

Abbé error — Abbé error occurs when the measuring point of interest is displaced from the actual measuring scale location and unwanted angular motion occurs in the positioning system.

Abbé error makes the indicated position either shorter or longer than the actual position, depending on the angular offset.

AC interferometer — A two-frequency interferometer.

Accuracy — The maximum deviation of a measurement from a known standard or true value.

Axis electronics — The modular electronics needed to run one axis of measurement.

Beam splitter — A device to separate and direct light beams, sending the beams straight through, reflecting them at a right angle, or both.

CMM — A precision coordinate measuring machine.

Compensation, Wavelength-of-Light — Correction for the small changes in the wavelength of light due to changes in the refractive index of air.

Cosine error — An error between the measured distance and the actual distance traveled. The error results from misalignment of the measurement axis (the laser beam) to the mechanical axis of motion. This error is called cosine error because its magnitude is proportional to the cosine of the angle of misalignment.

Cube corner — Also called a retroreflector. A mirror assembly that always reflects the light beam parallel to the incoming beam.

DC interferometer — A single-frequency interferometer.

Differential interferometer — An interferometer assembly in which the fixed reference mirror can be remotely mounted, allowing a differential measurement.

Differential measurement — A measurement in which both the reference beam and the measurement beam travel to external mirrors outside the interferometer housing.

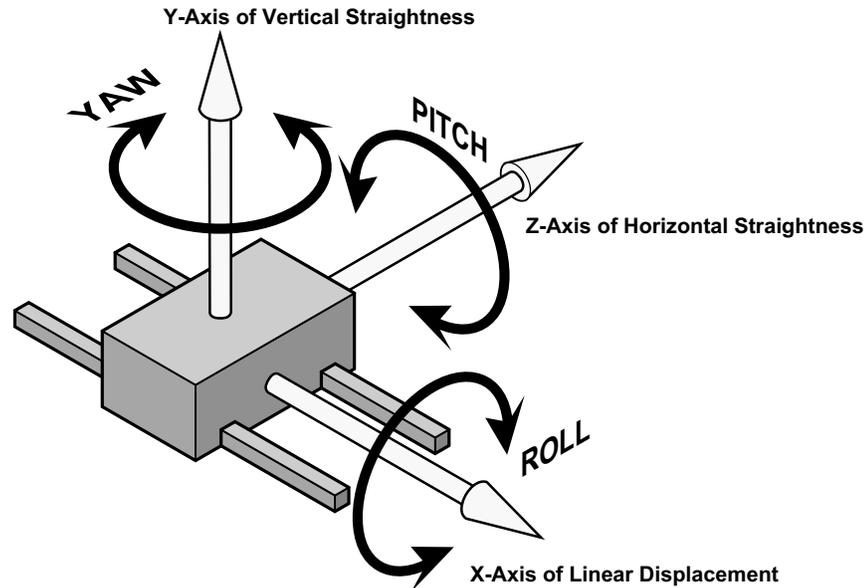
THE SIX DEGREES OF FREEDOM


Figure 18-1. Degrees of freedom (for X-Axis)

Degrees of freedom — Possible motions.

Generally, there are six degrees of freedom for each axis as shown in Figure 18-1. Three of the degrees of freedom are translational. Three of the degrees of freedom are rotational.

ESD — Electrostatic Discharge. A natural phenomenon which, while possibly insignificant on a human scale, can ruin a static-sensitive electronic component. For ESD-avoidance steps, see the Chapter 11, “Troubleshooting,” in this manual.

Etalon — An etalon is an optical reference cavity. When used in the wavelength tracker, the etalon provides a fixed physical distance reference to the differential interferometer. Any length change measured in the etalon is presumed to be due to a change in the optical path length through the air in the cavity, rather than a change in the cavity size

f_1 — The lower one of the two frequencies in the laser beam.

f_2 — The higher one of the two frequencies in the laser beam.

f_A , f_B — Frequency paths in an interferometer.

Half-wave plate — An optical element which introduces a relative phase shift of 180 degrees between the orthogonal components of a wave. This changes the handedness of elliptical and circular light, changing right to left and vice-versa.

HEX — Short for Hexadecimal. See Number systems.

Interferometer — The term interferometer may be applied to any optical arrangement where a beam of light from a light source is separated into two or more paths by a beam splitter and the parts are subsequently recombined after traversing different optical paths. The two components then produce interference.

Kinematic mounting — Kinematic means that all six degrees of freedom (3 translational, 3 rotational) are uniquely and unambiguously restricted.

