



DAILY ASSESSMENT FORMAT

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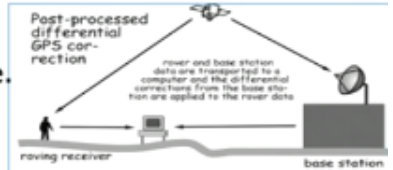
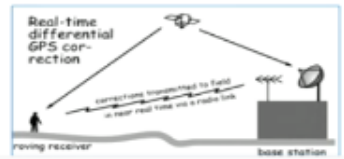
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Principle of Differential- GPS/GNSS



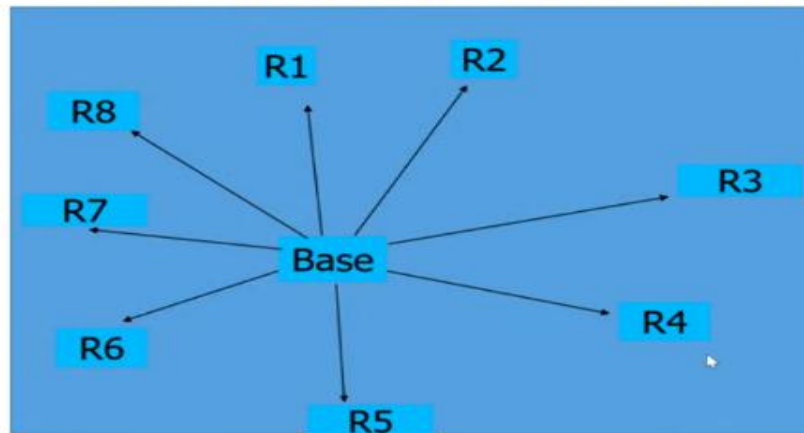
- the Reference Station may compute the errors Δx , Δy and Δz given by

$$\Delta x = x - x', \Delta y = y - y', \Delta z = z - z'$$
- where x, y, z are the correct known positions of the Reference Station and x', y', z' are the computed positions of the Reference Stations using 4 satellites.
- This can be transmitted to the User Receiver in real time.
- The user receiver computes his position using the Pseudoranges obtained from the same 4 GPS satellites and apply the corrections Δx , Δy and Δz .
- This also provides improved position estimate

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Example: Field Work- Static



Case1: Survey with Two GNSS Geodetic Receivers

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GPS?

The Global Positioning System (GPS) is a U.S.-owned utility that provides users with positioning, navigation, and timing (PNT) services. This system consists of three segments: the space segment, the control segment, and the user segment. The U.S. Air Force develops, maintains, and operates the space and control segments.

The Global Positioning System (GPS), originally NAVSTAR GPS, is a satellite-based radionavigation system owned by the United States Government and operated by the United States Space Force. It is one of the global navigation satellite systems (GNSS) that provides geolocation and time information to a GPS receiver anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. Obstacles such as mountains and buildings block the relatively weak GPS signals

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1.General overview of GPS

GPS stands for Global Positioning System by which anyone can always obtain the position information anywhere in the world.

2. Basic structure of GPS

Three-block configuration

GPS consists of the following three segments.

Space segment (GPS satellites)

A number of GPS satellites are deployed on six orbits around the earth at the altitude of approximately 20,000 km (four GPS satellites per one orbit), and move around the earth at 12-hour-intervals.

Control segment (Ground control stations)

Ground control stations play roles of monitoring, controlling and maintaining satellite orbit to make sure that the deviation of the satellites from the orbit as well as GPS timing are within the tolerance level.

User segment (GPS receivers)

User segment (GPS receivers)

GPS positioning

Firstly, the signal of time is sent from a GPS satellite at a given point. Subsequently, the time difference between GPS time and the point of time clock which GPS receiver receives the time signal will be calculated to generate the distance from the receiver to the satellite. The same process will be done with three other available satellites. It is possible to calculate the position of the GPS receiver from distance from the GPS receiver to three satellites. However, the position generated by means of this method is not accurate, for there is an error in calculated distance between satellites and a GPS receiver, which arises from a time error on the clock incorporated into a GPS receiver. For a satellite, an atomic clock is incorporated to generate on-the-spot time information, but the time generated by clocks incorporated into GPS receivers is not as precise as the time generated by atomic clocks on satellites. Here, the fourth satellite comes to play its role: the distance from the fourth satellite to the receiver can be used to compute the position in relations to the position data generated by distance between three satellites and the receiver, hence reducing the margin of error in position accuracy.

The Fig 1-3 below illustrates an example of positioning by two dimensions (position acquisition by using two given points). We can compute where we are at by calculating distance from two given points, and the GPS is the system that can be illustrated by multiplying given points and replacing them with GPS satellites on this figure.

GPS signals

GPS satellites broadcast beams in two carrier frequencies; L1 (1,575.42 MHz) and L2 (1,227.60 MHz). Beams that can be accessible to the general public are encoded in C/A (Coarse/Acquisition) code, and the beams that can be used only by the US military force are encoded in P (Precise) code. C/A code consists of identification codes of each satellite and is broadcast together with navigation messages. The data of the orbit of each satellite is called the ephemeris*, and the data of orbit of all satellite is called the almanac**. The navigation messages are broadcast at a rate of 50 bits per second. Utilizing this collection of data, GPS receiver calculates distance between satellites and the receiver in order to generate position data. In the Fig 1-4, the details of C/A code is described, and in the Fig 1-5, navigation messages are described.

*The ephemeris provides the precise orbit for the satellite itself, which can be used to generate precise location of the satellite, necessary information for calculating position information. It is the indigenous data that is used only by each of the GPS satellites with specific identification number.

**The almanac can be regarded as simplified ephemeris data and contains coarse orbit and status information for all satellites in the network. It is used to locate available satellites in order a GPS receiver to generate current position and time. It takes 12.5 minutes to receive all the almanac data.

What is C/A code?

L1 signal from the GPS satellites is phase-modulated in C/A code, which is the pseudorandom code. The pseudorandom code is also called pseudorandom noise code, which is known as a Gold code. As the Fig. 1-4 illustrates, C/A code is a sequence of digital signals “1” and “0”. In GPS, 1,023 consecutive patterns comprise a sequence, and subsequently, this sequence will continually repeat one after another.

Navigation message

Navigation message consists of 25 frames, each of which includes 5 subframes of 300 bits each. The data length of 1 bit is 20 ms, and thus, the length of each subframe is 6 seconds, and each frame is a grouping of 1,500 bits of information with the frame length of 30 seconds. Since navigation message consists of 25

frames, this would add up to the message length of 12.5 minutes ($30 \text{ seconds} \times 25 = 12.5 \text{ minutes}$). The GPS receiver requires 12.5 minutes to receive all the necessary set of data, necessary condition for positioning, when initial power activation takes place. The GPS receiver is capable of storing this set of data gained in the past internal backup battery, and it reads out the set of data when power reactivation takes place, hence instantaneously starting to receive GPS position.