❑ Holography

B.Tech-I

Conent:

- **Basic Principle of holography**
- **Construction and reconstruction of image on hologram**
- **Application of holography.**

How hologram work

- The time varying light field of a scene with all its physical properties is to be recorded and then regenerated
- Working of a hologram divided into two phases.

    1) Recording
    2) Reconstruction

Hologram :
Direct, object and conjugate waves

- **Direct wave: corresponds to zeroth order grating diffraction pattern.**
- **Object wave: gives virtual image of the object (reconstructs object wavefront) – first order diffraction.**
- **Conjugate wave: conjugate point, real image– first order diffraction.**
- **In general, we wish to view only the object wave – the other waves just confuse the issue.**

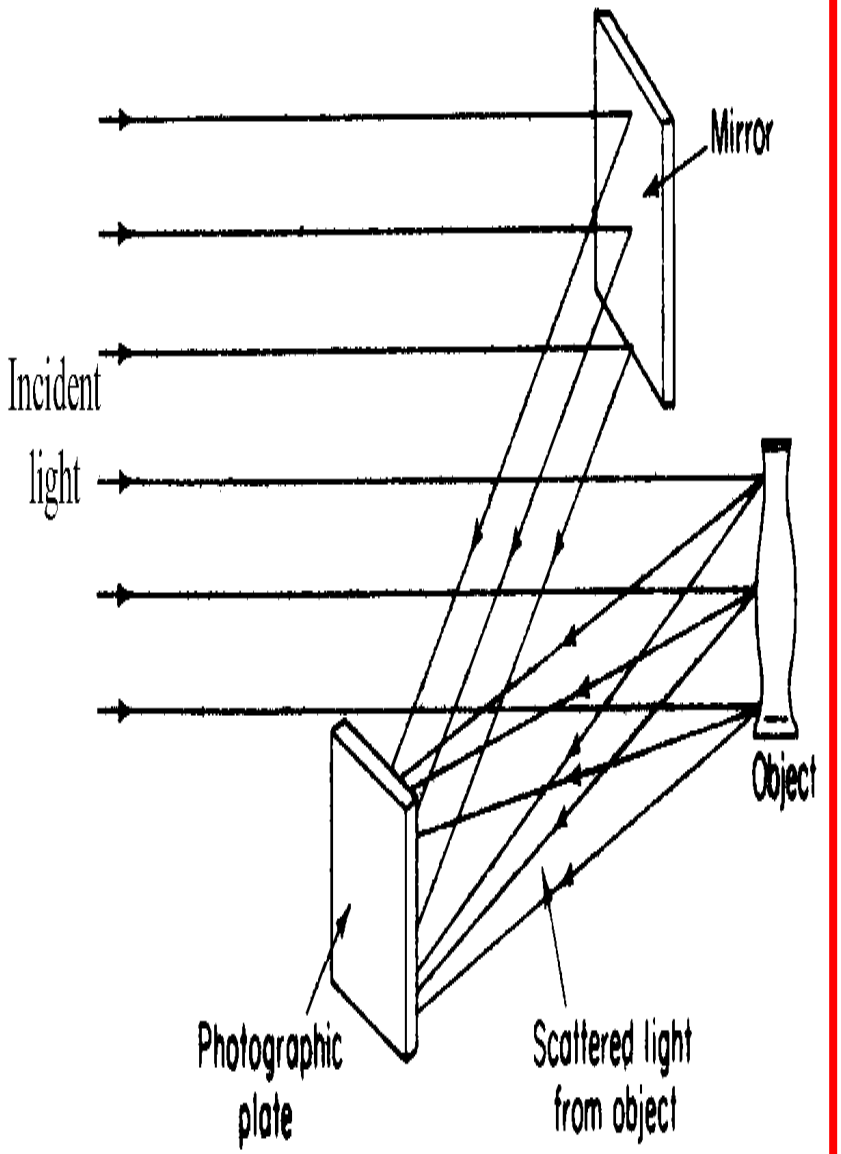
Recording of hologram

- Basic tools required to make a hologram includes
- Laser
- Lenses
- Beam spiltter
- Mirrors
- Holographic film
- Holograms are recorded in darker environment.

