GLOSSARY

of Terms Used in JAVAD GNSS Manuals

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GLOSSARY OF TERMS USED IN JAVAD GNSS MANUALS

A

Absolute Positioning Positioning mode in which a position is identified with respect to a well-defined coordinate system, commonly a geocentric system (i.e., a system whose point of origin coincides with the center of mass of the earth).

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 and is characterized as follows:
Predictable - The accuracy of a radionavigation system's position solution with respect to the charted solution. Both the position solution and the chart must be based upon the same geodetic datum.
Repeatable - The accuracy with which a user can return to a position whose coordinates have been measured at a previous time with the same navigation system.
Relative - The accuracy with which a user can measure position relative to that of another user of the same navigation system at the same time.

AFRM see Automatic File Rotation Mode

Almanac A data structure that contains orbit information about all satellites, clock corrections, atmospheric delays and some other related parameters. It is broadcast by a GPS satellite and is intended to facilitate rapid satellite acquisition within GPS receivers. Generally speaking, almanac data must be acquired before GPS navigation can begin.

Ambiguity Unknown number of full wavelengths counting from the reference satellite to the antenna phase center.

Analog A type of transmission characterized by variable waveforms representing information, contrasted with digital. A standard clock with moving hands is an analog device, whereas a clock with displayed and changing numbers is a digital device. The human voice and audible sounds are analog. Modern computers are invariably digital, but when they communicate over telephone lines, their signals must be converted to analog using a modem (a modulator/demodulator). The analog signal is converted back into a digital form before delivering it to a destination computer.

Antenna That part of the GPS receiver hardware which receives (and sometimes amplifies) the incoming L-Band signal. Antennas come in all shapes and sizes, but most these days use so-called “microstrip” or “patch” antenna elements. The geodetic antennas, on the other hand, may use a “choke-ring” to mitigate any multipath signals.

Anti-jamming Sophisticated technique used in JAVAD GNSS receivers to suppress in-band interference.

Anywhere fix The ability of a receiver to start position calculations without being given an approximate location and time.

Application software These programs accomplish the specialized tasks of the user, while operating system software allows the computer to work. A computer-aided dispatch system is application software, as is each word processing program.

ASCII Acronym for American Standard Code for Information Interchange.
The standard code used for information interchange among data processing systems, data communications systems, and associated equipment.

Automatic Vehicle Location (AVL) A type of system using any sort of technology to track or locate a vehicle.

Automatic File Rotation Mode (AFRM)

In this mode the receiver will periodically close/open log-files at scheduled (evenly spaced) times.

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.

AVL

see Automatic Vehicle Location

Azimuth

The horizontal direction of a celestial point from a terrestrial point, expressed as the angular distance from a reference direction, usually measured from 0° at the reference direction clockwise through 359°.

B

Bandwidth

The difference between the limiting frequencies within which performance of a unit/device, in respect to some characteristic, lies within specified limits.

Baseline

The three-dimensional vector that represents the distance and direction from one survey station to another. It is the result of processing GPS observations that were collected simultaneously at each station.

Base station

Also referred to as a reference station. Base station is a receiver set up on a known location and intended to collect data for rover receivers running in differential mode. In code differential, for example, the base station calculates the pseudorange error for each satellite and, through differential correction, improves the accuracy of a roving GPS receiver's position.

Bearing

The compass direction from position to a destination.

Bias

All GPS measurements are affected by biases and errors. Their combined magnitudes will affect the accuracy of the positioning results (they will bias the position or baseline solution). Biases may be defined as being those systematic errors that cause the true measurements to be different from observed measurements by a “constant, predictable or systematic amount”, such as, for example, all distances being measured too short, or too long. Biases must somehow be accounted for in the measurement model used for data processing if high accuracy is sought. There are several sources of biases with varying characteristics, such as magnitude, periodicity, satellite or receiver dependency, etc. Biases may have physical bases, such as the atmosphere effects on signal propagation or ambiguities in the carrier phase measurements, but may also enter at the data processing stage through imperfect knowledge of constants, for example any “fixed” parameters such as the satellite ephemeris information, station coordinates, velocity of light, antenna height errors, etc. Random errors will not bias a solution. However, outlier measurements, or measurements significantly affected by multipath disturbance (which may be considered a transient, unmodelled bias), will bias a solution if the proportion of affected measurements is relatively high compared to the number of unaffected measurements. For this reason, long period static GPS Surveying is more accurate (less likely to be biased) than “rapid static surveying” or kinematic (single-epoch) positioning.

BINEX

BINEX, for “BINary EXchange”, is an operational binary format standard for GPS/GLONASS/SBAS research purposes.
It has been designed to allow encapsulation of all (or most) of the information currently allowed for in RINEX OBS, GPS RINEX NAV, GLONASS RINEX NAV, RINEX MET, IONEX, SP3, SINEX, and so on, plus other GNSS-related data and metadata as encountered, including next-generation GNSS.

bit

Abbreviation for binary digit. A character used to represent one of the two digits in the numeration system with a base of two, and only two, possible states of a physical entity or system.

Bit Rate

In a bit stream, the number of bits occurring per unit time, usually expressed in bits per second.

