

## GPS Tips & Tricks — A User Guide for Optimal GPS Accuracy

It is difficult to imagine living in a world without GPS. We depend on it for personal and vehicle navigation, construction grading and excavation, natural disaster recovery, and GIS mapping among many other uses, all of which significantly impacts the world around us.

Although GPS has its advantages, obstacles in accuracy and reliability often occur. This guide will identify the most common problems with GPS and explain why they occur, pinpoint solutions to resolve them, and ultimately help you achieve optimal accuracy and results from your GPS receiver.

### **Problem #1: Obstructions**

Because the GPS signal coming from the satellites is very faint, there are several objects that can obstruct the direct line of GPS signals from reaching the GPS receiver, whether they are overhead or adjacent obstructions. These objects include mountains or other terrain, tree canopy, buildings, and your body.

#### Solutions

- Step away from the obstructed area until you're in more of a clearing.
- Hold the handheld computer and GPS receiver in a position such that the GPS antenna is facing away from all obstructions.
- Use the manual point collection feature (instead of the timed interval collection feature) while mapping lines and polygons next to buildings or under tree canopy. This allows you to collect a point away from the obstruction and then connect it to a point taken

at the end of the line (these points may need to be adjusted).

- Watch your PDOP (position dilution of precision) settings. PDOP is an indirect measure of the accuracy of your position, so lower numbers are better, preferably less than three. Start out with a threshold setting of five and adjust up or down depending on conditions. Remember that a high threshold setting will make it easier to get a signal, but your accuracy will worsen, and vice versa. You may also try rotating your body to improve your PDOP.
- Set the point averaging setting to collect more points. While you may gather accurate data when collecting an average of two or three points in a clear and unobstructed area, it is recommended that you collect an average of 10-20 points in obstructed areas. Keep in mind that it takes at least one second to collect each point, so if you are averaging 20 points, it will take a minimum of 20 seconds or even longer if your PDOP is high and conditions are poor.

### **Problem #2: Multipath or Signal Reflection**

Multipath errors or signal reflection occur when the GPS signal reflects off of buildings or other objects, resulting in multiple delayed signals. Since the GPS system works off of time, anything that causes delays can result in errors in position. The GPS receiver picks up the direct GPS signal and detects the reflected signals, therefore disrupting the accurate data already collected by the handheld. If you are near a building and your GPS is showing 12 of 12 satellites are visible, yet your GPS position is bouncing around on the screen, it is very

possible that some multipath errors are occurring in which some satellites are being counted twice by the GPS receiver.

## Solutions

- Stand with your back to the building, resulting in the GPS antenna pointing away from the obstruction.
- Watch your PDOP (position dilution of precision) settings. PDOP is an indirect measure of the accuracy of your position, so lower numbers are better, preferably less than three. Start out with a threshold setting of five and adjust up or down depending on conditions. Remember that a high threshold setting will make it easier to get a signal, but your accuracy will worsen, and vice versa. You may also try rotating your body to improve your PDOP.
- Record an offset point measurement at some distance away from the intended measurement point, then enter a manually edited point based on the offset point location.

## **Problem #3: Map Error**

When using GPS with a handheld computer, you have several options of background imagery or aerial photography to use as your base map. Often times, the base map will not be referenced to the same datum or projection as the GPS receiver, resulting in discrepancies between the object's actual GPS coordinates and where it is mapped on the base map displayed on the handheld. For example, the GPS receiver data may be reported in WGS84 datum, while the aerial photography is reported in a different projection, such as NAD83. This results in a mismatch of data that can reach up to 4-6 feet or more.

Another reason for map error is simply because the map was created in the past and is now outdated. Items such as roads and buildings may not have existed when the map was created. Changes in elevation, photography angles, and the curvature of the earth may also affect the accuracy of the imagery.

## Solutions

- Change your map so its datum or projection matches the GPS receiver.
- Remember that you may have the capability of manually editing and adjusting the point positions, depending on the type of mapping software you are using. As you manually move points, be sure that the software you are using automatically changes the GPS coordinates to the correct location to maintain accuracy.

## **General Suggestions**

- If mapping close to a building or other obstructions, try to stay more than twice the height of the building away. This isn't possible in all cases, but is a good rule of thumb to remember.
- Try to keep as many satellites visible as possible. At any location on earth, up to 12 satellites may be visible, so 11 out of 12 or 12 out of 12 satellites will produce the most accurate results. Simply turning and facing different directions can help increase the number of satellites in view.
- If you are standing still and the GPS point starts bouncing around, this most likely means that there is interference nearby affecting your signal. The best way to avoid this is to walk away from overhead obstructions and into more of a clearing.