ENSC 460/894 Lab 2, Apr. 4, 2005
V2.0

Purpose
The purpose of the lab is
(i) to Observe and create a Transmission beam hologram with the Argon Ion laser

Description
In this lab you will gain experience in a simple holography set up: a single beam transmission hologram setup. You will create a hologram of our standard object and try any other object that you wish. If you wish to use your own test objects make certain they are bright white or silver. A quarter, nickel or tunie makes a good test object.

(1) To being turn on the Argon ion laser in the following manner. Turn on the water flow from the valve on the wall by turning it straight out. Check the water flow on the meter is at least 2.5 gal/min. Then turn on the key of the laser power supply (at the bottom left side of the laser table). The status lights should come on the front of the power supply. Then press the on button on the remote control pad, and watch the 30 second countdown for the laser to turn on. Make certain the laser current on that pad display shows 10 Amps (see lab 1 instructions). Running at this lower power produces only the 488 nm laser output. Turn on the laser warning light outside.

(2) Remove the neutral density filter (if present) so that the beam goes through the concave lens expander and strikes the mirror. Adjust the mirror position if necessary so the beam expands over the table to form an illuminated area of about 5x5 cm (see Figure 1).

(3) Now create the set up for your own hologram. Put a 0.8 ND filter in the beam path in the desired post. Then make certain the beam from the concave mirror/concave lens combination covers the plate holder and the blue lab jack beside it. Place the test object (test screw) on the lab jack close to the plate such that there is an illuminated partition of the object facing where the plate will be (see Fig. 1). Do not have the shadow from the object touch the plate position.

(4) Turn off the room lights. Turn on the safety light, insert the shutter plate in the laser beam and close the laser shutter. Remove a plate from the dark box. Place the plate on the holder, emulsion side towards the object. To identify the emulsion you can use two techniques.
(a) Moisten your finger and touch a side of the plate on what would be near the top edge. The side with the emulsion will feel sticky.
(b) Take a sharp knife or pin and scratch a side of the plate on what would be near the top edge. The glass side will not scratch while the emulsion side will. You can feel the scratch with your finger.

(5) Expose the plate for about 2 sec (1 - 6 sec works) by raising and lowering the shutter plate, close the laser shutter to turn off the laser beam and then put the plate in the dark box. Then bring to the dark room.

(6) In the darkroom arrange the development as shown (Fig. 2) by putting out 3 trays for development. In the right tray put the Developer (D-11), in the centre water, and the holographic bleach on the left side. Put water in the final tray.

(7) With the dark room lights out, turn on the safe light, and make certain the darkroom timer is on the first stage setting (showing 2 minutes). NOTE: do not put your fingers in the chemicals: use gloves or tongs. Start the timer and place the plate (emulsion side up) in the developer. Agitate slowly for the 2-2.25 minutes by rocking the tray. When timer ends remove the plate and place in the stop bath (water) and activate the time second stage which should time 30 sec. Set the timer for the 3 stage (1 minute) and place the pate in the bleach. Plate should be clear. Then place the plate in running water for 5 minutes. Stand plate up and allow to dry (about 1 hour).

(8) Take your hologram in and view it - make certain it forms an image. Place the hologram in the beam path so that it is fully illuminated. Put the hologram at a shallow angle to the beam, with emulsion towards you. Look slightly down to observe a bolt on the mount plate in the hologram. You may need to move your head around a bit. Remember this for observing your own holograms and use this standard hologram to check your illumination set up. If it works make a second hologram of another object.

If you wish you can try one of the more advanced holograms in the reference book: Homemade Holograms by Iovine (copies of these pages are next to the laser). I suggest the Reflection hologram (pg 67) or Double channel type (pg 83) but in a transmission set up.

Writeup

The aim of the writeup will be to see what you have learned in hologram work. In this writeup the theory/introduction/ section can be skipped. Cover the procedure in your setup noting anything you did different. Also cover the results/analysis and conclusion. In these describe all the settings/times used. Describe the viewing setup for your hologram. Include copies or originals of your lab notes. Final report length should be less than 10 pages. In the report you to include your holograms (they will be returned) so that I can view them.

