

Accuracy

The degree of conformance between the estimated or measured position, time and/or velocity of a GPS receiver and its true time, position and/or velocity as compared with a constant standard radionavigation system. Accuracy is usually presented as a statistical measure of system error.

Almanac

A set of parameters included in the GPS satellite navigation message that is used by a receiver to predict the approximate location of a satellite. The almanac contains information about all satellites in the NAVSTAR constellation.

Ambiguity

The initial bias in a carrier-phase observation of an arbitrary number of cycles. The initial phase measurement made when a GPS receiver first locks onto a satellite signal is ambiguous by an integer number of cycles since the receiver has no way of knowing when the carrier wave left the satellite. This ambiguity remains constant as long as the receiver remains locked onto the satellite signal and is resolved when the carrier-phase data are processed.

Anti-Spoofing (A-S)

The process of encrypting the P-code by modulo-2 addition of the P-code and a secret encryption W-code. The resulting code is termed Y-code. A-S prevents an encryption-keyed receiver from being fooled or "spoofed" by a bogus P-code signal sent by an enemy.

Availability

The percentage of time that the services of a navigation system can be used within a particular coverage area. Signal availability is the percentage of time that navigational signals transmitted from external sources are available for use. Availability is a function of both the physical characteristics of the operational environment and the technical capabilities of the transmitter facilities.

Block I, II, IIR, IIF Satellites

There are several generations of GPS satellites. Block I were prototype satellites that began being launched in 1978; 24 Block II satellites made up the fully operational GPS constellation declared in 1995; Block IIR are replenishment satellites; and Block IIF refers to the follow-on generation.

C/A Code

The Coarse/Acquisition or Clear/Acquisition code modulated into the GPS L1 signal. This pseudo random noise (PRN) code is a sequence of 1023 pseudo random binary biphasic modulations on the GPS carrier at a chipping rate of 1.023 MHz, thus having a code repetition period of 1 millisecond. The code was selected to provide good acquisition properties. Also known as the "civilian code." C/A codes are transmitted only on the L1 frequency.

Carrier

A radio wave having at least one characteristic, such as frequency, amplitude or phase, that may be varied from a known reference value by modulation.

Carrier-Aided Tracking

A signal processing strategy that uses the GPS carrier signal to achieve an exact lock on the pseudorandom code.

Carrier Frequency

The frequency of the unmodulated fundamental output of a radio transmitter. The GPS L1 carrier frequency is 1575.42 MHz.

Carrier Phase Measurements

GPS measurements based on the L1 or L2 carrier signal.

Channel

A channel of a GPS receiver consists of the circuitry necessary to receive the signal from a single GPS satellite.

Chip

The length of time to transmit either a "0" or a "1" in a binary pulse code. A PRN code consists of a sequence of chips.

Chip Rate

Number of chips per second. For example, C/A code chip rate = 1.023 MHz.

Circular Error Probable (CEP)

A measure of accuracy in horizontal coordinates in navigation. In a circular normal distribution, the radius of the circle containing 50 percent of the individual measurements being made, or the radius of the circle within which there is a 50 percent probability of being located.

Clock Bias

The difference between the clock's indicated time and true universal time.

Clock Offset

Constant difference in the time reading between two clocks.

Code Division Multiple Access (CDMA)

A method of frequency reuse whereby many radios use the same frequency but each one has a unique code. GPS uses CDMA techniques with Gold codes for their unique cross-correlation properties.

Code Phase GPS

GPS measurements based on the C/A code.

Control Segment

A world-wide network of GPS monitor and control stations that ensure the accuracy of satellite positions and their locks.

Cycle Slip

A discontinuity in the measured carrier beat phase resulting from a temporary loss-of-lock in the carrier tracking loop of a GPS receiver.

Data Message

A message included in the GPS signal that reports the satellite's location, clock corrections and health. Included is rough information about the other satellites in the constellation.

