University of technology
Laser and optoelectronics eng. Dept.

LASER APPLICATION COURSE
4TH YEAR
LEC.11

Metrological & Scientific Applications

- There are many types of metrological & scientific applications in use today such as (distance, velocity, pollution) measurements. The purpose of this chapter is to discuss the some of these techniques. And all systems that use lasers for metrological & scientific applications

OPTICAL ALIGNMENT

- The simplest applications of lasers such as the HeNe laser is in producing a visible line which can be used for[4,9]:
- Positioning an object.
- Surveying, guidance of equipment in construction.
- Aiming other lasers or optical instruments.
- The use of a beam of light for alignment, often called ***optical tooling***.
- ***Advantages of optical alignment:***
- The optical alignment are fast compared to mechanical alignment.
- Very easy to used.
- Often required one operator.
- The ***accuracy*** of laser alignment is limited by the ***divergence*** of the beam. And the divergence can be reduced by expanding the beam.

Laser Depth Sounder(LDS

- A Nd-YAG laser system is being used to sound & map the sea floor by Royal Australian Navy. Both the primary radiation of 1.06 μm & the SHG or frequency-doubled 0.532 μm wavelengths are being directed to the sea surface from an airplane.
- The 1.06 μm infrared radiation IR is mostly reflected from the surface of the water, while the green 0.532 μm traverses the water & is reflected from the sea floor back to the receiver of the sounder. The delay between the two beams determines the depth of the sea or ocean floor. It is reported that the depths to 30m have been thus measured with a resolution of one meter

- The principle of measurement of the sea floor are dependence on the calculate the trip time of the laser pulse, and this is similar to that of a rangefinder, with the exception that here there are two laser beams project to the target, where one beam reflects from the surface of the water & the other reflects from the sea floor as shown as in Fig.3.1

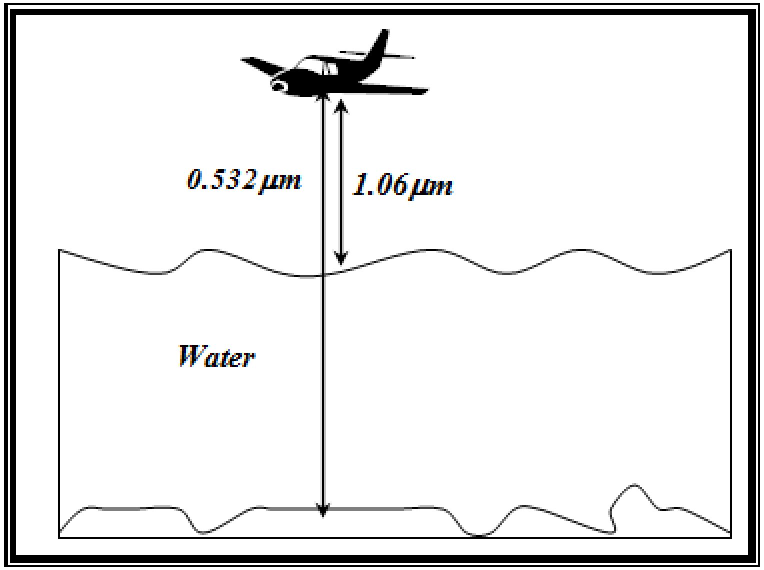

Figure 3.1 Laser depth Sounder

- The computer of the laser depth sounder subtracts the distance of plane-to-
- water surface from the total distance of plan-to-sea floor, and the remainder is the depth of the sea floor from the surface of the water. Putting this relation in a simplified equation form:

$$D = F - S \qquad \text{..} \textbf{\textit{(3.1)}}$$

- Where:
- ***D***- the depth of the sea floor from the surface of the water.
- ***F***- the distance of plan-to-sea floor.
- ***S***- the distance of plane-to-water surface.

However, the distance F & S are equal to:

$$F = \frac{CT_F}{2} \qquad \text{...}(3.2)$$

$$S = \frac{CT_S}{2} \qquad \text{...}(3.3)$$

Where:

C- $3x10^8$ m/s

T_F- time of plan-to-sea floor pulse trip.

T_S- time of plane-to-water surface pulse trip.

In Eqa.3.2 & Eqa.3.3 we divided the trip time on two to obtained the leaving time of laser pulse.

Combining the Eqa.3.2 with Eqa.3.3 & substituting them in Eqa.3.1 we have:

$$D = \frac{CT_F}{2} - \frac{CT_S}{2} \qquad \text{...}(3.4)$$

$$D = \frac{C}{2}(T_F - T_S) \qquad \text{...}(3.5)$$

ADVANTAGES

- 1. High resolution about one meter.
- 2. Faster than conventional methods.
- 3. Safe at the shallow levels.