Block I, II, IIR, IIF

The various 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.

Boolean value

Type of variable widely used in mathematical logic, programming languages, etc. Takes two values, “true” and “false”. In the context of JAVAD GNSS manuals, we normally use “on” and “off” or “yes” and “no”, which are synonymous with “true” and “false”.

C

C/A code

The coarse/acquisition or clear/acquisition code modulated onto the GPS L1 signal. This code is a sequence of 1023 pseudorandom binary biphase 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.”

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 frequency

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

Carrier phase

GPS measurements based on the L1 or L2 carrier signal. One of the parameters of carrier wave which is measured by JAVAD GNSS receiver.

Carrier-aided tracking

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

Cartesian system coordinate

Earth-fixed spatial Cartesian system (X, Y, Z). The Z-axis coincides with the mean rotational axis of the earth (Polar motion, CIO Pole). The mean equatorial plane perpendicular to this axis forms the (X-Y) plane. The (X-Z) plane is generated by the mean meridian plane of Greenwich. The Y-axis is directed so as to obtain a right handed system.

CDMA see Code division multiple access

CEP see Circular error probable

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

Checksum Checksum is the “additional” part of a transmitted message that allows verification/correction of the informative part of the message on the receiver side.

Chip The length of time to transmit either a “0” or a “1” in a binary pulse code. Also, an integrated circuit.

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

Circular error probable CEP 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.

Civilian code see C/A code.

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.

CMR Compact Measurement Record format.

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's codes for their unique cross-correlation properties.

Code phase GPS GPS measurements based on the C/A code.

Common tracking

Sophisticated technique used in JAVAD GNSS receivers to substantially improve the tracking characteristics of an individual channel by means of using all tracking data from this and the other receiver channels all together.

Computer-aided dispatch

An automated system for processing dispatch business and automating many of the tasks typically performed by a dispatcher. Abbreviated CAD (not to be confused with computer-aided design which is also known as CAD) is application software with numerous features and functions. A basic CAD system provides the integrated capability to process calls for service, fleet management and geographical referencing.

Constellation

Refers to either the specific set of satellites used in calculating positions or all the satellites visible to a GPS receiver at one time.

Control point

Also called a control station. A monumented point to which coordinates have been, or are being assigned by the use of surveying observations. The National Geodetic Survey maintains a nation-wide set of control points.
Control segment A world-wide network of GPS monitoring and control stations that ensure the accuracy of satellite positions and their clocks.

Control segment

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

Cyclic Redundancy Checking (CRC)

Cyclic Redundancy Checking is a method of checking for errors in data transmitted on a communications link. Cycle slip A discontinuity of an integer number of cycles in the measured carrier beat phase resulting from a temporary loss-of-lock in the carrier tracking loop of a GPS receiver.

Crosstrack Error (XTE)

The distance you are off a desired course in either direction. Commonly used in marine or air navigation.

Cutoff Angle

The minimum acceptable satellite elevation angle (above the horizon) to avoid blockage of line-of-sight, multipath errors or too high Tropospheric or Ionospheric Delay values. May be preset in the receiver, or applied during data post-processing. For navigation receivers may be set as low as 5°, while for GPS Surveying typically a cutoff angle of 15° is used.

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.

D

Data message

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

DGPS

See Differential GPS

DATUM

Datum is a means by which coordinates determined by any means may be related to a well-defined Reference Frame. The Reference Frame may be visualised as a 3-D Cartesian coordinate system consisting, as a minimum, of information concerning the origin of the axes, and the directions of two principal axes fixed to the earth. The Reference Frame may be globally applicable, such as WGS84 or ITRF, in which case it is “geocentric” (having its origin at the earth's centre of mass), or be locally applicable as in the case of traditional national geodetic frames such as the Australian Geodetic Datum. In any case, the Datum may be considered synonymous to the Reference Frame, or be restricted to refer to the set of coordinates of geodetic stations or benchmarks which provide the physical realization of the Reference Frame. A satellite-defined Datum such as WGS84 may, in addition, be released by the time-varying coordinates of the satellites themselves (the Ephemerides). Finally, the Datum may be defined only in the horizontal sense or for the vertical component. An example of a Horizontal Datum is a Reference Ellipsoid (located and oriented in such a way as to be compatible to the Reference Frame to which it is attached), upon which coordinate information is expressed in terms of Latitude and Longitude. (WGS84 has a Reference Ellipsoid associated with it.) A Vertical Datum may be defined by a local realization of Mean Sea Level, or as height above the Reference Ellipsoid.

Delay mode

JAVAD GNSS receivers support two RTK modes, delay and extrapolation. When a rover receiver is running in delay mode, the RTK engine will compute the position only for the epochs for which the differential correction data (from the base) are available on the rover end. Due to the data transfer latency and other reasons, the differential correction data are always delayed at the rover. Thus the name of the mode. Note that delay mode is normally used for static surveying in RTK applications.

Differential GPS (DGPS)

A technique to improve GPS accuracy that uses pseudorange errors measured at a known location to improve the measurements made by other GPS receivers within the same general geographic area.

