2.3 EXTRINSIC SENSORS

Extrinsic fiber optic sensors use an optical fiber cable, normally a multimode one, to transmit modulated light from either a non-fiber optical sensor, or an electronic sensor connected to an optical transmitter. A major benefit of extrinsic sensors is their ability to reach places which are otherwise inaccessible. An example is the measurement of temperature inside air craft jet engines by using a fiber to transmit radiation into a radiation pyrometer located outside the engine. Extrinsic sensors can also be used in the same way to measure the internal temperature of electrical transformers, where the extreme electromagnetic fields present make other measurement techniques impossible.

Extrinsic fiber optic sensors provide excellent protection of measurement signals against noise corruption. Unfortunately, many conventional sensors produce electrical output which must be converted into an optical signal for use with fiber. For example, in the case of a platinum resistance thermometer, the temperature changes are translated into resistance changes. The PRT must therefore have an electrical power supply. The modulated voltage level at the output of the PRT can then be injected into the optical fiber via the usual type of transmitter. This complicates the measurement process and means that low-voltage power cables must be routed to the transducer.

Extrinsic sensors are used to measure vibration, rotation, displacement, velocity, acceleration, torque, and twisting.

Phase Modulated Fiber Optic Sensors:

The most sensitive fiber optic sensing method is based on the optical phase modulation. The total phase of the light along an optical fiber depends on the properties like the physical length of the fiber, transverse geometrical dimension of the guide, refractive index and the index profile of the waveguide. If we assume that index profile remains constant with environmental variations, then the depth of phase modulation depends on the other remaining parameters. The total physical length of an optical fiber may be modulated by the perturbations like thermal expansion, application of longitudinal strain and application of a hydrostatic pressure causing expansion via Poisson's ratio. The refractive index varies with temperature, pressure and longitudinal strain via photo elastic effect. Waveguide dimensions vary with radial strain in a pressure field, longitudinal strain in a pressure field and by thermal expansion. The phase change occurring in an optical fiber is detected using optical fiber Inter ferometric techniques that convert phase modulation into intensity modulation’s:".

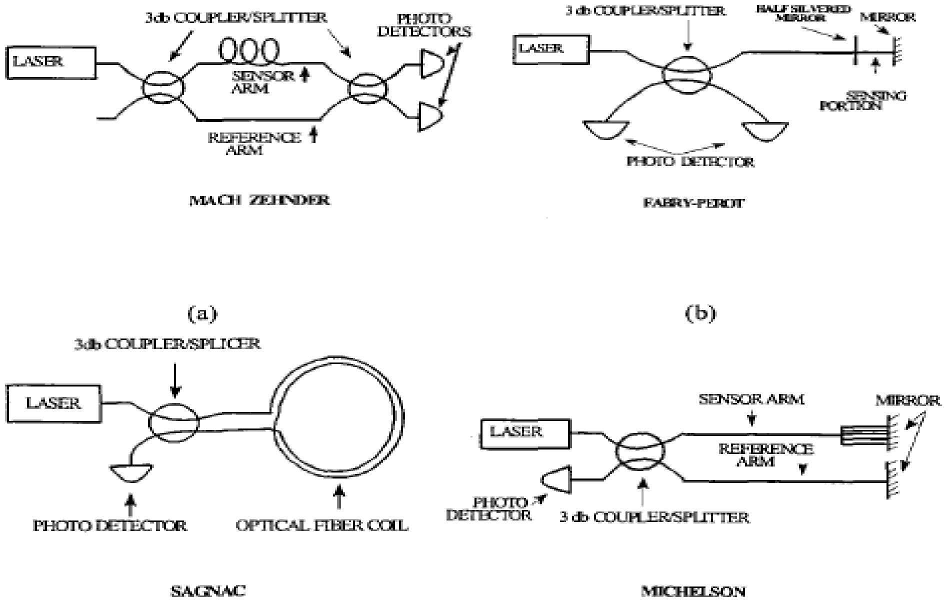

Figure 2.3.1 Phase Modulated Fibre Optic Sensor

[Source: “Optical Fibre Communications” by J.M.Senior, Page:242]

Displacement sensor (Extrinsic Sensor) Principle:

Light is sent through a transmitting fiber and is made to fall on a moving target. The reflected light from the target is sensed by a detector with respect to intensity of light reflected and the displacement of the target is measured.

