MEMS Technology

Basic MEMS Terminology

Acceleration:
Acceleration is the change in linear velocity.

Accelerometer:
An accelerometer is a sensor that measures acceleration.

Analog Output Sensor:
An analog output sensor provides a voltage that is proportional to its input stimulus.

Digital Output Sensor:
A digital output sensor provides a discrete binary code that is proportional to its input stimulus.

Angular Acceleration:
Angular acceleration is the rate of change of angular velocity over time.

Angular Velocity:
Angular velocity is the rate of change of angular displacement with respect to time.

Angular Displacement:
Angular displacement is the relative change in angular position.

Coriolis Force:
When an object is moving in a periodic fashion (either oscillating or rotating), rotating the object in an orthogonal plane to its periodic motion causes a translational force in the other orthogonal direction. Gyroscopes measure angular rate by measuring the Coriolis Force generated when an internal vibrating mass is rotated.

Dead Reckoning:
Dead Reckoning is a method of determining position using a combination of previous position, direction, and acceleration. A gyroscope can be used to measure rate of rotation, which is integrated once to obtain heading information. An accelerometer can be used to measure acceleration, which is integrated twice to obtain distance traveled.

Degrees of Freedom:
Degrees of freedom (DoF) are the set of displacements and rotations along which an object can move. 6 degrees of freedom (x, y, z translational; pitch, roll, yaw rotational) are sufficient to fully define motion in free space.

Double Tap:
A double tap refers to two taps in close succession.

FIFO:
FIFO refers to a First-In, First-Out memory stack. Data points are processed in the same order in which they are stored. Having a FIFO built in to a sensor provides a data storage buffer that can be used to reduce the resources required by the host processor.

Free-Fall:
Free-fall is the state of motion with no acceleration other than acceleration due to gravity.

Gee (*g*):
G is the unit of acceleration approximately equal to the acceleration due to gravity on the earth's surface. 1 g = 9.8 m/s^2

Gyroscope:
A gyroscope is a sensor that measures rate of rotation.

Heading:
Heading is the direction toward which an object in motion is pointing.

Image Stabilization:
Image stabilization is a technique used to decrease image blurriness and is enabled by using gyroscope technology. It is often used when compensating for camera vibration (shaking).

Inertia:
Inertia is the resistance of an object to change its state of motion.

Inertial Measurement Unit (IMU):
An IMU senses motion — including the type, rate, and direction of that motion — using a combination of accelerometers and gyroscopes.

Inertial Sensor:
An inertial sensor is an instrument that uses the principles of inertia to perform measurement. An accelerometer, for example, compares the motion of a mass fixed to the accelerating object, and a suspended mass. The fixed mass moves with an accelerating object, but the response of the suspended mass lags due to its inertia or resistance to change. The difference in motion can be related to the object's acceleration.

MEMS:
Microelectromechanical systems (MEMS) integrate mechanical elements and electronics all patterned on a silicon substrate with standard microfabrication techniques. Feature dimensions are on the order of 1 µm.

Microfabrication:
Microfabrication is the technology used to fabricate components on a micrometer-sized (or smaller) scale.

Micrometer:
A micrometer or micron (symbol µm) is one millionth of a meter or equivalently one thousandth of a millimeter.

Orientation:
Orientation is the position in free space and is commonly identified as portrait/landscape. An accelerometer's response to Earth's gravitational field can be used to determine orientation.

Orthogonal Plane:
An orthogonal plane is a set of mutually perpendicular axes meeting at right angles.

Oscillation:
Oscillation is repetitive back and forth movement such as a vibration.

Periodic Motion:
Periodic motion is motion that repeats itself at definite intervals of time.

Pitch Axis:
Pitch axis is the Y rotation axis in a 3D system. (See Figure 1)

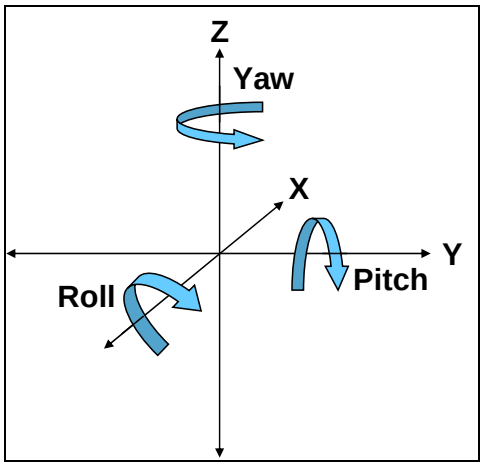

Figure 1

Roll Axis:
Roll axis is the X rotation axis in a 3D system. (See Figure 1)

Rotation:
Rotation can be defined as a single complete turn on an axis.

Shock:
Shock is a sudden force of large magnitude and short duration. Because a shock is close to an acceleration impulse, the frequency spectrum of its force can have components with high frequencies. As acceleration is proportional to the square of the frequency, a shock produces very large acceleration values.

Tap:
Tap is a short impact or strike, similar to a mouse click.

Tilt, inclination:
Tilt or inclination is the angle displacement from a defined reference. In many cases, that defined reference point is the earth's horizon. An accelerometer's response to Earth's gravitational field can be used to determine tilt with respect to the Earth's surface.

Trajectory:
Trajectory is the path that a moving object follows through space.

Translational motion:
Translational motion is motion along a straight line, such as an axis. Accelerometer data can be used to map an object's trajectory in translational motion.

User Interface:
A user interface is the means by which users interact with a system. The use of an accelerometer enables the creation of a more intuitive user interface.

Vibration:
Vibration is periodic mechanical oscillation. Vibration causes acceleration proportional to the square of the frequency of oscillation, so a high-frequency vibration with very small displacement causes very high acceleration values.

Yaw Axis:
The Yaw axis is the Z rotation axis in a 3D system. (See Figure 1)