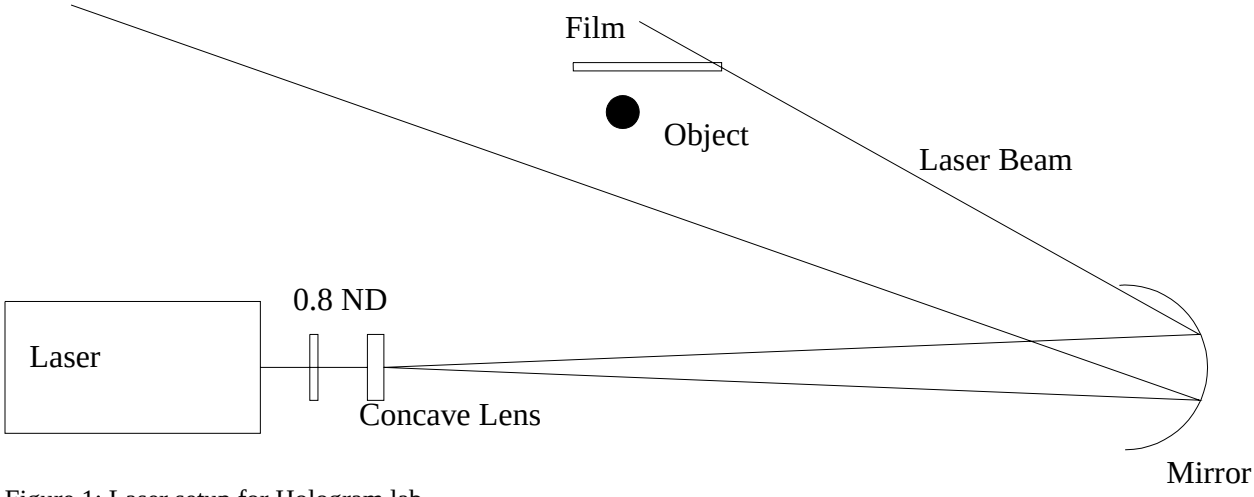

Figure 1: Laser setup for Hologram lab

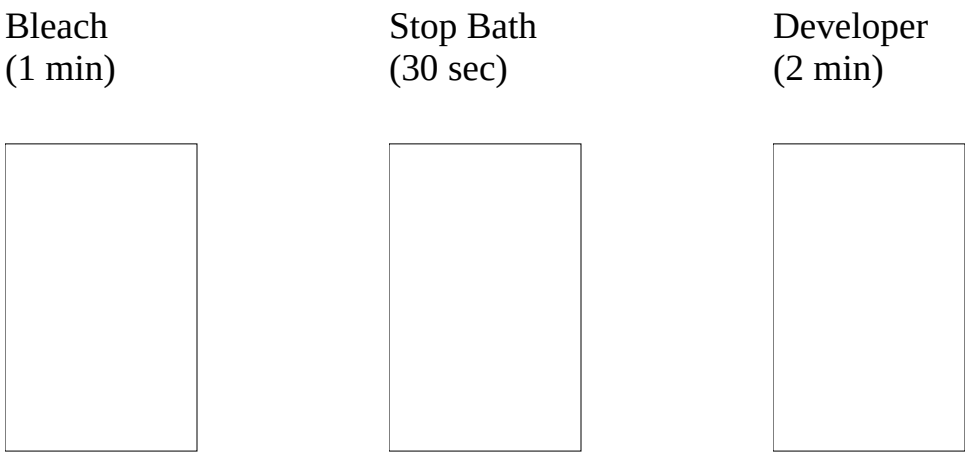

Figure 2: Dark Room Tray setup

Appendix I: Photographic Solutions

Developer
For the plate developer any high contrast Kodak developer can be used. Best is Kodak D-11. These solutions should be mixed at least several hours before use. The developer and stop bath create a regular negative image of the hologram. However this is too dark for regular use.

Bleach
To get the hologram the developed plate must use a reversal bleach, which removes the metallic silver (black). This does not remove the image in a hologram (as would happen with a regular negative film). Instead the remaining silver halide is a copy of the hologram interference pattern and creates a brighter image than would occur with the regular development. The bleach formula is

1 liter DI water
4 milliliters concentrated sulphuric acid
4 grams potassium dichromate

The bleach lasts a long time and will be prepared for you ahead of time.