060010715-Wireless Networks-Gyroscope Sensor

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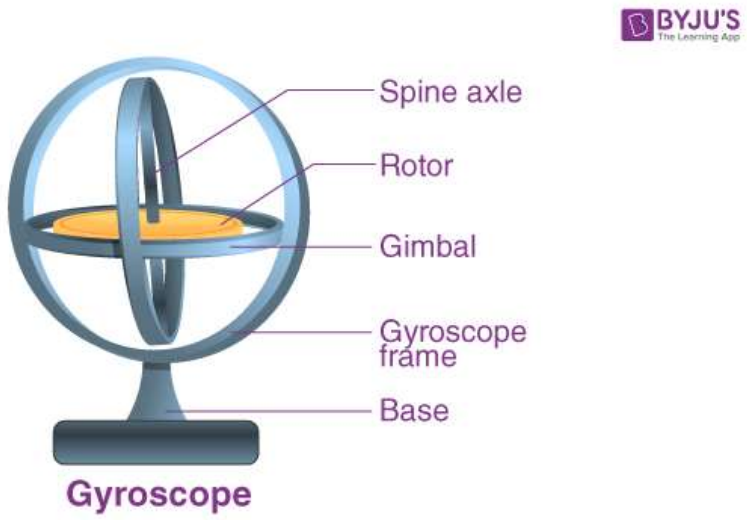
Gyroscope sensors is known as angular rate sensors or angular velocity sensors, are devices that sense angular velocity. Angular velocity is the change in rotational angel per unit of time. Angular velocity is generally expressed in deg/s (degree per second).



A gyroscope consists of the following parts:

- Spin axis
- Gimbal
- Rotor
- Gyroscope frame

Design of Gyroscope

A gyroscope can be considered as a massive rotor that is fixed on the supporting rings known as the gimbals. The central rotor is isolated from the external torques with the help of frictionless bearings that are present in the gimbals. The spin axis is defined by the axle of the spinning wheel.

The rotor has exceptional stability at high speeds as it maintains the high-speed rotation axis at the central rotor. The rotor has three degrees of rotational freedom.

Gyroscope Working Principle

The working principle of gyroscope is based on gravity and is explained as the product of angular momentum which is experienced by the torque on a disc to produce a gyroscopic precession in the spinning wheel.

This process is termed gyroscopic motion or gyroscopic force and is defined as the tendency of a rotating object to maintain the orientation of its rotation.

We know that the rotating object possesses angular momentum and this needs to be conserved. This is done because when there is any change in the axis of rotation, there will be a change in the orientation which changes the angular momentum. Therefore, it can be said the working principle of gyroscope is based on the conservation of angular momentum.

Types of Gyroscopes

The following are the three types of gyroscopes:

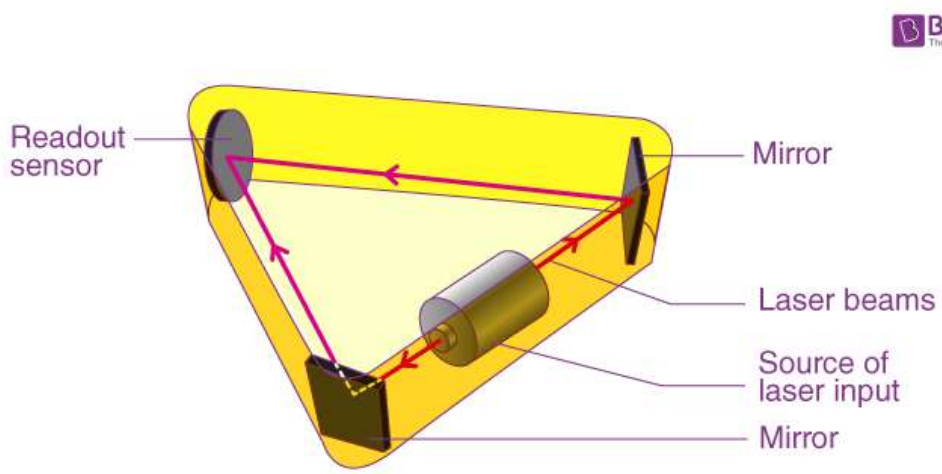
- Mechanical gyroscope
- Optical gyroscope
- Gas-bearing gyroscope

Mechanical Gyroscope

The working principle of the mechanical gyroscope is based on the conservation of angular momentum. This is also one of the most commonly known gyroscopes. The mechanical gyroscope is dependent on the ball bearing to spin. These gyroscopes are replaced with modern forms of gyroscopes as they are noisier. They find applications in the navigation of large aircraft and missile guidance.

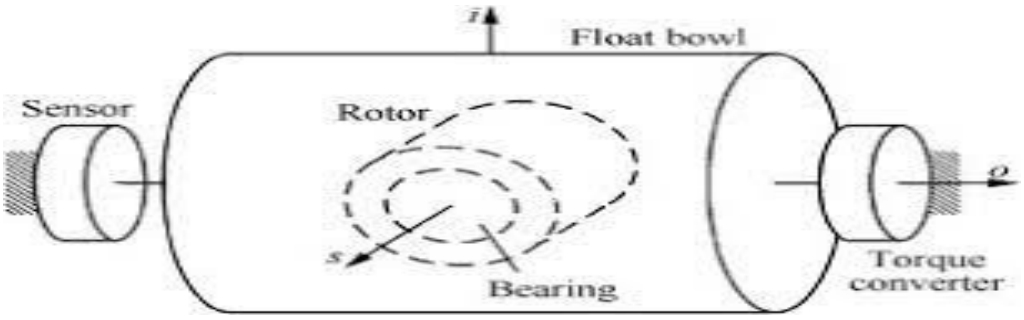
Optical Gyroscopes

These gyroscopes are dependent on the ball bearing or the rotating wheel. They are also not based on the conservation of angular momentum. Optical gyroscopes use two coils of optic fibre that are spun in different orientations. Since there is no movement in the optical gyroscopes, these are considered to be durable and find applications in modern spacecraft and rockets.



Gas-Bearing Gyroscopes

In a gas-bearing gyroscope, the amount of friction between the moving parts is reduced by suspending the rotor with the help of pressurized gas. NASA used a gas-bearing gyroscope in the development of the Hubble telescope. When compared to the other types of gyroscopes, gas-bearing is quieter and more accurate.



Drawbacks of Gyroscope:

- They are more expensive alternative to navigation and tilt sensing applications. Due to advancement in MEMS (Micro Electro-Mechanical System) technology, MEMS version of gyroscopes are available at lower costs.
- Free moving gyroscope type is always dependent on rotation of the Earth. Hence fast-moving objects moving on trajectory from the east to the west cannot use gyroscopes for navigation purpose.
- It does not measure linear motion in any direction, or any static angle of orientation.
- It is subjected to relative azimuth drift unlike compass.

Applications of Gyroscope


Radio-controlled helicopters
SLR cameras
Attitude control
Camera-shake correction