Differential GPS (DGPS)

A technique used to improve positioning or navigation accuracy by determining the positioning error at a known location and subsequently incorporating a corrective factor (by real-time transmission of correction or by post-processing) into the position calculations of another receiver operating in the same area and simultaneously tracking the same satellites.

Dilution of Precision – DOP

A dimensionless number that accounts for the purely geometric contribution of the position of the satellites to the uncertainty in a position fix. Standard terms for the GPS application are: GDOP–Geometric Dilution of Precision (three position coordinates plus clock offset in the solution); PDOP–Position Dilution of Precision (three coordinates); HDOP–Horizontal Dilution of Precision (two horizontal coordinates); VDOP–Vertical Dilution of Precision (height only); TDOP–Time Dilution of Precision (clock offset only); RDOP–Relative Dilution of Precision (normalized to 60 seconds).

Distance Root Mean Square (DRMS)

It is the root-mean-square value of the horizontal distance error. The root-mean-square value of the distances from the true location point of the position fixes in a collection of measurements. As typically used in GPS positioning, 2 drms is twice the root mean square of error ellipse. This implies that the probability of finding the true horizontal position is within 95%.

Dithering

The introduction of digital noise. This is the process the DOD used to add inaccuracy to GPS signals to induce Selective Availability.

Doppler-aiding

A signal processing strategy that uses a measured Doppler shift to help the receiver smoothly track the GPS signal. Allows more precise velocity and position measurement.

Doppler Shift

The apparent change in the frequency of a signal caused by the relative motion of the transmitter and receiver.

Earth-Centered Earth-Fixed (ECEF)

Cartesian coordinate system where the X direction is the intersection of the prime meridian (Greenwich) with the equator. The vectors rotate with the earth. Z is the direction of the spin axis.

Elevation

Height above mean sea level. Vertical distance above the geoid.

Elevation Mask Angle

That angle below which satellites should not be tracked. Normally set to 15 degrees to avoid interference problems caused by buildings and trees and multipath errors.

Ellipsoid

In geodesy, a mathematical figure formed by revolving an ellipse about its minor axis. It is often used interchangeably with spheroid. Two quantities define an ellipsoid, the length of the semi-major axis, a , and the flattening, $f = (a - b)/a$, where b is the length of the semi-minor axis.

Ellipsoid Height

The measure of vertical distance above the ellipsoid. Not the same as elevation above sea level. GPS receivers output position fix height in the WGS-84 datum.

Ephemeris

A description of the path of a celestial object as a function of time. Available as “broadcast ephemeris” or as post-processed “precise ephemeris.”

Epoch

Measurement interval or data frequency, as in making observations every 15 seconds. “Loading data using 30-second epochs” means loading every other measurement.

Fast-switching Channel

A single channel that rapidly samples a number of satellite ranges. “Fast” means that the switching time is sufficiently fast (2 to 5 milliseconds) to recover the data message.

Geodetic Datum

A mathematical model designed to best fit part or all of the geoid. It is defined by an ellipsoid and the relationship between the ellipsoid and a point on the topographic surface established as the origin of datum.

Geoid

The particular equipotential surface that coincides with mean sea level and that may be imagined to extend through the continents. This surface is everywhere perpendicular to the force of gravity.

Geoid Height

The height above the geoid, often called elevation above mean sea level.

GPS

The US Department of Defense Global Positioning System: A constellation of 24 satellites orbiting the earth at a very high altitude. GPS satellites transmit signals that allow one to determine, with great accuracy, the locations of GPS receivers. The receivers can be fixed on the Earth, in moving vehicles, aircraft, or in low Earth-orbiting satellites. GPS is used in air, land and sea navigation, mapping, surveying and other applications where precise positioning is necessary.

GPS ICD-200

The GPS Interface Control Document is a government document that contains the full technical description of the interface between the satellites and the user.

