Holography HW 2

Note Title 10/9/2009

Holography and coherent imaging

Fall 2009

Homework 2

Due 11 September 2009

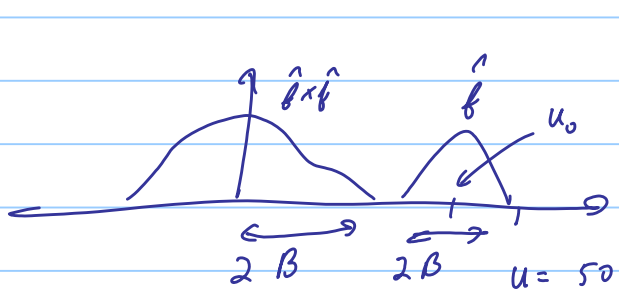
1. Using a 1 inch circular holographic plate and a 532 nm laser, estimate the minimum feature size one could resolve in an object at a range of
   a. 1 mm .260 u
   b. 10 cm 2 um
   c. 100 cm 20 um

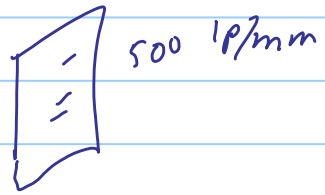
   $\Delta x \sim \frac{\lambda z}{A} \approx \frac{.532 \cdot 10^{-6}}{2.54 \cdot 10^{-2}} z \approx 2 \cdot 10^{-5} z$

   $\Delta x > \frac{\lambda}{2}$ (diffraction limit)

   Discuss the significance of recording geometry on this problem. Does the resolution depend on whether one records an off-axis or on axis hologram? no
2. A certain holographic recording material supports a maximum fringe frequency of 500 line pairs/mm. Using 600 nm light, design a system to use this material to record an off axis hologram such that the signal field can be unambiguously isolated from background terms.Estimate the maximum spatial bandwith allowed in the signal field and the angle between the signal field axis and the reference. Assuming that the resolution is not aperture limited, estimate the resolution achieved in the holographic image.
3. Explain why display holograms use a reflection geometry. Why can they be reconstructed using white light. What determines their apparent color?

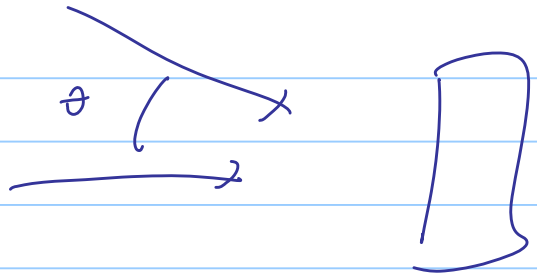
2.





$B < \frac{u}{4}$ $\quad u_0 = 3B = \frac{3u}{4} = 375$ lp/mm

$B < 125$ lp/mm



$$u_0 = \frac{\sin\theta}{\lambda}$$

$$\theta = \sin^{-1}\left(.6\ 10^{-6}\ \frac{375}{1}\ 10^{3}\right)$$

$$= 13^{\circ}$$

$$\Delta x \sim \frac{1}{B} = 8\ \mu m$$

3. Display holograms use Bragg filtering to reconstruct in a single color

$$\lambda = 2n$$