Differential positioning

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 corrections or by postprocessing) into the position calculations of another receiver operating in the same area and simultaneously tracking the same satellites.

Digital

Generally, information is expressed, stored and transmitted by either analog or digital means. In a digital form, this information is seen in a binary state as either a one or a zero, a plus or a minus. The computer uses digital technology for most actions.

Dilution of Precision (DOP)

A description of the purely geometrical contribution to the uncertainty in a position fix. Standard terms for the GPS application are: GDOP:
Geometric (3 position coordinates plus clock offset in the solution)
PDOP: Position (3 coordinates)
HDOP: Horizontal (2 horizontal coordinates)
VDOP: Vertical (height only)
TDOP: Time (clock offset only)
RDOP: Relative (normalized to 60 seconds)

Dithering

The introduction of digital noise into the system. “Clock dithering” is the process by which the U.S. Department of Defense (DoD) degrades the accuracy of the Standard Positioning Service (i.e. absolute positioning of a C/A-Code capable receiver). “Clock dithering” is the additional satellite clock “bias” induced by the DoD's “Selective Availability” policy that cannot be corrected for by the broadcast Navigation Message clock correction parameters.

Distance root mean square (drms)

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 the radius of a circle that contains at least 95 percent of all possible fixes that can be obtained with a system at any one place.

Dithering

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

DOP see Dilution of precision

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

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.

Dual-Frequency Refers to the instrumentation that can make measurements on both L-Band frequencies, or to the measurements themselves (e.g., L1 and L2 pseudo-range or carrier phase measurements). Dual-frequency measurements are useful for high precision (pseudo-range-based) navigation because the Ionospheric Delay bias can be determined, and the data corrected for it. In the case of Double-Differenced carrier phase, dual-frequency observations can account for the residual ionospheric bias (for case of long baselines), or aid Ambiguity Resolution for “rapid static” or “kinematic” baseline determination. All “top-of-the-line” GPS receivers are of the dual-frequency variety, and are comparatively expensive because of the special signal processing techniques that must be implemented to make measurements on the L2 carrier under the policy of Anti-Spoofing.

Dynamic positioning See Kinematic Positioning.

E

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.

ECEF see Earth-centered earth-fixed

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

Elevation mask The angle below which satellites will not be tracked by a GPS/GLONASS receiver.

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

Ellipsoid In the context of JAVAD GNSS manuals, a 3D-rotation body generated by rotating an ellipse around the earth's polar 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 (pl. Ephemerides) The file of values from which a satellite's position and velocity (the so-called “satellite state vector”) at any instant in time can be obtained. The “Broadcast Ephemeris (or Ephemerides)” for a satellite are the predictions of the current satellite position and velocity determined by the Master Control Station, uploaded by the Control Segment to the GPS satellites, and transmitted to the user receiver in the Data Message. “Precise Ephemeris (or Ephemerides)” are post-processed values derived by, for example, the International GPS Service (IGS), and available to users post-mission via the Internet.

Ephemeris Errors Errors (or “biases”) which are present in the (Broadcast or Precise) Ephemeris data. Broadcast Ephemeris errors are typically at the few metre level, while Precise Ephemeris errors are at the decimeter-level. Ephemeris errors are largely mitigated by differential correction (in DGPS Positioning) or in double-differenced observables (formed from carrier phase measurements) when the receivers are not up to a few tens of kilometres apart. In very high precision applications and/or where the baseline lengths are hundreds or thousands of kilometres, residual Ephemeris Errors may limit the accuracy of the baseline solution.

Epoch In GPS, an epoch is the moment at which a measurement is made by a receiver. Measurement interval or data frequency, as in making observations every 15 seconds. “Loading data using 30-second epochs” means loading every other measurement.

Ethernet

Ethernet is the most widely-installed local area network (LAN) technology. The IEEE standard 802.3 defines the rules for configuring an Ethernet network. It is a 10 Mbps, CSMA/CD (Carrier Sense Multiple Access / Collision Detection) baseband network that runs over thin coax, thick coax, twisted pair or fiber optic cable.

Event signal

JAVAD GNSS receiver is capable of receiving an external device's event signals and measuring their reception times in the selected time scale.

Extrapolation mode

JAVAD GNSS receivers support two RTK modes, delay and extrapolation. When a rover receiver is running in extrapolation mode, its RTK engine will update the position for the current epoch irrespective of whether the differential correction data for this epoch have been received from the base or not. If the differential correction data for the current epoch are not received from the base yet, the RTK engine will extrapolate the most recent of the base's carrier phase measurements to the current epoch. Note that extrapolation mode is normally used when dynamic surveying is carried out in RTK.

F

Fast-multiplexing channel

see Fast-switching channel

Fast-switching channel

A single channel which 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.

FCN

See Frequency Channel Number

Fix

A single position with latitude, longitude (or grid position), altitude (or height), time, and date.

Frequency Channel Number (GLONASS) (FCN)

Frequency Hopping Repeated switching of frequencies during radio transmission according to a specified algorithm, to minimize unauthorized interception or jamming of radio communications.

Frequency band A particular range of frequencies.

Frequency spectrum The distribution of signal amplitudes as a function of frequency.