Handover Word

The word in the GPS message that contains synchronization information for the transfer of tracking from the C/A to the P-code.

Ionosphere

The band of charged particles 80 to 120 miles above the earth’s surface, which represents a nonhomogeneous and dispersive medium for radio signals.

Ionospheric Delay

A wave propagating through the ionosphere experiences delay. Phase delay depends on electron content and affects carrier signals. Group delay depends on dispersion in the ionosphere as well, and affects signal modulation (codes). The phase and group delay are of the same magnitude but opposite sign.

Ionospheric Refraction

The change in the propagation speed of a signal as it passes through the ionosphere.

Kalman Filter

An optimizing mathematical procedure used to recursively estimate dynamically changing parameters, such as position and velocity track in the presence of noise.

L-Band

The group of radio frequencies extending from 390 MHz to 1550 MHz. The GPS carrier frequencies (1227.6 MHz and 1575.42 MHz) are in the L band.

Local Area DGPS (LADGPS)

A form of DGPS in which the user’s GPS system receives real-time pseudorange and, possibly, carrier-phase corrections from a reference receiver located within line of sight.

Multipath

Interference caused by reflected GPS signals arriving at the receiver, typically as a result of nearby structures or other reflective surfaces. Signals travelling longer paths produce higher (erroneous) pseudorange estimates and, consequently, positioning errors.

Multiplexing Channel

A receiver channel through which a series of signals from different satellites can be sequenced.

NAD-83

North American Datum, 1983.

Narrow Correlator

A correlator in a code-tracking loop in which the spacing between early and late versions of the receiver-generated PRN code is less than about 0.2 chip. This results in pseudorange observations with lower noise and lower multipath effects.

Nav Message

The 37,500-bit navigation message broadcast by each GPS satellite at 50 bps on the L1 and/or L2 signals. This message contains system time, clock correction parameters, ionospheric delay model parameters, and the vehicle's ephemeris and health. The information is used to process GPS signals to give user time, position and velocity.

On-The-Fly (OTF)

The term used to identify a technique that resolves differential carrier phase integer ambiguities without requiring a GPS receiver to be stationary at any time.

P-code

The precise or precision code of the GPS signal, typically used alone by US and allied military receivers. A very long sequence of pseudo-random binary biphase modulations on the GPS carrier at a chip rate of 10.23 MHz which repeats about every 267 days. Each one-week segment of this code is unique to one GPS satellite and is reset each week.

Phase Lock

The technique whereby the phase of an oscillator signal is made to follow exactly the phase of a reference signal. The receiver first compares the phases of the two signals, then uses the resulting phase difference signal to adjust the reference oscillator frequency. This eliminates phase difference when the two signals are next compared.

Point Positioning

A geographic position produced from one receiver in a stand-alone mode.

Position Dilution of Precision (PDOP)

A unitless figure of merit expressing the relationship between the error in user position and the error in satellite position, which is a function of the configuration of satellites from which signals are derived in positioning. Geometrically, PDOP is proportional to 1 divided by the volume of the pyramid formed by lines running from the receiver to four observed satellites. Small values, such as "3," are good for positioning, while higher values produce less accurate position solutions. Small PDOP is associated with widely separated satellites.

Precise Positioning Service (PPS)

The highest level of military dynamic positioning accuracy provided by GPS, using the dual-frequency P-code.

Pseudorange

A distance measurement, based on the correlation of a satellite-transmitted code and the local receivers reference code, that has not been corrected for errors in synchronization between the transmitter's clock and the receiver's clock.

Radionavigation

The determination of position, or the obtaining of information relative to position, for the purpose of navigation by means of the propagation properties of radio waves. GPS is a method of radionavigation.

Range Rate

The rate of change between the satellite and receiver. The range to a satellite changes due to satellite and observer motions. Range rate is determined by measuring the Doppler shift of the satellite beacon carrier.

