Problems and Attempts : CGH

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Abstract

This is a record of the problems I encountered while studying computer-generated holography (CGH) and my attempts to solve them.

1 Hologram Calculation

Q1.1 (2024.07.25) How to calculate a hologram that successfully reconstructs a desired size and resolution 3D image at a desired distance? To display the hologram on a Digital Micromirror Device (DMD), hologram resolution should be fixed to $5\mu m$.
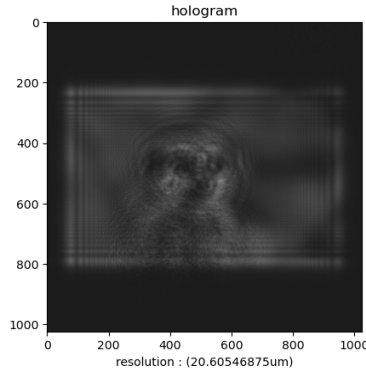

Figure 1: Hologram

(24.07.29) I came up with the idea of adjusting the hologram resolution on the computer to fit the display resolution. For example, I can use the cv2.resize method in Python. I did this, but.. what I need to do is create a hologram that displays a 3D image at the desired distance and size. While resizing can fit the hologram pattern to the DMD physically, it does not create the desired pattern.

2 Aliasing

Q2.1 (2024.07.25) When performing a Fourier transform on a hologram, weird aliasing occurs as shown below. Why does this happen, and how can it be fixed?
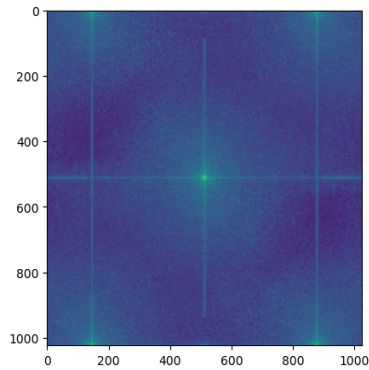

Figure 2: Fourier transform of the hologram

Q2.2 (2024.07.25) When simulating hologram reconstruction on a computer, aliasing occurs. Why does this happen, and how can it be fixed?
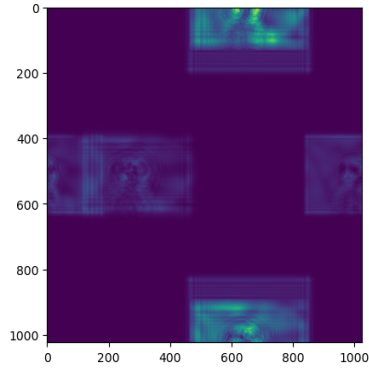

Figure 3: Aliasing in reconstructed image ($\theta = \pi/5$)