

4. Image Plane Hologram

The difference between Fresnel and image plane hologram is that the former is recorded with object light diffused directly from an object to a holographic plate; while the latter employs an imaging lens to form an image of an object near a holographic plate to interfere with a ray of reference light as shown in Figure 5.

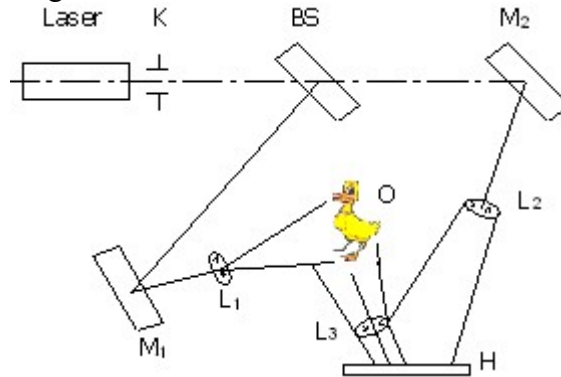


Figure 5 Schematic of image plane hologram recording

Laser: Diode laser with 2-D adjustable holder (SZ-19) on magnetic base (SZ-04)

K: Exposure timer (LEPO-30) on magnetic base (SZ-04)

BS: Beam splitter with plate holder (SZ-12) on magnetic base (SZ-04)

M₁: Plane mirror (Φ40 mm) with 2-D holder (SZ-07) on magnetic base (SZ-04)

M₂: Plane mirror (Φ40 mm) with 2-D holder (SZ-07) on magnetic base (SZ-04)

L₁: Beam expander ($f=4.5$ mm) with 2-D holder (SZ-07) on magnetic base (SZ-03)

L₂: Beam expander ($f=4.5$ mm) with 2-D holder (SZ-07) on magnetic base (SZ-03)

L₃: Imaging lens ($f=225$ mm) with lens holder (SZ-08) on magnetic base (SZ-04)

H: Holographic plate with plate holder (SZ-12) on magnetic base (SZ-04)

O: Small object on object loading platform (SZ-20) with magnetic base (SZ-04)

Experimental Procedure

1. Align laser beam and other optical components such as exposure shutter, beam expander, mirrors, lenses, plate holder, and small object to be axial (at identical height).
2. Based on Figure 5, align object light path and let $BSM_1+M_1O+OH=A$. Move L_1 back and forth until object O is fully illuminated. Insert lens L_3 between object O and holographic plate H and move L_3 back or forth to image the object near the holographic plate (either at the front or at the back of the plate).
3. Align reference light path and let $BSM_2+M_2H=A$. Insert L_2 in the reference light path and move L_2 or L_1 back and forth until the intensity ratio of object light to reference light falls within the range of 1:2 and 1:5. The intersection angle between object beam and reference beam should be between 30° and 50° . If not, adjust the locations of mirror M_1 , or M_2 or object O .
6. Upon the completion of optical configuration, make sure all the magnetic bases are secured on the optical table. Put a photopolymer plate on the plate holder with the film side towards the laser. Fasten the holographic plate on the plate holder and wait 2 minutes until the stress

added the locking screw of the holder is released. Expose the holographic plate with desired exposure time duration (90s to 120s if a glass or ceramic object is used and the laser power is around 40 mW).

7. For post-exposure processing procedure of holographic plates, read the user instructions of light sensitive photopolymer (RSP) plates.

5. Two-Step Rainbow Hologram

Typically, an off-axis Fresnel hologram (or transmissive hologram) can only be reconstructed with laser light. The so-called two-step rainbow holography is to view a laser reconstructed hologram with white light. First, a hologram is recorded with laser light. Then, reconstruct the hologram with laser light so that the reconstructed real image of the original object is formed near a second holographic plate to be interfered with a ray of reference light. The second hologram can be reconstructed with white light, as shown in Figure 6.

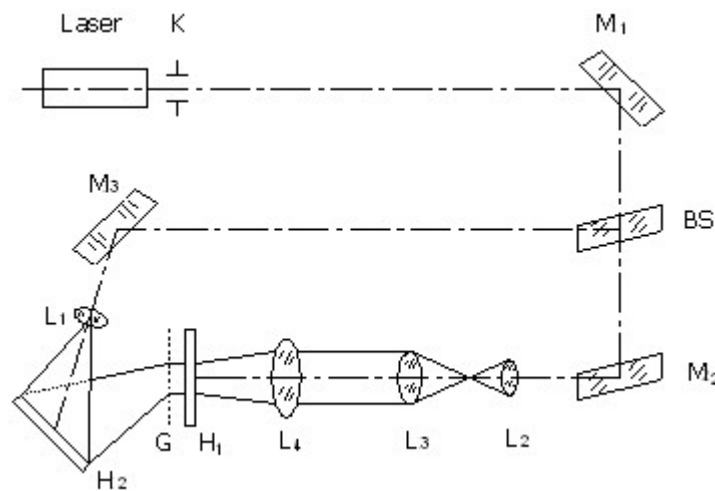


Figure 6 Schematic of two-step rainbow hologram recording

Laser: Diode laser with 2-D adjustable holder (SZ-19) on magnetic base (SZ-04)

K: Exposure timer (LEPO-30) on magnetic base (SZ-04)

BS: Beam splitter with plate holder (SZ-12) on magnetic base (SZ-04)

M₁: Plane mirror (Φ40 mm) with 2-D holder (SZ-07) on magnetic base (SZ-04)

M₂: Plane mirror (Φ40 mm) with 2-D holder (SZ-07) on magnetic base (SZ-04)

M₃: Plane mirror (Φ40 mm) with 2-D holder (SZ-07) on magnetic base (SZ-04)

L₁: Beam expander ($f=4.5$ mm) with 2-D holder (SZ-07) on magnetic base (SZ-03)

L₂: Beam expander ($f=6.2$ mm) with 2-D holder (SZ-07) on magnetic base (SZ-03)

L₃: Collimating lens ($f=225$ mm) with 2-D holder (SZ-07) on magnetic base (SZ-04)

L₄: Imaging lens ($f=150$ mm) with lens holder (SZ-08) on magnetic base (SZ-04)

G: Slit screen with plate holder (SZ-12) on magnetic base (SZ-04)

H₁: Fresnel hologram with plate holder (SZ-12) on magnetic base (SZ-04)

H₂: Holographic plate with plate holder (SZ-12B) on magnetic base (SZ-01)

Experimental Procedure

1. Based on Figure 6, align object light path with beam expander L_2 , collimating lens L_3 , and imaging lens L_4 so that object light is incident on Fresnel hologram H_1 . The reconstructed real image is formed on holographic plate H_2 through slit G .
2. As object light is imaged through a narrow slit, the spectral bandwidth of the reconstructing light is suppressed by the slit when reconstructing the hologram thus avoiding a blurry image. The width of the slit should be around 5 to 8 mm. If the width of the slit is too wide, then the reconstructed image becomes blurry; if the width is too narrow, the intensity of the object light becomes inadequate.
3. For white light reconstruction, the direction of the slit should be orientated vertically to maintain the horizontal parallax of the object. When the hologram or the observation eye is moved horizontally, the horizontal parallax of the object will be observed; when hologram or eye is moved vertically, only the color of the reconstructed image varies.
4. Repeat steps 6 and 7 in sec. 2.