G

Geodesy The science related to the determination of the size and shape of the Earth (geoid) by direct measurements.

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.

Geodetic Survey Global surveys for the establishment of control networks (comprised of Reference or Control Points), which are the basis for accurate land mapping. Maybe carried out using either terrestrial or satellite positioning (e.g. GPS) techniques. The outcome is a network of benchmarks which are a physical realization of the Geodetic Datum or Reference System.

Geographic Information System (GIS) A computer-based system that is capable of collecting, managing and analyzing geospatial data. This capability includes storing and utilising maps, displaying the results of data queries and conducting spatial analysis.

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 is often called elevation above mean sea level.

Geometric Dilution of Precision (GDOP) see Dilution of Precision

Global Orbiting Navigation Satellite System (GLONASS)

This is the Russian counterpart to GPS. It consists of a constellation of 24 satellites (though the number may vary due to difficulties in funding for the system) transmitting on a variety of frequencies in the ranges from 1597-1617MHz and 1240-1260MHz (each satellite transmits on two different L1 and L2 frequencies). GLONASS provides worldwide coverage, however, its accuracy performance is optimized for northern latitudes, where it is better than GPS's SPS (there being no “Selective Availability” on GLONASS satellites). GLONASS positions are referred to a different Datum to those of GPS, i.e. PZ90 rather than WGS84.

GLONASS system time

High precision time scale using the atomic hydrogen maser oscillator (H-maser) of the GLONASS Central Clock (instability does not exceed 5*10-14 per day).

Global Navigation Satellite System (GNSS)

Organizing concept of a European system that would incorporate GPS, GLONASS, and other space-based and ground-based segments to support all forms of navigation.

Global Positioning System (GPS)

The U.S. 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.

GPS Surveying

Conventional static GPS surveying has the following characteristics:
(1) The points being coordinated are not moving, i.e. they are “static”.
(2) GPS data are collected over some “observation session”, typically ranging in length from an hour to several hours (or perhaps days for very precise GPS Geodesy applications).
(3) The results are not required immediately, for in-the-field use.
(4) The relative positioning mode of operation is the only mode employed, requiring the use of a minimum of two GPS receivers for all survey work.
(5) The measurements used for data reduction are those made on the transmitted L-Band carrier wave, requiring specialized hardware and software.
(6) A variety of processing algorithms can be employed, including “bias-free” and “bias-fixed” solutions.
(7) Mostly associated with the traditional surveying and mapping functions.
Since the late 1980's considerable attention has been paid to the first three points, as they were considered to be unnecessarily restrictive for typical GPS surveying applications. As a result of vigorous R&D, new GPS surveying methodologies have been developed, which complement the “conventional static” technique. These modern GPS Surveying techniques are given a variety of names but the following are considered generic: (a) rapid static positioning techniques, (b) “stop & go” techniques, and (c) “on-the-fly” positioning techniques.
Each of the techniques represents a technological solution to the problem of obtaining high productivity (measure as many baselines in as short a period of time as possible) and/or versatility (for example, the ability to obtain results even while the receiver is in motion) without sacrificing very much in terms of accuracy and reliability. None of these techniques is as accurate or reliable as conventional static GPS surveying, and each of these techniques has its special strengths and weaknesses. They represent the state-of-the-art in precision carrier phase-based GPS positioning, and are a direct outcome of considerable innovation by instrument manufacturers seeking to address surveying and non-surveying applications.

GPS system time

GPS system time is referenced to the Master Clock (MC) at the USNO and steered to UTC (USNO) from which system time will not deviate by more than one microsecond.

Grid

A map coordinate system that projects the surface of the earth onto a flat surface such as a “map”, using square zones for position measurements. Common map grids include that defined by the UTM (Universal Transverse Mercator) projection.

Ground Speed The velocity you are travelling relative to a ground position. Typically measured in “knots” (nautical miles per hour), but may be expressed in km/hr or m/s.

H

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.

Hardware The physical components of a computer system. Reference is often made to “hardware” and “software”; in that context, “hardware” consists of the computer, input and output devices and other peripheral equipment.

Heading The heading option is aimed to calculate the heading and pitch angles using two receivers.
Heading option for all new receivers means every two single antenna receivers connected together are able to estimate heading and pitch and output them in:
nmea/HDT - heading,
nmea/P_ATT - pitch and heading,
jps/ha - binary, pitch and heading,

Height (Ellipsoidal) The height coordinate determined from GPS observations is related to the surface of a Reference Ellipsoid. The coordinates are derived initially in the 3-D Cartesian system (as XYZ values), and then for display/output purposes they are transformed to Latitude, Longitude and (Ellipsoidal) Height using well known formulae to an ellipsoid such as that associated with the WGS84 Datum (semi-major axis: 6378137m; inverse flattening: 298.257223563). The surface of the ellipsoid is the zero ellipsoidal height datum. In Relative Positioning, the height component of the receiver whose coordinates are being determined relative to the Base Station can also be related to an ellipsoid by transforming the baseline vector from the 3-D form (DXDYDZ) to a change in Latitude, change in Longitude, and change in Ellipsoidal Height.

