5.1 HOLOGRAPHY

Basic Principle:

Holography is the science of producing holograms; it is an advanced form of photography that allows an image to be recorded in three dimensions. The Hungarian-British physicist Dennis Gabor was awarded the Nobel Prize in Physics in 1971 "for his invention and development of the holographic method". His work, done in the late 1940s, built on pioneering work in the field of X-ray microscopy by other scientists including Mieczys ław Wolfke in 1920 and WL Bragg in 1939. The discovery was an unexpected result of research into improving electron microscopes at the British Thomson- Houston (BTH) Company in Rugby, England, and the company filed a patent in December 1947 (patent GB685286). The technique as originally invented is still used in electron microscopy, where it is known as electron holography, but optical holography did not really advance until the development of the laser in 1960. The word holography comes from the Greek words hólos; "whole", grapy; "writing" or "drawing").

Holography Vs. Photography

Holography may be better understood via an examination of its differences from ordinary photography:

- A hologram represents a recording of information regarding the light that came from the original scene as scattered in a range of directions rather than from only one direction, as in a photograph. This allows the scene to be viewed from a range of different angles, as if it were still present.
- A photograph can be recorded using normal light sources (sunlight or electric lighting) whereas a laser is required to record a hologram.
- A lens is required in photography to record the image, whereas in holography, the light from the object is scattered directly onto the recording medium.
- A holographic recording requires a second light beam (the reference beam) to be directed onto the recording medium.
- A photograph can be viewed in a wide range of lighting conditions, whereas holograms can only be viewed with very specific forms of illumination.

- When a photograph is cut in half, each piece shows half of the scene. When a hologram is cut in half, the whole scene can still be seen in each piece. This is because, whereas each point in a photograph only represents light scattered from a single point in the scene, *each point* on a holographic recording includes information about light scattered from *every point* in the scene. It can be thought of as viewing a street outside a house through a 4 ft x 4 ft window, then through a 2 ft x 2 ft window. One can see all of the same things through the smaller window (by moving the head to change the viewing angle), but the viewer can see more *at once* through the 4 ft window.
- A photograph is a two dimensional representation that can only reproduce a rudimentary three-dimensional effect, whereas the reproduced viewing range of a hologram adds many more depth perception cues that were present in the original scene. These cues are recognized by the human brain and translated into the same perception of a three-dimensional image as when the original scene might have been viewed.
- A photograph clearly maps out the light field of the original scene. The developed hologram's surface consists of a very fine, seemingly random pattern, which appears to bear no relationship to the scene it recorded.