For kinematic mounting uses a locating plane, a locating line, and a locating point.

The locating plane will be the surface to which the top or the bottom of the interferometer is bolted.

The locating line should be a 2-point contact (or rail) which aligns the front face of the interferometer.

The locating point should be a 1-point contact (or pad) which constrains side-to-side translations of the interferometer.

When installing the interferometer, press it firmly against its locating plane, line, and point while torquing down the mounting screws. If the platform is made with reasonable accuracy, this mounting method can completely eliminate the need to adjust or align a referenced interferometer during installation. Then only the laser beam itself will need to be aligned to its proper position.

Laser — An acronym for “Light Amplification by Stimulated Emission of Radiation.” A laser is a device that uses the natural oscillations of atoms or molecules between energy levels for generating coherent light.

Laser Head — The laser source with its focusing and polarization components.

Laser Interferometry — A technique for measuring distance using the wavelength of laser light by observing and counting optical interference patterns. It can also refer to devices using interferometric techniques to measure surface flatness.

Linear interferometer — An interferometer designed to use cube corners (retroreflectors) as opposed to plane mirrors.

Measurement frequency — The frequency of interference wavefronts detected by the receiver.

MTC — Material Temperature Compensation term.

Number systems — Number systems used in dealing with the computer are typically one (or more) of the following: binary, octal, decimal, or hexadecimal (hex). To help you understand the relationship of these number systems, refer to Table 18-2. Calculators and computer programs that can convert from one of these number systems to another are available from Agilent Technologies and other sources.

Throughout this manual, numbers may be represented in binary (base 2), octal (base 8), decimal (base 10), or hexadecimal (base 16) number systems. Where it is necessary to specify the number system used in order to reduce the possibility of confusion, a base number will be indicated as a subscript or in brackets (“[]”) at the end of the number.

For example, $100[16] = 256[10] = 400[8] = 10000000[2]$.

Table 18-1. Number systems

Base	Binary 2	Octal 8	Hexa- decimal 16	Decimal 10
	0 000 0 001 0 010 0 011	0 0 0 1 0 2 0 3	0 1 2 3	0 1 2 3
	0 100 0 001 0 110 0 111	0 4 0 5 0 6 0 7	4 5 6 7	4 5 6 7
	1 000 1 001 1 010 1 011	1 0 1 1 1 2 1 3	8 9 A B	8 9 10 11
	1 100 1 001 1 110 1 111	1 4 1 5 1 6 1 7	C D E F	12 13 14 15
Note that any one or more of the hexadecimal values shown here as “A” through “F” may be represented in lower case (“a”, “b”, etc).				

Parallelism measurement — A parallelism measurement consists of two straightness measurements made along the same axis from the same straightness reflector.

Parallelism is calculated by comparing the slopes of the two straightness measurements.

Plane mirror interferometer — An interferometer designed to use plane (flat) mirrors to measure motion.

Proportional error — A laser wavelength error that is a function of the distance measured.

Quarter-wave plate — An optical element which introduces a relative phase shift of 90 degrees between the orthogonal components of a wave. This converts linear polarized light to elliptical light and vice versa.

Receiver — The detector, mixer, and electronics to convert the optical signal to an electrical signal.

Reference frequency — The laser Reference Frequency is the difference in frequency between the two orthogonally polarized frequency components of the laser beam. The higher the reference frequency, the greater the measurement velocity or slew rate allowed during a measurement (except as limited by system electronics).

The Reference Frequency may also be referred to as the split frequency.

Referenced interferometer — An interferometer having internal optical components and laser beam paths whose positions are related to reference surfaces on its housing in specified ways.

Repeatability — The maximum deviation between measurements under the same conditions and with the same measuring instrument. This also refers to how stable the measurement will be over time.

Retroreflector — Also called a cube corner. A mirror assembly that always reflects light back parallel to the incoming beam.

Split frequency — Another name for the Reference Frequency.

The difference between the two frequencies in a two-frequency laser system.

Straightness — Straightness is a measurement of displacement perpendicular to the axis of intended motion of the optics.

TCN — Total Compensation Number.

This is a combined compensation term that contains a Wavelength-of-Light compensation term (WCN) and a Material Temperature compensation term (MTC).

Wavelength tracker — A device with an interferometer and a fixed measurement path that is immune to ambient temperature and pressure changes. By monitoring the apparent changes in this fixed pathlength, wavelength changes can be very accurately detected (and corrected).

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