Producing the hologram

- **Practical setup**

- **Light source: laser**
- **Object: solid, 3D**
- **Photographic film: high resolution**
- **Hologram pattern: interference fringes**
  - **—uniform gray**
  - **—cannot be seen by naked eye containing a series of fringes of various lengths and spacing**



Recoding and reconstruction of Hologram

- **Hologram recorded intensity**
- **Light wave: vector**
- **A_1 — the signal,**
- **A_2 — the reference,**

$$A = |A| e^{-i(\omega t + \varphi)}$$

- **Each point on hologram:**

$$\begin{aligned} I(x,y) &= (\mathbf{A}_1 + \mathbf{A}_2)^2 \\ &= (\mathbf{A}_1 + \mathbf{A}_2)(\mathbf{A}_1 + \mathbf{A}_2)^* \\ &= |\mathbf{A}_1|^2 + |\mathbf{A}_2|^2 + \mathbf{A}_1\mathbf{A}_2^* + \mathbf{A}_1^*\mathbf{A}_2 \end{aligned}$$

- **The transmittance function:**

$$T(x,y) \propto \mathbf{A}_1\mathbf{A}_2^* + \mathbf{A}_1^*\mathbf{A}_2$$

Holography

- Holography is the production of holograms by the use of laser.
- Holos—greek for whole massage
- A hologram is a 3D image recorded in a special photographic plate.
- Converts phase information into amplitude information(in phase maximum amplitude out of phase minimum amplitude)
- Interfere wavefront of light from a scene with a reference wave
- The hologram is a complex interference pattern of microscopically spacecd fringes.
- The image appears to float in space and to move when the viewer moves.

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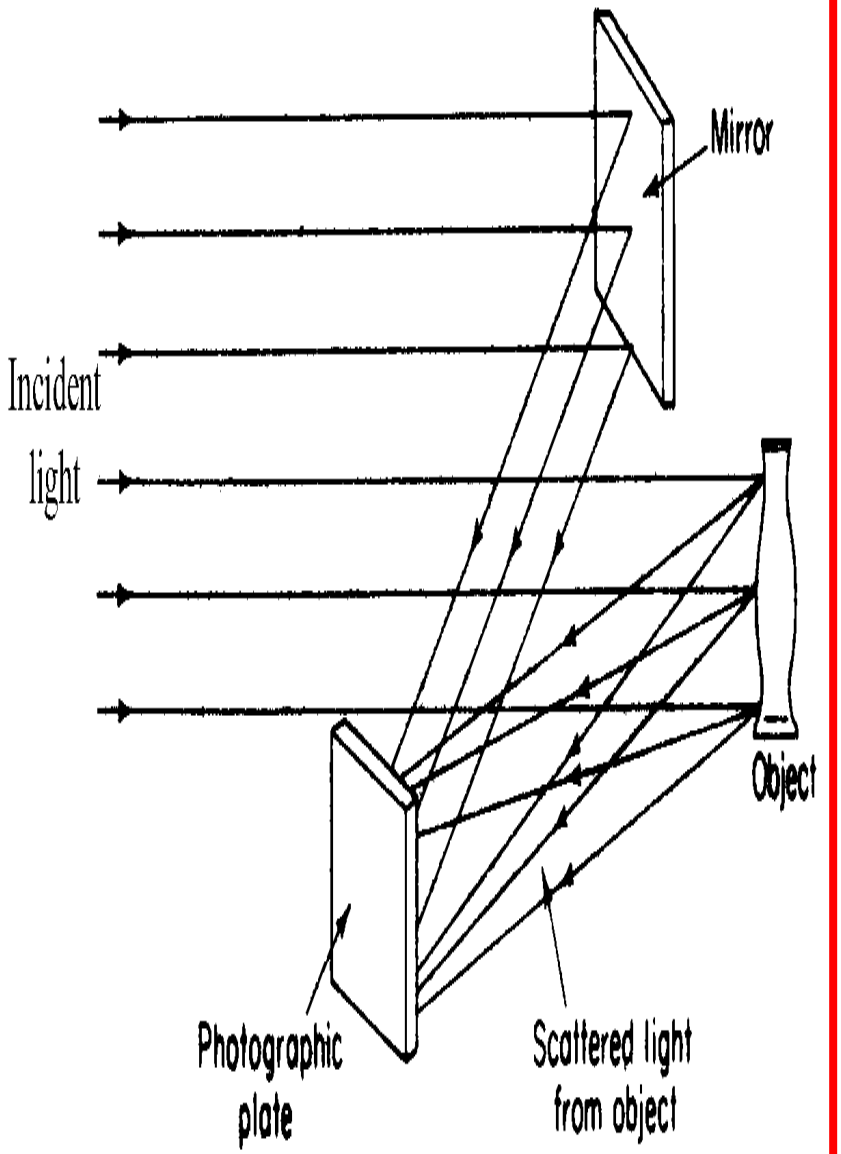