Description:

- It consists of a bundle of transmitting fibers coupled to the laser source and a bundle of receiving fibers coupled to the detector.

- The axis of the transmitting fiber and the receiving fiber with respect to the moving target can be adjusted to increase the sensitivity of the sensor.

Working:

Light from the source is transmitted through the transmitting fiber and is made to fall on the moving target. The light reflected from the target is made to pass through the receiving fiber and the same is detected by the detector.

Based on the intensity of light received, the displacement of the target can be measured, (i.e.) If the received intensity is more, then we can say that the target is moving towards the sensor and if the intensity is less, we can say that the target is moving away from the sensor.

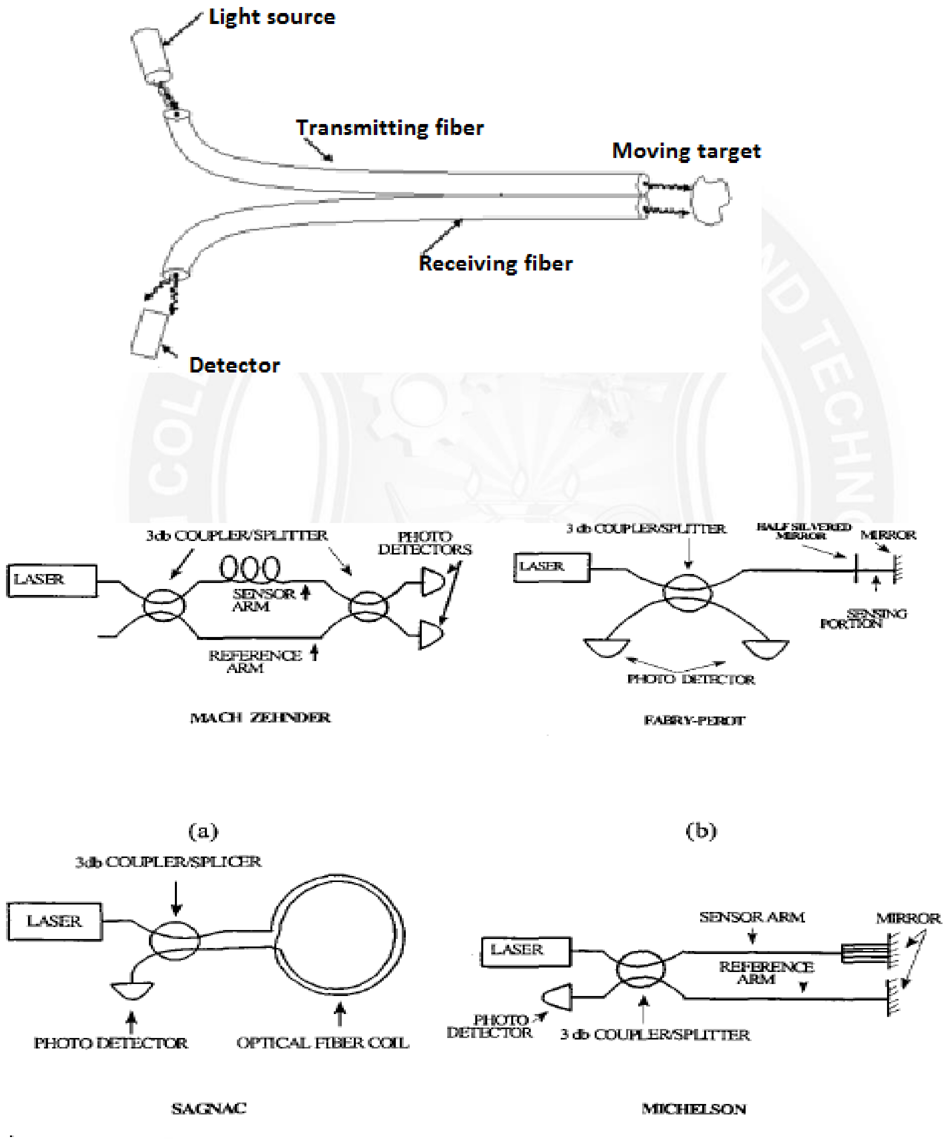

Figure 2.3.2 Displacement Sensor

[Source: "Optical Fibre Communications" by J.M.Senior, Page:242]