Blasting with a GPS

Author: Wes Bender

(from the Fall 2000 issue of *The Primer*)

Considering the current interest in Global Positioning System (GPS) usage, it might be timely to address this subject. Due to space limitations in *The Primer*, we can't do an in-depth article on GPS. Instead, if you can find a copy, I would suggest that you read the article in the July/August 2000 issue of the Journal of Explosives Engineering for a little background.

One must understand that, even with the government's removal of "selective availability", where they had intentionally introduced errors, there is still a limitation as to how accurately these instruments can plot your location. (I'm assuming here that you haven't purchased a Differential GPS system. These surveyor's instruments are quite expensive, but can provide measurements to the nearest centimeter.)

If you are attempting to measure 100 to 200 feet or less, use a tape. You want to be within at least 5-10% and a GPS just won't do it. On the other hand, if you are measuring out to 1000 feet or beyond, the GPS will work quite nicely. Be sure and wait for it to settle down before storing your reading. Also try to avoid being in the proximity of buildings or other objects where multi-path problems can cause errors. Bear in mind that the instrument is using arrival times of radio signals from satellites to calculate distances and triangulate locations. If some of those radio waves are traveling farther because they have bounced off an object, the GPS doesn't know it and might give you an erroneous reading.

There is one aspect of GPS that I have not seen covered in most articles on GPS usage. Back in 1994 when I first used a GPS, I struggled with degrees, minutes, seconds and tenths of seconds of both latitude and longitude in trying to determine distances between points. I even went to the trouble of developing a program for my scientific calculator to help resolve the distance. Granted, you could get the GPS to tell you, in hundredths of a mile (52.8 feet), how far it was between points. Plus or minus 53 feet didn't seem very accurate to me for distances under a few hundred feet.

One day Bruce Redpath mentioned to me that I should be using UTM. I had noticed something about UTM in the GPS manual but hadn't paid much attention to it.

UTM (Universal Transverse Mercator) is a coordinate system that was developed by the Defense Mapping Agency (now the National Imagery and Mapping Agency) and is built into most GPS units. It has been in use by the military since 1947.

Basically, the UTM system divides the world into 60 North-South zones, each covering 6 degrees of east-west longitude, commencing at the International Date Line and proceeding to the east. Those of you in California west of 120 degrees are in zone 10. Nevada and the rest of California are in zone 11 and I'm in zone 12 in Arizona. Within each zone, coordinates for a specific location are always measured east and then north in meters. A central meridian is located in each zone and is assigned a value of 500,000 meters, thus locations west of the meridian will be less than 500,000 and locations east of it will be more than 500,000. There are no negative numbers. The north coordinate starts with 0 at the Equator and proceeds north. (In the southern hemisphere, 0 starts at the South Pole and proceeds north.) For example, a UTM reading might be 12 S 0667985 (the easting value) and 3748390 (the northing value). (There is some variation in this system near the north and south poles, but I won't bother you with those details….you're not likely to be blasting there anyway.)

UTM allows you to deal with numbers that are much easier to use in your calculations. If you wish to know the distance between two points that you have stored with your GPS, you need only square the difference between the two easting values, add it to the square of the difference in the two northing values and take the square root of the result. The answer is the distance in meters between the two points. A further advantage of using UTM is that most USGS topographical maps also show UTM grid lines.

If you are using your GPS in conjunction with a topographical map, you need to make sure that your GPS is set to use the same map datum on which the topo map is based. This will most likely be North American Datum 1927 (CONUS) or in some cases North American Datum 1983. (The difference between the two varies. Here in Arizona it can be as much as 60 meters.) If you are not using a map, you don't need to concern yourself with the Datum being used. Just make sure that you don't change the Datum setting in the GPS between taking the readings at the two locations.

If there is an appreciable difference in elevation between the two points, that should also be taken into consideration. Due to satellite geometry, the possible error (Dilution of Precision, or DoP) for elevation readings can be quite large. In most cases it can be large enough to make the GPS useless for accurate elevation readings. A topo map would prove valuable for determining elevations. Just be sure to convert the difference in elevation from feet (as shown on the topo map) to meters before you do the remainder of the calculations. To do this, multiply the difference (in feet) by 0.3048 to obtain the elevation difference in meters.

When including elevation in the calculations, square the difference in the two elevations (in meters). Then add it to the squared differences in the eastings and the northings. Derive the square root of that sum and you will have the slant distance between the two points in meters.

If you need to measure distances (other than in very close proximity) give a GPS using UTM a try. You can obtain a reasonably good one for around $300.00. Make sure it is capable of using the UTM coordinate system. I found it to be advantageous to have one with a detachable antenna so that it can be more easily used in vehicles, boats and ATVs.

If you use your GPS in conjunction with topographical maps, you can obtain a very useful plastic grid overlay and a 45 page instruction booklet on the use of UTM at http://www.maptools.com/products/UTMGuide.html. It is also available through Amazon.com. The cost (around $8, plus shipping) is quite reasonable.