UNDERSTANDING GPS ACCURACY

GPS Accuracy Definitions

Pass-to-pass accuracy measures the relative accuracy of a GPS receiver over a 15-minute interval. It does not reflect the long-term accuracy, which is affected by GPS drift.

Year-to-year repeatability is the measure of repeatable accuracy that allows one to return to the same point and follow the same guidance path a day, week, month or year after being initially established.

Different System Accuracies:

GPS Receivers	Pass-to-Pass Accuracy	Year-to-Year Repeatability
RTK	+/- 1 in/2 cm (also referred to as centimeter or sub-inch)	+/- 1 in/2 cm
OmniSTAR HP	+/- 2-4 in/5-10 cm (also referred to as decimeter)	+/- 4 in/10 cm
OmniSTAR XP	+/- 3-5 in/8-13 cm (also referred to as decimeter)	+/- 8 in/20 cm
OmniSTAR VBS, Beacon, WAAS, EGNOS	+/- 6-10 in/15-25 cm (also referred to as sub-meter)	+/- 3 ft/1 m

GPS Glossary

Antenna:
A device for transmitting and receiving radio frequency (RF) signals. In terms of guidance devices, a GPS/GNSS antenna merely accepts signals from satellites or base stations. No internal calculations are performed within the antenna.

Base Station:
A stationary GPS/GNSS receiver that serves as a reference point, providing correction data to a “rover” GPS/GNSS unit. Correction data can be broadcast via RF, cellular signal or the Internet.

Commercial Satellite Provider:
Another common source for DGPS signals. Error correction information obtained from their base stations is sent to a communications satellite (separate from the GPS satellites) and broadcast to the user. These satellite-based corrections tend to have more widespread coverage than tower-based broadcasts (FM links), and system accuracy is not greatly affected by the user’s distance from the base station receivers. Most of these service providers require a subscription fee for use. A commonly known provider is OmniSTAR®.

GPS Glossary

CORS (Continuously Operating Reference Station)/ Network RTK:
A series of base stations spread across a given geographic region (such as an entire state/county) that are networked via a centralized computer and which broadcast RTK correction data over the Internet. CORS networks may be publicly or privately owned/operated and may offer a free signal or require an annual subscription fee. By accessing a CORS network via a cellular connection, the end-user eliminates the need to own a base station.

Differential GPS (DGPS):
The most common way to correct for normally occurring GPS errors. Examples of DGPS include WAAS, EGNOS, OmniSTAR® and RTK.

Dual Frequency or L1/L2:
This term refers to a navigational receiver capable of using L1 and L2C satellite frequencies to derive a position.

EGNOS (European Geostationary Navigation Overlay Service):
A satellite based augmentation system (SBAS) developed jointly by the European Space Agency (ESA), European Community and EUROCONTROL. The system is free to use and provides differential correction coverage primarily across the European continent. EGNOS delivers pass-to-pass accuracies of 6-10 in/15-25 cm and year-to-year accuracies of 3 ft /+/-1 m.

GLONASS (Global Navigation Satellite System):
A global satellite navigation system developed and operated by the Russian government. It is composed of approximately 24 satellites which continuously orbit the earth. While early GNSS receivers typically utilized only GPS signals, many of today's GNSS receivers can utilize signals from both GPS and GLONASS, effectively increasing the total number of satellites available for use.

GPS (Global Positioning System):
The name of the satellite-navigation network maintained by the U.S. Department of Defense. It is composed of approximately 30 satellites which continuously orbit the earth. The term is also used to refer to any device that depends on navigation satellites for functionality.

GPS Drift:
Positional shift that can be caused by changes in satellite constellation, operating near trees or other obstacles and satellite clock errors. RTK correction is recommended for field applications where the effects of GPS drift need to be minimized.

GPS Receiver:
Converts the satellites' signals received via antenna into position, velocity and time. This information is used for navigation, positioning, time dissemination and research.

GNSS (Global Navigation Satellite System):
A general term that refers to a multiple satellite navigation system used by a receiver to compute its position. Examples of these systems include: GPS developed by the United States and GLONASS by Russia. Additional systems in development include Galileo by the European Union and Compass by China. New generation GNSS receivers are being designed to utilize multiple GNSS signals (such as GPS and GLONASS). Depending on constellation and desired accuracy levels, system performance may be improved by having access to a greater number of satellites.

RTK (Real Time Kinematic):
Currently the most accurate GPS correction system available that uses a land-based reference station located in relatively close proximity to the GPS receiver. RTK can provide one-inch, also known as centimeter, pass-to-pass accuracy and also provides year-to-year position stability. RTK users can have their own base stations, subscribe to RTK Networks or use CORS.

SBAS (Satellite Based Augmentation System):
A general term that refers to any satellite-based differential correction system. Examples of SBAS include: WAAS in the United States, EGNOS in Europe and MSAS in Japan. Additional SBAS covering other regions of the world will likely be coming online in the future.

WAAS (Wide-Area Augmentation System):
A satellite correction service developed by the Federal Aviation Administration (FAA). It is free to use and provides coverage across the U.S. along with parts of Canada and Mexico. WAAS delivers pass-to-pass accuracies of 6-10 in/15-25 cm; however, year-to-year accuracy will be in the range of +/- 3 ft /1 m.