Height (Orthometric) The Orthometric Height is the height of a station on the earth's surface, measured along the local plumbline direction through that station, above the Geoid surface. It is approximated by the “Height Above Mean Sea Level”, where the MSL Datum is assumed to be defined by the mean tide gauge observations over several years. The relationship between Orthometric Height (H) and Ellipsoidal Height (h) is: h = H + N, where N is the Geoid Height or Geoid Undulation with respect to the Reference Ellipsoid. Orthometric Height is traditionally derived from geodetic levelling (using such techniques as optical levelling, trigonometrical levelling, barometric levelling).

I

I/O Abbreviation for Input/Output.

In-Band Interference Rejection (IBIR) In-Band interference usually is caused by harmonics of external transmitters (like TV stations) located close to GPS receiver. Interference decreases SNR and may stop receiver operation completely. JAVAD GNSS In-Band Interference Rejection technique suppresses interference and recovers SNR.

Integrated Doppler A measurement of Doppler shift frequency or phase over time.

Integrity The ability of a system to provide timely warnings to users when the system should not be used for navigation as a result of errors or failures in the system.

Interface A shared boundary between various systems or programs. An interface is also the equipment or device that makes it possible to interoperate two systems. For example, it is common to interface the 911 telephone system with a computer-aided dispatch (CAD) system. Both hardware and software are needed to provide that interface.

Independent Baseline

These are baselines observed using GPS Relative Positioning techniques which are the minimum necessary to transfer the Datum from one Base Station to all other stations within a ground network. For example, if there are M stations, there will be M-1 independent baselines linking all the stations. Any extra baselines that are measured are “redundant” baselines which may improve the quality and reliability of the station coordinates after Network Adjustment.

Ionosphere

The band of charged particles 80 to 120 miles above the earth's surface, which represent 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.

J

JPO (Joint Program Office)

That part of the U.S. Department of Defense responsible for managing the GPS development, deployment and operation of the GPS system (in particular the Control Segment and the Space Segment, as well as the military User Segment).

K

Kalman filter

A numerical method used to track a time-varying signal in the presence of noise.

Kinematic Positioning

Kinematic Positioning refers to applications in which the position of a non-stationary object (vehicle, ship, aircraft) is determined.

L

L1 Frequency

1575.42MHz GPS carrier frequency which contains the C/A-Code, the encrypted P-Code (or Y-Code) and the Navigation Message. Commercial GPS navigation receivers can track only the L1 carrier to make pseudo-range (and sometime carrier phase and Doppler frequency) measurements.

L2 Frequency

1227.60MHz GPS carrier frequency which contains only the encrypted P-Code (or Y-Code) and the Navigation Message. Military Y-Code capable receivers can, in addition to making L1 measurements, make pseudo-range measurements on the L2 carrier. The combination of the two measurements (on L1 and L2) permits the Ionospheric Delay to be corrected for. Dual-frequency GPS receivers intended for Surveying applications can make L2 measurements using proprietary signal processing techniques. Such measurements are essential if the Ionospheric Delay on carrier phase is to be corrected for (especially on baselines of length greater than about 20-30km) and/or where fast Ambiguity Resolution is needed.

Latitude

A north/south angular measurement of position relative to the equator, in the meridian plane which contains the earth's rotation axis.

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.

Log file

A receiver’s internal file to which various message types are recorded (raw data measurements, time tags, position&velocity estimates, ephemeris and almanac data and many more).

Local Area Augmentation System (LAAS)

Plan by which Local Area Differential GPS (LADGPS), which generates and transmits differential corrections to appropriately equipped aircraft users, is augmented with integrity messages transmitted from the ground and additional ranging signals. LAAS is set up near a major airport, and consists of the DGPS reference station, the integrity monitoring receiver and a pseudolite which transmits “satellite-like” PRN-coded signals to incoming aircraft.

Longitude

An east/west angular measurement of position in relation to the Prime Meridian. The angle between the two great circles, one being the Prime (or Greenwich) Meridian and the other a meridian passing through the point of interest. (A great circle that passes through the north and south poles, and hence contains the earth's rotation axis.

M

Minimally Constrained

A form of least squares solution in which the observed baseline vectors are treated as “observations” in a secondary network adjustment (see Network Adjustment), and only one coordinate must be held fixed to its known value while all others are allowed to adjust. Typically GPS surveys measure more baselines than the minimum needed to coordinate all the points in the network. These extra “observations” are redundant information that a minimally constrained network adjustment uses to derive optimum estimates of the coordinate parameters, as well as valuable quality information in the form of parameter standard deviations and error ellipses (or ellipsoids).

MinPad

User’s interface allows the user to control and display the operation of the receiver.

Mobile Data Terminal (MDT)

A device, typically installed in a vehicle, that consists of a small screen, a keyboard or other operator interface, and various amounts of memory and processing capabilities.

Modem

A modulator/demodulator. When two computers communicate over telephone lines and similar media, digital signals must be converted to analog during transmission, then back again to digital at the destination. Modems are always used in pairs, one at each end. They are rated according to the speed, typically in “bits per second,” at which the information can pass through the transmission medium.

