated holograms (CGHs) that shows super realistic 3D images (depth cues, photorealistic appearance, etc.)

Problems

- Computational cost
- Resolution in deep scene
- Material reproduction

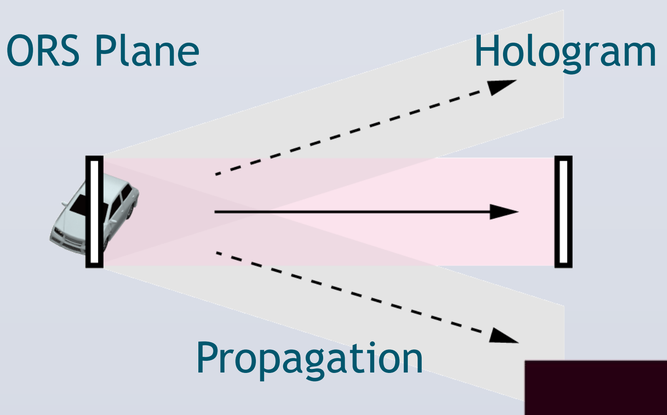


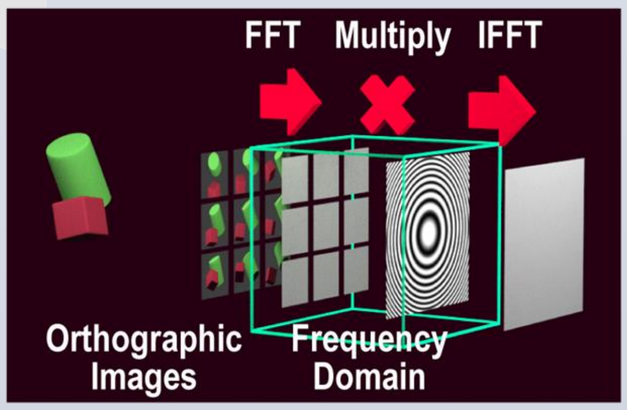
2. Calculation of holograms using orthographic ray-sampling plane

We propose an efficient CGH calculation method called "orthographic ray-sampling plane method."

Algorithm

1. An intermediate plane is defined near objects.
2. Orthographic images (parallel rays) are captured in various different angles.
3. Orthographic images are Fourier transformed to obtain angular spectra at the ORS plane.
4. Angular spectra are multiplied with transfer function of propagation.
5. Inverse Fourier transform of the result corresponds to the wavefront at the hologram.



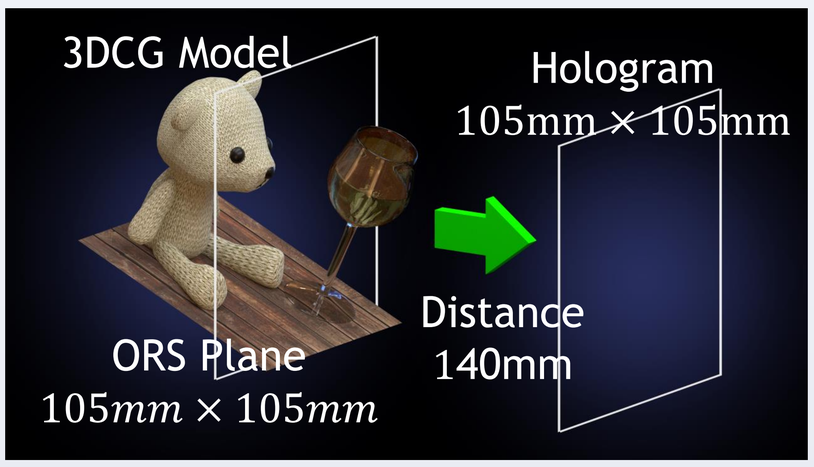


Advantages

- Photorealistic appearance of ray-information
- High resolution in deep scene due to wave propagation
- Efficient calculation of large holograms by omitting redundant propagation

3. Experimental Results

A hologram of "a stuff of bear and a glass of wine" was calculated using the proposed method.



Firstly, orthographic images were rendered from 64×64 different angles.

Hologram	$128K \times 128K$
Pixel pitch	$0.8\mu m$
Viewing angle	$\pm 23.3°$

Rendering time : 5h

CGH calculation : 13h

Generated fringe pattern was fabricated by a laser-lithography system of "Kan-Dai Digital Holo Studio."

Photorealistic material appearance (reflection, refraction, and texture of wool) was successfully reproduced as 3D images.

4. Conclusion

We proposed an efficient algorithm to calculate photorealistic and deep scene hologram with large size of display.

Photorealistic CGH was calculated and fabricated.