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Geodesy

Do you know where you are? - The Global Positioning System

Using the Global Positioning System (GPS), every point on Earth can be given its own unique address -- its latitude, longitude, and height. The U.S. Department of Defense developed GPS satellites as a strategic system in 1978. But now, anyone can gather data from them. For instance, many new cars have a GPS receiver built into them. These receivers help drivers know exactly where they are, and can help them from getting lost.

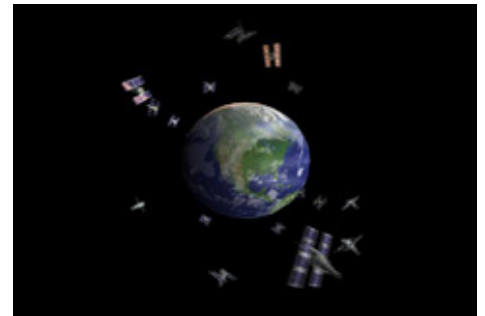
GPS is a constellation of satellites that orbit approximately 11,000 miles above the Earth and transmit radio wave signals to receivers across the planet. By determining the time that it takes for a GPS satellite signal to reach your receiver, you can calculate your distance to the satellite and figure out your exact location on the Earth. Sound easy? In fact it is a very complicated process. For the GPS system to work, you need to have incredibly precise clocks on the satellites and receivers, and you must be able to access and interpret the signals from several orbiting satellites simultaneously. Fortunately, the receivers take care of all the calculations.

Let's tackle the distance calculation first. GPS satellites have very precise clocks that tell time to within 40 nanoseconds or 40 billionths (0.000000040) of a second. There are also clocks in the GPS receivers. Radio wave signals from the satellites travel at 186,000 miles per second. To find the distance from a satellite to a receiver, use the following equation: $(186,000 \text{ mi/sec}) \times (\text{signal travel time in seconds}) = \text{Distance of the satellite to the receiver in miles}$.

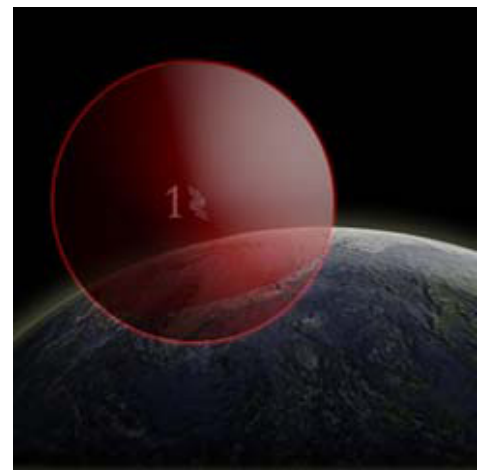
Think of it this way: When construction workers begin to build, they have to be sure that the area where they are building is free from dangerous power lines. The construction team will have to find out where the power lines are and make sure they are not building on top of them. To ensure success, the team needs to know the coordinates of the building site and of the local power lines. The NSRS provides a framework for identifying these coordinates. The team can then compare the two sets of coordinates and make sure they do not overlap.

To identify the benchmarks in the NSRS, NGS has traditionally placed markers, or permanent monuments, where the coordinates have been determined. These markers are brass or bronze disks (metals that sustain weathering) and are set in concrete or bedrock. Each marker is about 9 centimeters wide and has information about NGS printed on its surface.

With the advent of the Global Positioning System (GPS), NGS began to use different kinds of markers. These are made from long steel rods, driven to refusal (pushed into the ground until they won't go any farther.) The top of each rod is then covered with a metal plate. This method ensures that the mark won't move and that people can't destroy or remove it. After tying these marks into a specific horizontal or vertical datum, the mark can be included in the NSRS database. Once the coordinates of the mark are entered into this database, they are available for anyone to use.



The Global Positioning System (GPS) is a constellation of satellites orbiting the Earth approximately 11,000 miles in space. **Click on the image** for an animated view.



It takes four GPS satellites to calculate a precise location on the Earth using the Global Positioning System. **Click on the image** for larger view.

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