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Using Gyroscopes to Enhance Motion Detection

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Using Gyroscopes to Enhance Motion Detection

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Gyroscopes are used to stabilize, guide, and measure rotational motion. How can these devices be used to enhance motion detectors, and what benefits do they possess? We will explore these answers through analyzing the functionality and usage of gyroscopes in this trade article.

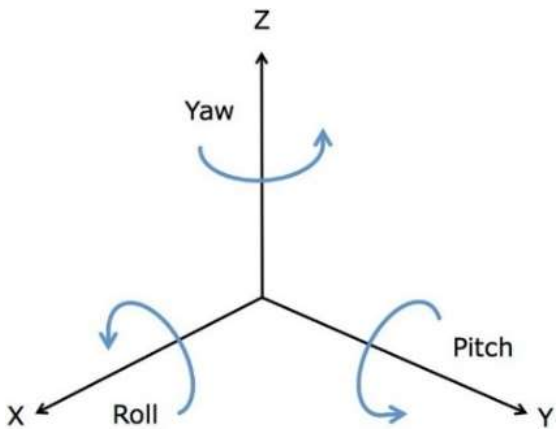
Introduction

A gyroscope has the capability to use the earth's gravity to determine orientation around a set of axes, allowing them to sense rotation of an object around said axes. This allows gyroscopes to stabilize, guide, and measure the rotational motion around the axes. These functions can also be used to measure the overall motion of an object, allowing the gyroscope to act as a motion sensor. Today, gyroscopes can be found in devices such as cell phones, enhancing their overall capability and usability.

Function of the Gyroscope

A functional use of the gyroscope was not found until the early 1900's when Hermann Anschiutz-Kaempfe, a German inventor, created the gyrocompass to allow for more stable navigation for undersea exploration. Since then, gyroscopes have had several functions and applications, including autopilot and targeting features that take advantage of the gyroscope's sense of direction determined through an object's orientation with the earth.

In all these applications, inventors have taken advantage of the gyroscopes ability to sense angular velocity, which is the change in the rotational angle of an object (measured in degrees per second). Because of this, the gyroscope can measure motion of an object though its angular velocity. There are three types of angular velocity: yaw, pitch, and roll. Yaw is the horizontal rotation on a flat surface when seeing the object from above. Pitch is the vertical rotation when seeing the object from the front. Roll is the horizontal rotation when seeing the object from the front. The image gives a visual of these



rotations around their specific axis. The sensing of angular velocity makes the gyroscope beneficial for measuring motion in several devices.

Vibrational Structure Gyroscope

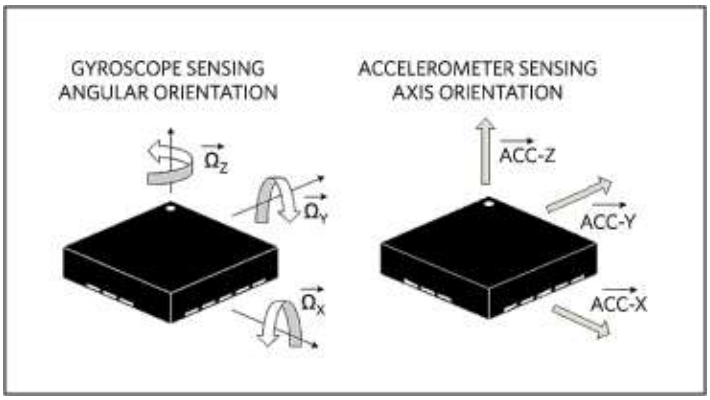
One of the many types of gyroscopes include the vibrating structure gyroscope, or the Coriolis vibratory gyroscope (CVG). This gyroscope contains a vibrating object that countiues to vibrate in the same space even if the support moves. The gyroscope then uses the Coriolis effect to measure the rate of rotation. The Coriolis effect is the object's change in velocity due to the inertial or frictious force called Coriolis force. This force acts on objects that are in motion within a frame of reference that rotates with respect to an inertial frame. When it senses clockwise rotation, the forces act to the left of the object, and acts to the right when it senses counterclockwise rotation. The gyroscope measures the exertion of this force on the support structure to determine and sense the rate of rotation of an object. These types of gyroscopes are found in smartphones, gaming devices, cameras, and other devices.

Application in Smartphones

Vibrational structure gyroscopes have been a part of cellular devices since 2010 when Apple released the iPhone 4. Although they maintain the same functionality as traditional gyroscopes, gyroscopes in cell phones or smart phones contain an electric version of a vibrating structure gyroscope. This version of a gyroscope senses the rotation rate via angular velocity and converts it into an electrical signal. This process can be seen when you tilt or change orientation from horizontal to vertical or vice versa when you are watching a video or playing a game on your phone. The gyroscope in the smart phone detects this change in motion and adjusts the screen to the preferred viewing selection. The application of the gyroscope into cellular devices created a new way to play mobile games and convenient way to interact with one's phone that is often overlooked.

Gyroscopes vs. Accelerometers

Along with gyroscopes, accelerometers are another tool used to detect and sense motion. Accelerometers measure and sense linear motion, such as acceleration and direction. In terms of smart phones, accelerometers are used to track steps as well as know when you are driving, walking, or standing still. This is different from gyroscopes as they measure rotation and orientation rather than linear motion. Due to this, gyroscopes can be seen as more advanced than accelerometers, but both have their respective uses. The sensor difference can be seen in the image below.



Despite their differences, the combination of these sensors allows for even greater motion detection as they offer the freedom of movement in a 3D space, also known as the six degrees of freedom. Each of the sensors provide three of the six degrees of freedom. The accelerometer offers the three measurements of up/down, left/right, and forward/backwards while the gyroscope offers the measurements of yaw, pitch, and roll. These sensors account for different measurements and motion, but they have each offered unique and convenient applications that have given many individuals new ways to interact with certain devices.

Conclusion

The gyroscope's ability to measure and maintain the orientation and angular velocity around the yaw, pitch, and roll axes makes them ideal devices to use for motion sensors. This capability is more advanced than accelerometers which only measure linear motion, but both are unique motion sensors that have changed the way people interact with certain devices. The functional elements of gyroscopes allow them to measure the motion of an object through rotation rate and is applied to certain devices when orientation cannot be sensed by humans.

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