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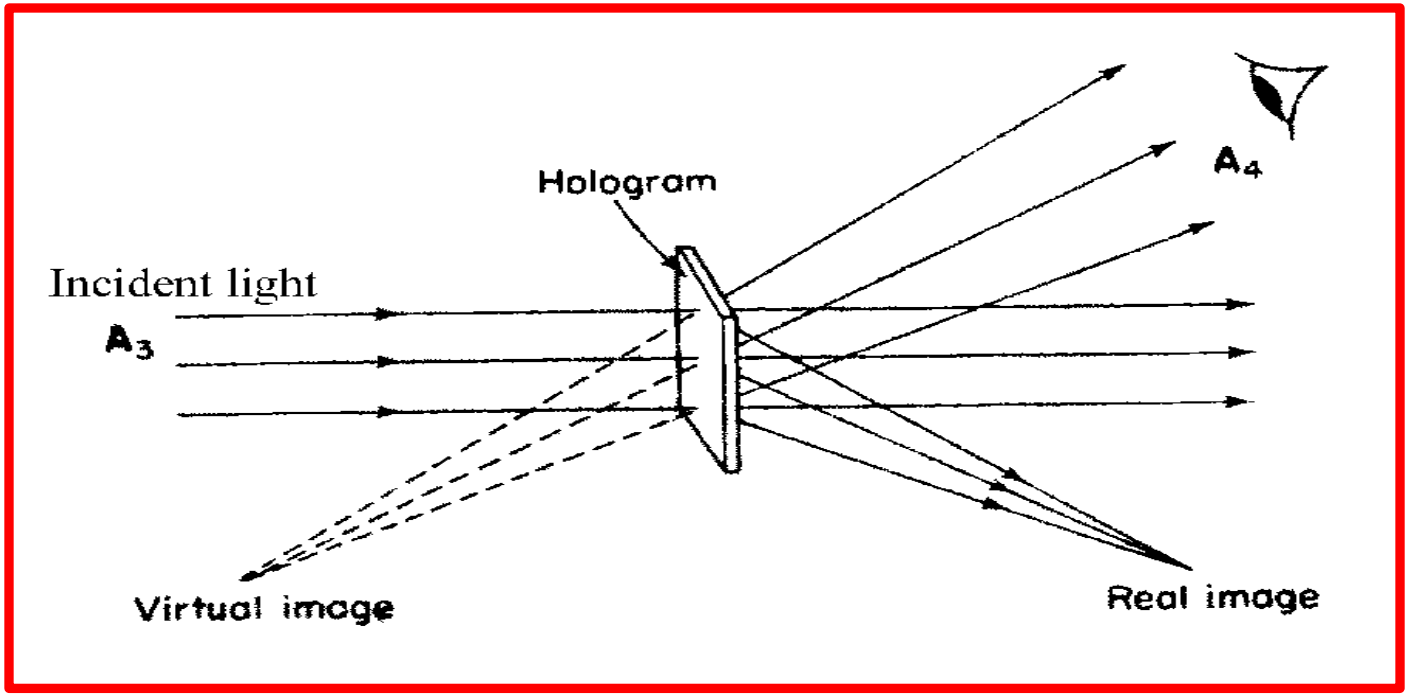
Reconstruction of the hologram

- The photographic plate is illuminated with the orignal reference beam (light source) used for recording



Source: http://upload.wikimedia.org/wikipedia/commons/thumb/a/a0/Holography-reconstruct.svg/300px-Holography-reconstruct.svg.png

Types of hologram

- **Transmission hologram**: refrence and object waves traverse the film from the same side
- **Reflection:** refrence and object waves traverse the film from the oposite side.
- **Rainbow**
- **Colour**
- **Lens hologram**
- **fourier**

Hologram properties

Provides depth perception.

- **If you look at these holograms from different angles you see object from different prospectives,just like you would if you were looking at the object.**
- **They usually just look like sparky pictures or smears of color.**
- **If you cut one in half each hellp contains whole views of the entire holographic image.**

Why holographic display

- A high resolution 3-D recording of an object
- Glasses free 3-D display
- No need for projection screen
- Interactive display
- Life like images

Conventional vs. Holographic photography

- **Conventional:**
  - 2-d version of a 3-d scene.
  - Photograph lacks depth perception or parallax.
  - Film sensitive only to radiant energy.
  - Phase relation (i.e. interference) are lost.
- **Hologram:**
  - Freezes the intricate wavefront of light that carries all the visual information of the scene.
  - To view a hologram, the wavefront is reconstructed.
  - View what we would have seen if present at the original scene through the window defined by the hologram.
  - Provides depth perception and parallax.

Application of Holography

- Educational application.
- Marketing with 3-D holographic display.
- 3D simulation displays for scientific visualization.
- Improved virtual reality and Augmented reality.
- Telepresence and video conferencing.
- Entertainment displays.
- Millitary and space application.
- Holographic checkpoint for military,battelfield simulation.s
- Intense and real gaming rooms.
- In future holographic displays will be replacing alll sizes from small phonesscreen to large projectors.