Monitor stations

One of the worldwide group of stations used in the GPS control segment to track satellite clock and orbital parameters. Data collected at monitor stations are linked to a master control station at which corrections are calculated and from which correction data is uploaded to the satellites as needed.

Multi-base Differential mode in which the rover is allowed to receive and use differential corrections from more than one reference station.

Multi-channel receiver A receiver containing multiple independent channels, each of which tracks one satellite continuously, so that position solutions are derived from simultaneous calculations of pseudoranges.

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

Multipath Error Errors caused by the interference of a signal that has reached the receiver antenna by two or more different paths. This is usually caused by one path being bounced or reflected. The impact on a pseudo-range measurement may be up to a few metres. In the case of carrier phase, this is of the order of a few centimeters.

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

N

NAD-83 North American Datum, 1983

Nanosecond One billionth (10^{-9}) of a second.

Nav message The 1500-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.

NAVSTAR The name sometimes given to the GPS satellite system. NAVSTAR is an acronym for NAVigation Satellite Timing and Ranging.

Network Adjustment A form of least squares solution in which the observed baseline vectors are treated as “observations” in a secondary adjustment (see Minimally Constrained). It may be a minimally constrained network adjustment with only one station coordinate held fixed, or it may be constrained by more than one fixed (known) coordinates. The latter is typical of a GPS survey carried out to densify or connect some newly coordinated points to a previously established control or geodetic framework (see Datum).

NMEA National Marine Electronics Association, a U.S. standards body that defines message structure, content and protocols to allow electronic equipment installed within ships and boats to communicate with each other. GPS receivers can be configured to output various types of messages in the “NMEA format”.

O

Observation The period of time over which GPS data is collected simultaneously by two or more receivers.

OEM Original Equipment Manufacturer. Typically GPS receiver “boardsets” or “engines” that a product developer can embed within some application or hardware package.

On-The-Fly (OTF) This is a form of Ambiguity Resolution (AR) which does not require that the receivers remain stationary for any length of time. Hence this AR technique is suitable for initializing carrier phase-based Kinematic Positioning. For many applications this introduces considerable flexibility. For example, aircraft do not have to be parked on the ground in order to resolve the carrier cycle ambiguities, and then require that signal lock-on be maintained throughout the kinematic survey. However, dual-frequency instrumentation capable of making both carrier phase and precise (P-Code level) pseudo-range measurements is required.

Order of Survey

In an analogous manner to “Class of Survey”, Order of Survey is a means of categorising the quality, or precision, of a static survey. However, it relates to the external quality, and is influenced by the quality of the “external” network information.
The number of categories, the notation applied, and the accuracy tolerances defining the transition from one order to another are defined by individual nations. Typically they mirror the categories of Class of Survey, hence an A Class survey may correspond to a 1st Order survey.
The labeling of a particular Order (e.g. 1st, 2nd, etc.) to a survey points within a “network” (whether it is carried out using GPS or any other technique) is performed as part of the process of Network Adjustment in which the relative error ellipses (in the horizontal case) between coordinated stations are computed and compared with the accuracy standards that must be met for various categories of Order.
However, unlike the Minimally Constrained Network Adjustment that is a prerequisite to establishing the Class of Survey, the Network Adjustment must be constrained to the surrounding geodetic control. Hence a very high quality GPS network (therefore a high Class survey) may be distorted to “fit” the existing control which may have been determined using a lower Class survey.
The resulting Order of the Survey would have to match the lower of either the Class of the GPS survey or the Class of the existing geodetic control.
If the existing geodetic control is of a lower quality to what can be achieved using modern GPS Surveying techniques, then the geodetic control network must be upgraded or “renovated” using more precise GPS Geodesy techniques.

Oscillator

An electronic circuit designed to produce an ideally stable alternating voltage or current.

Outage

Defined as a loss of Availability, due to either there not being enough satellites visible to calculate a position, or the value of the DOP indicator is greater than some specified value (implying that the accuracy of the position is unreliable).

P

PDOP

See Position dilution of precision

P-code

The precise or precision code of the GPS signal, typically used alone by U.S. 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.

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 (see DOP). 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.

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.

Phase lock loop (PLL)

An electronic circuit that controls an oscillator so that it maintains a constant phase angle relative to a reference signal.

Point Positioning

A geographic position produced from one receiver in a standalone mode.

Position

The 3-D coordinates of a point, usually given in the form of Latitude, Longitude, and Altitude (or Ellipsoidal Height), though it may be provided in the 3-D Cartesian form, or any other transformed map or geodetic reference system. An estimate of error is often associated with a position.

Post-Processed GPS

In post-processed (Differential or Relative) GPS the base and user (or roving or mobile) receivers have no data communication link between them. Instead, each receiver records the satellite observations that will allow differential correction (in the case of pseudo-range-based positioning), or the processing of double-differenced observables (in the case of carrier phase-based positioning) at a later time. Data processing software is used to combine and process the data collected from these receivers.

PPS see Precise Positioning Service

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

PRN Pseudo-Random Noise A sequence of digital 1's and 0's which appears to be randomly distributed like noise, but can be exactly reproduced. Each NAVSTAR and GLONASS satellite has its own unique C/A and P pseudo-random-noise codes and are often referred to by their PRN number.

