

Digital Terrain Models: GPS or Aerial-Satellite Sensing?

—by Jeff Thurston

Both GPS and aerial-satellite sensors are used to generate data suitable for creating a digital terrain model (DTM). In the case of GPS, a series of points are measured through triangulating signals originating from a series of GPS satellites. Alternatively, data from aerial or satellite sensors can be used to generate a DTM. When is it better to generate a DTM from GPS as compared to aerial or satellite sensing?

Many people depend upon a digital terrain model for a number of different reasons. Elevation measurement of the Earth's surface is an integral piece of information in creating DTM. Flood mapping depends upon correct elevation data. DTM helps us to understand where rising water levels will appear, and it provides valuable information for emergency planning and response. Elevation data support the determination of the aspect (north-south-east-west) of a given point. This determination will help us determine where the sun will or will not shine, where the winds will mostly occur, and whether particular land use—for instance, agriculture, construction or transportation—can be supported by the land.

Traditionally, elevation has been measured by running a traverse across the land, carefully calculating the elevations of a series of points relative to known benchmark elevations. By tying these traverse points to survey control points whose elevation is known, a coordinated system can be calculated based on the newly acquired survey data and the already existing measurements.

The same principle applies to aerial sensing for photogrammetric purposes, as flight planning often entails determining flight lines to avoid excessive overlap (sidelap, endlap) and boundaries. Flight lines are interpreted similarly to ground transect lines, with information gathered along them using either GPS on the ground or cameras onboard an airplane.

In the case of GPS, advanced techniques are often used, and this may include GPS networks. For example, the Ordnance Survey in the U.K. operates a GPS network across the country—as, indeed, do many other countries. The accuracy of measurements obtained with advanced GPS techniques is often better than half-a-meter and may approach centimeter levels. This is also true for data collected using digital photogrammetry. Satellite sensors can acquire elevation data with a very high level of accuracy and precision.

The question is, “Is one technology better for a given application than the other? For national or regional projects which need similar data across long distances, it is often impractical to start building a grid of GPS points. If the points are widely separated, then the derived terrain model may not represent

undulations and changes occurring between measured points accurately.

Conversely, generating digital terrain models (DTM) from data collected by airborne or satellite sensors may include costs that are prohibitive, particularly for small and intermediate companies.

However, DTMs are often created for more than one application, with data from various sources. It is not uncommon, for DTMs to utilize data from expensive sensors measuring, for instance, radiance, salinity, aerosols, or traffic and combine this data with topography data collected on the ground.

Companies or groups of producers who base their decisions on science, knowledge, and new tools, are among the early adopters of a new technology, and this is no different for DTM. Farmers have been among the early adopters of DTM. They view food production is a series of processes, much like constructing a building. They understand that information about the topography of the area they grow crops in will influence the decisions they make about seeding, crop harvesting, distribution, and even marketing. They are pursuing “sustainable agricultural systems” where topography (particularly elevation) plays an important role in the production cycle.

Remote sensing and radar can provide a more densely measured elevation network than does GPS. However, the role of GPS is about to change and become more tightly linked to advanced sensors and the production of 3D models of the “digital farm.”

Are aerial and remote sensing more effective for creating 3D data applications than GPS? I suspect they will eventually converge to support a given process more effectively. The decision to use all three technologies together or each separately will most likely depend on the desired future development of the production process DTM is adopted to improve.

Jeff Thurston is editor and co-founder of *V1 Magazine*. He is editor for Europe, Middle East, and Africa, and he is based in Berlin, Germany.