

IEEE Standard for Inertial Sensor Terminology

Sponsor

**Gyro and Accelerometer Panel
of the
IEEE Aerospace and Electronic Systems Society**

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IEEE Standards Board

Abstract: Terms and definitions relating to inertial sensors are presented. Usage as understood by the inertial sensor community is given preference over general technical usage of the terms herein. The criterion for inclusion of a term and its definition in this document is usefulness as related to inertial sensor technology.

Keywords: inertial sensor technology, inertial sensor terminology

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Introduction

(This introduction is not part of IEEE Std 528-1994, IEEE Standard for Inertial Sensor Terminology.)

IEEE Std 528-1994 is a revision of IEEE Std 528-1984. This standard is a listing of terms and definitions relating to inertial sensors. The criterion for inclusion of terms and definitions in this standard is their general usefulness as related to inertial sensor technology. This revision adds new terms associated with recent advancements in inertial sensor technology.

This standard represents a consensus of manufacturers and users in industry, government agencies, and other interested groups. When necessary, the needs of the inertial sensor community have been given preference over general technical usage. For example, “degree-of-freedom,” “rotor angular momentum,” and “pendulosity” are defined in a specialized sense, as applied to inertial sensors. In general, definitions that might be found in a standard textbook have not been included; for example, “damping ratio” and “orthogonality.”

This standard was prepared by the Gyro and Accelerometer Panel of the Aerospace Electronics Systems Society of the Institute of Electrical and Electronics Engineers. This revision represents a group effort on a large scale. A total of 166 individuals attended 53 meetings of the Gyro and Accelerometer Panel while this standard was in preparation. The major contributors to this standard were as follows:

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The final conditions for approval of this standard were met on April 5, 1994. This standard was conditionally approved by the IEEE Standards Board on March 17, 1994, with the following membership:

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IEEE Standard for Inertial Sensor Terminology

1. Overview

This document presents terms and definitions relating to inertial sensors. Usage as understood by the inertial sensor community is given preference over general technical usage of the terms herein. The criterion for inclusion of a term and its definition in this document is usefulness as related to inertial sensor technology.

2. Definitions

2.1 acceleration-insensitive drift rate (gyro). The component of systematic drift rate that has no correlation with acceleration. *See:* **systematic drift rate.**

2.2 acceleration-sensitive drift rate (gyro). Those components of systematic drift rates that are correlated with the first power of linear acceleration applied to the gyro case. The relationship of these components of drift rate to acceleration can be stated by means of coefficients having dimensions of angular displacement per unit time per unit acceleration for accelerations along each of the principal axes of the gyro (for example, drift rate caused by mass unbalance). *See:* **systematic drift rate.**

2.3 acceleration-squared-sensitive drift rate (gyro). Those components of systematic drift rates that are correlated with the second power or product of linear accelerations applied to the gyro case. The relationship of these components of drift rate to acceleration can be stated by means of coefficients having dimensions of angular displacement per unit time per unit acceleration squared for accelerations along each of the principal axes of the gyro and angular displacement per unit time per the product of accelerations along combinations of two principal axes of the gyro (for example, drift rate caused by anisotropy).

2.4 accelerometer. A device that senses the inertial reaction of a proof mass for the purpose of measuring linear or angular acceleration. *Note:* In its simplest form, an accelerometer consists of a case-mounted spring and mass arrangement in which displacement of the mass from its rest position, relative to the case, is proportional to the total nongravitational acceleration experienced along the instrument's sensitive axes.

2.5 activation time (gyro, accelerometer). *See:* **turn-on time.**

2.6 alignment (gyro, accelerometer). *See:* **input-axis misalignment.**

2.7 angle random walk (gyro). *See:* **random walk (angle).**

2.8 angular acceleration sensitivity (1) (accelerometer). The output (divided by the scale factor) of a linear accelerometer that is produced per unit of angular acceleration input about a specified axis.