Pseudolite (shortened form of pseudo-satellite) A ground-based differential GPS receiver that simulates the signal of a GPS satellite and can be used for ranging. The data portion of the signal may also contain differential corrections that can be used by receivers to correct for GPS errors.

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

R

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.

RAIM see Receiver Autonomous Integrity Monitoring.

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.

Receiver Autonomous Integrity Monitoring (RAIM)

A form of receiver self-checking in which redundant pseudo-range observations are used to detect if there is a problem or "failure" with any of the measurements -- only four measurements are needed to derive 3-D coordinates and the receiver clock error, hence any extra measurements can be used for checking. Once the failed measurements have been identified they may be eliminated from the navigation fix. RAIM is a concept that has been introduced by aviation users who are concerned that GPS does not have the level of Integrity necessary for non-precision airport approaches or GPS-aided landing.

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.

Reliability

The probability of performing a specified function without failure under given conditions for a specified period of time.

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 postprocessing software. The format includes definitions for time, phase, and range.

Root Mean Square (RMS)

The square root of the average of the squared errors.

RMS value

A typical value of a number (n) of values of a quantity (x1,x2,x3...) equal to the square root of the sum of the squares of the values divided by n.

Rover

Any mobile GPS receiver collecting data during a field session.

Radio Technical Committee for Maritime Applications (RTCM)

RTCM Special Committee 104 has developed standard message types for use by differential GPS transmitting stations. The message content has been defined and hence when the RTCM-104 standard (version 2.2 is the latest) is implemented within a user receiver, it is able to decode and apply the DGPS corrections to its raw data in order to generate a DGPS-corrected coordinate.

Real Time Kinematic (RTK)

The Relative Positioning procedure whereby carrier phase measurements (or corrections) are transmitted in real-time from a Reference or Base Station to the user's roving receiver. Centimeter accuracy is achieved without the need to record and post-process double-differenced carrier phase observables.

RTK Rate

RTK rate means the rate the RTK rover updates its position. It can be up to 100 Hz if vehicle navigation or control task demands that.
For geodetic applications normally 1 Hz update (once per second) is enough.
In any case, whatever the update rate is chosen for the RTK rover, the RTK base can operate at 1 Hz sending corrections only once per second. The RTK rover is able to extrapolate the base measurements if necessary, provided the base is located at the static position.

S

Satellite Constellation

See Constellation, or Space Segment.

SA

see Selective availability

Selective availability SA

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

SEP

see Spherical Error Probable

Sleep mode

You can switch your JAVAD GNSS receiver to a low power consumption mode. In this mode, the receiver’s processor is allowed to go into a sleep state while idling.

Space segment

The portion of the GPS system that is 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 the sphere that will contain 50% of the expected errors in three dimensions.

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.

SPS

see Standard positioning service

Squaring-type channel

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

Stand-alone positioning mode

Mode in which a JAVAD GNSS receiver computes its position “autonomously”, i.e. without using measurements and some other data from any other receivers. The position is identified with respect to a well-defined coordinate system, commonly a geocentric system.

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 when the receiver's antenna is presumed to be stationary on the earth. In the case of pseudo-range-based techniques this allows the use of various averaging techniques to improve the accuracy. Static Positioning is usually associated with GPS Surveying techniques, where the two GPS receivers are static for some observation period which may range from minutes to hours (and even in the case of GPS geodesy, several days).

Stop-and-Go Positioning

This is a GPS Surveying “high productivity” technique which is used to determine centimeter accuracy baselines to static points, using site observation times of the order of 1 minute. Only carrier phase that has been converted into unambiguous “carrier pseudo-range” is used, necessitating that the ambiguities be resolved BEFORE the survey starts (and again at any time the satellite tracking is cut, e.g. due to signal obstructions). It is known as the “stop & go” technique because the coordinates of the receiver are only of interest when it is stationary (the “stop” part), but the receiver continues to function while it is being moved (the “go” part) from one stationary setup to the next. As the receiver must track the satellite signals at all times, hence the transport of the receiver from one static point to another must be done carefully.

SV

Satellite vehicle or space vehicle.

T

Time to first fix (TTFF)

Time To First Fix (TTFF) is a specification detailing the time required for a GPS receiver to acquire satellite signals and navigation data, and calculate a position solution (called a fix).
Typical TTFF for 30 km base lines and open sky conditions does not exceed 30 sec in most cases.
TTFF for 50 km is typically < 2 min.

Track (TRK)

The direction of movement relative to a ground position. Commonly associated with navigation applications.

Triple-Difference

A linear combination of Double-Difference carrier phase observables by which the cycle ambiguity parameters can be eliminated and which is less affected by unrepaired cycle slips than Double-Differences.
A Triple-Differenced observable is created by differencing two consecutive Double-Differences (the same pair of receivers and the same pair of satellites, but separated in time). A useful observable for obtaining approximate baseline solutions or for detecting cycle slips in the Double-Differenced observables.