Real-Time Kinematic (RTK)

The DGPS procedure whereby carrier-phase corrections are transmitted in real time from a reference station to the user's roving receiver.

Relative Navigation

A technique similar to relative positioning, except that one or both of the points may be moving. A data link is used to relay error terms to the moving vessel or aircraft to improve real-time navigation.

Relative Positioning

The process of determining the relative difference in position between two locations; in the case of GPS, by placing a receiver over each site and making simultaneous measurements observing the same set of satellites at the same time. This technique allows the receiver to cancel errors that are common to both receivers, such as satellite clock and ephemeris errors, propagation delays and so forth.

RINEX Receiver INdependent EXchange Format

A set of standard definitions and formats that permits interchangeable use of GPS data from dissimilar GPS receiver models or post processing software. The format includes definitions for time, phase and range.

RTCM SC-104

The special committee of the Radio Technical Commission for Maritime Services that develops recommended standards for DGPS.

Satellite Constellation

The arrangement in space of a set of satellites. In the case of GPS, the fully operational constellation is composed of four orbital planes, each containing six satellites. GLONASS has three orbital planes containing eight satellites each.

Selective Availability (SA)

A DOD program that controls the accuracy of pseudorange measurements, degrading the signal available to unqualified receivers by dithering the time and ephemerides data provided in the navigation message.

Space Segment

The portion of the GPS system located in space, that is, the GPS satellites and any ancillary spacecraft that provide GPS augmentation information (i.e., differential corrections, integrity messages, etc.)

Spherical Error Probable (SEP)

The radius of a sphere within which there is a 50 percent probability of locating a point or being located. SEP is the three dimensional analogue of CEP.

Spread Spectrum

The received GPS signal is wide bandwidth and low power (160 dBW). The L-band signal is modulated with a PRN code to spread the signal energy over a much wider bandwidth than the signal information bandwidth. This provides the ability to receive all satellites unambiguously and to give some resistance to noise and multipath.

Squaring-type Channel

A GPS receiver channel that multiplies the received signal by itself to obtain a second harmonic of the carriers and does not contain the code modulation. Used in "codeless" receiver channels.

Standard Deviation (Sigma)

A measure of the dispersion of random errors about the mean value. If a large number of measurements or observations of the same quantity are made, the standard deviation is the square root of the sum of the squares of deviations from the mean value divided by the number of observations less one.

Standard Positioning Service (SPS)

The normal civilian positioning accuracy obtained by using the single frequency C/A code. Under selective availability conditions, guaranteed to be no worse than 100 meters 95 percent of the time (2 drms).

Static Positioning

Location determination accomplished with a stationary receiver. This allows the use of various averaging or differential techniques.

SV

Satellite vehicle or space vehicle.

Universal Coordinated Time (UTC)

Also termed Coordinated Universal Time. An international, highly accurate and stable uniform atomic time system kept very close, by offsets, to the universal time corrected-for seasonal variations in the earth's rotation rate. Maintained by the US Naval Observatory. GPS time can be related directly to UTC.

User Range Accuracy (URA)

The contribution to the range-measurement error from an individual error source (apparent clock and ephemeris prediction accuracies). This is converted into range units, assuming that the error source is uncorrelated with all other error sources.

User Segment

The part of the whole GPS system that includes the receivers of GPS signals.

World Geodetic System-1984 (WGS-84)

The mathematical ellipsoid used by GPS since January, 1987.

Wide-Area Augmentation System (WAAS)

The Federal Aviation Administration (FAA) in concert with other US government agencies is developing a system that enhances the GPS SPS signal and is available over a wide area of North America. The WAAS signal will provide pseudorange correction data and satellite integrity data to aviation and other users.

World Geodetic System

A consistent set of parameters describing the size and shape of the Earth, the positions of a network of points with respect to the center of mass of the Earth, transformations from major geodetic datums, and the potential of the Earth (usually in terms of harmonic coefficients).

Y-code

The encrypted version of the P-code.