(2) (gyro). The ratio of drift rate due to angular acceleration about a gyro axis divided by the angular acceleration causing it. *Note:* In single-degree-of-freedom gyros, it is nominally equal to the effective moment of inertia of the gimbal assembly divided by the angular momentum.

2.9 angular accelerometer. A device that senses angular acceleration about an input axis. An output signal is produced by the reaction of the moment of inertia of a proof mass to an angular acceleration input. The output is usually an electrical signal proportional to applied angular acceleration.

2.10 angular-case-motion sensitivity (dynamically tuned gyro). The drift rate resulting from an oscillatory angular input about an axis normal to the spin axis at twice the rotor spin frequency. This effect is due to the single-degree-of-freedom of the gimbal relative to the support shaft and is proportional to the input amplitude and phase relative to the flexure axes. *See: two-N (2N) angular sensitivity.*

2.11 angular vibration sensitivity (gyro). The ratio of the change in output due to angular vibration about a sensor axis divided by the amplitude of the angular vibration causing it.

2.12 anisoelasticity (gyro). The inequality of compliance of a structure in different directions. *See: acceleration-squared-sensitive drift rate; principal axis of compliance.*

2.13 anisoinertia (1) (accelerometer). A relationship among the principal axis moments of inertia of an accelerometer pendulum in which the moment of inertia about the output axis differs from the difference of the moments of inertia about the other two principal axes. This inequality causes the effective centers of mass for angular velocity and for angular acceleration to be physically separated. In a system in which the accelerometer is modeled as though it were located at the effective center of mass for angular acceleration, there will be an offset in accelerometer output proportional to the product of the angular rates about the input and pendulous axes. Anisoinertia may be expressed as the magnitude of the actual separation in units of length, or as a compensation term in units of $\mu\text{g}/(\text{rad/s})$ squared. Anisoinertia, in this usage, differs from standard physical definitions, but it describes a real effect that is closely analogous to the effect of the same name in gyros. **(2) (gyro).** The inequality of the moments of inertia about the gimbal principal axes. When the gyro is subjected to angular rates about the input and spin axes, and the moments of inertia about these axes are unequal, a torque is developed about the output axis that is proportional to the difference of the inertias about the input and spin axes multiplied by the product of the rates about these two axes.

2.14 anti-lock means (laser gyro). A means of preventing lock-in, such as magneto-optical (Faraday cell, magnetic mirrors), mechanical (dither, rate biasing), or mechanical-optical (mirror dither). *See: lock-in.*

2.15 anti-lock residual (laser gyro). Output noise remaining after compensation for anti-lock means.

2.16 attitude storage (gyro). The transient deviation of the output of a rate-integrating gyro from that of an ideal integrator when the gyro is subjected to an input rate. It is a function of the gyro characteristic time (see figure 1). *See: float storage; torque-command storage.*

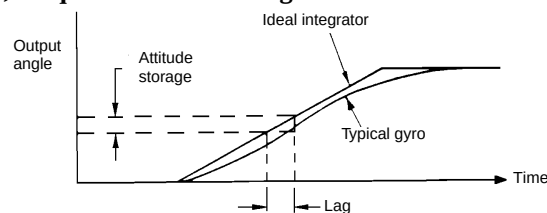


Figure 1—Attitude storage

2.17 autoerection (gyro). The process by which gimbal axis friction causes the spin axis of a free gyro to tend to align with the axis about which the case is rotated. The resulting drift rate is a function of the angular displacement between the spin axis and the rotation axis.

2.18 automatic bias nulling (washout) (gyro, accelerometer). A circuit or system technique for setting the mean value of sensor output, averaged over a defined time period, to zero, or to some defined value.

2.19 axis-of-freedom (gyro). The axis about which a gimbal provides a degree-of-freedom.

2.20 bias (1) (accelerometer). The average component of accelerometer output, which has no correlation with input acceleration. Bias is typically expressed in units of gravity. **(2) (gyro).** The average component of