Trivial Baseline

Trivial Baselines are those baselines formed when more than two GPS receivers are used simultaneously in the field to perform static GPS surveys. For example, when 3 receivers at points A, B, C are deployed only 2 baselines are independent (either A-B & A-C, AB & B-C, or AC & C-B), with the other one being trivial.
This trivial baseline may be processed, but because the data used for this baseline has already been used to process the independent baselines, the baseline results should not be used for Network Adjustment or for quality control purposes unless the statistics (and variance-covariance matrix) are appropriately downweighted.

Troposphere, Tropospheric Delay

The Troposphere is the neutral atmosphere comprising the lower 8km of the atmosphere. The Tropospheric Delay on GPS signals is of the non-dispersive variety because it is not frequency-dependent and hence impacts on both the L1 and L2 signals by the same amount (unlike that within the Ionosphere). The wet and dry components of the Troposphere cause the Delay to the signals, with the wet component be responsible for approximately 10% of the total delay. Various Tropospheric Delay models have been developed to estimate the Delay as a function of the satellite elevation angle, receiver height, and meteorological parameters such as temperature, pressure and humidity. The Delay in the Zenith direction is approximately 2.5m, increasing as the elevation angle of the satellite signal reduces. (This behaviour is described by the so-called Mapping Function, so that the Delay near the horizon is 3-5 times higher than in the Zenith direction.) The Delay is largely eliminated in Relative or Differential Positioning, however the residual Tropospheric Delay increases as the baseline length increases and may be a significant source of error (especially in the height component) for very high precision GPS Geodesy.

TTFF

See Time To First Fix

2drms — A position accuracy measure defined as twice the RMS of the horizontal error. This approximately corresponds to the 95% confidence interval, or "two sigma" value. For example, under the policy of "Selective Availability" GPS Absolute Positioning accuracy is claimed to be 100m 2drms, which means that approximately 95% of the horizontal position solutions will be within 100m of the correct value.

U

Universal time coordinated UTC — 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 U.S. Naval Observatory.
GPS time is directly relatable to UTC: UTC-GPS = seconds. (The changing constant = 5 seconds in 1988.)

URA — see User range accuracy

USB — Universal Serial Bus is a "plug and play" interface between a computer and add-on devices.

User interface — The hardware and operating software by which a receiver operator executes procedures on equipment (such as a GPS receiver) and the means by which the equipment conveys information to the person using it: the controls and displays.

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. Values < 10 are preferred.

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

USNO — U.S. Naval Observatory.

UTC — see Universal time coordinated.

W

Waypoint

A (usually two-dimensional) coordinate that is input into a navigation device, such as a GPS receiver, representing a position that a vessel, aircraft, vehicle or person has to navigate to, with the aid of GPS (and/or any other position fixing device).

WAAS

Wide Area Augmentation System. WAAS is a US Federal Aviation Authority (FAA) funded system of equipment and software that augments GPS accuracy, availability and integrity. The WAAS provides a satellite signal for WAAS users to support enroute and precision approach aircraft navigation. Similar systems are under development in Europe (where it is known as EGNOS -- European Geostationary Navigation Overlay System), Japan (where it is known as MT-SAT), and Australia.

Wait state

A wait state is a situation in which a computer program or processor is waiting for the completion of some event before resuming activity.

WGS-84 (World Geodetic System 1984)

A global Geodetic Datum defined and maintained by the US Department of Defense. As the Control Segment coordinates and the Broadcast Ephemerides are expressed in this Datum, the GPS positioning results are said to be in the WGS84 Datum. In the case of Point Positioning this is largely true, although the level of accuracy achievable under the policy of Selective Availability is so poor that the link to the WGS84 Datum is very approximate. In the case of Relative Positioning, the baseline vector may be determined to quite high accuracy (at the sub-centimetre level using precise GPS Surveying techniques), however the coordinate (and therefore the Datum) of the unknown point is almost completely defined by the Datum of the Base Station. This may not be coincident with the WGS84 Datum at better than a few tens of metres! If GPS Geodesy techniques are used, with known station coordinates expressed in the ITRS and precise ephemerides obtained from the IGS, it is more correct to state that the subsequent set of coordinates are expressed in one of the ITRS frames (e.g. ITRF92, ITRF94, etc.). The WGS84 and the ITRS are compatible at the one metre level. However, the ITRS is a more precise realisation of an earth-fixed, earth-centred terrestrial reference system.

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).

X

XTE See Crosstrack Error

Y

Y code The term used to refer to the encrypted P-Code, generated within the satellites and transmitted on both the L1 and L2 carrier signals under the policy of “Anti-Spoofing”. Civilian GPS receivers use proprietary signal processing techniques to make measurements of pseudo-range and carrier phase on both L-Band frequencies.

Z

Zero Baseline A Zero Baseline test can be used to study the precision of receiver measurements (and hence its correct operation), as well as the data processing software. The experimental setup, as the name implies, involves connecting two GPS receivers to the same antenna. When two receivers share the same antenna, biases such as those which are satellite (clock and ephemeris) and atmospheric path (troposphere and ionosphere) dependent, as well as errors such as multipath CANCEL during data processing. The quality of the resulting “zero baseline” is therefore a function of random observation error (or noise), and the propagation of any receiver biases that do not cancel in double-differencing.

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