NO LONGER DIVIDED

BY VICKI SPEED

Ever since GPS was introduced and implemented into the world of surveying, experts have predicted the blending of conventional survey instruments with satellite positioning technology.

They imagined that GPS would eventually function within these conventional tools much like it is used as part of today's in-car navigation systems.

This concept has become increasingly desirable as more surveyors seek the benefits of satellite positioning tools in addition to conventional total station instrumentation. While GPS, in particular real-time kinematic (RTK) GPS, is widely used and provides surveyors with an efficient tool to conduct survey activities, there are still many surveyors who do not benefit from GPS technology because of a perception of complexity and expense.

That may change. The latest advancement in surveying instrumentation is closely following the experts' vision with the introduction of a total station integrated with GPS functionality–in effect, a total station that talks to satellites.

Building Momentum

The surveying industry already boasts several systems that integrate GPS technology. Because satellite surveying data and total station data are so different, manufacturers have been making step-by-step progression toward improving the data flow between the two technologies by providing the user with a common database. Thus, it has now become possible to easily generate results and conclusions by merging surveying measurements from these two technologies. Manufacturers have also built systems that have greater commonality in the application programs and user interface, and even the physical data collection and instrument control devices used with RTK GPS and total stations.

Many surveyors have found real benefit in the combination of these tools. A surveyor can now gather control points with the GPS and traverse with the total station. While each system—the GPS and the total station—works autonomously, the surveyor has just one system to carry to and from a job. The disadvantage is that the surveyor must have training on both GPS and the total station technology to gain real advantage.

The Next Generation

A natural follow-up to this combined total station and GPS framework is to embed the GPS into the total station functionality. The benefits of such a system are many, including improved productivity, reduced learning curves (since surveyors would theoretically need less detailed knowledge about GPS operation because much of it is automated) and site setup flexibility to meet a wide range of applications.

The Leica System 1200 SmartStation is the first such system, a survey tool designed to maximize a surveyor's efficiency during routine tasks such as boundary surveys or construction stakeout. With its combined total station and GPS capabilities, SmartStation eliminates the need for lengthy traverses and multiple setups by integrating RTK GPS into a total station.

Andrew Hurley, director of product marketing for Leica, says that "Fundamentally, it's a total station with GPS capabilities, a complete survey instrument that has the intelligence to gather and process RTK GPS data seamlessly while still providing all the necessary angle and distance measurements required of a total station."

A new system from Leica Geosystems lines up satellites with a total station— all in one unit.

The key elements of the System 1200 SmartStation include the TPS1200 total station series with the Leica SmartTrack dual-frequency GPS receiver. This advanced GPS technology, which is mounted directly on the total station, is able to acquire all visible satellites and work in less than perfect conditions. Hurley adds, "We made sure existing TPS1200 instrument owners can also take advantage of these new features. All existing TPS1200 instruments are SmartStation ready."

In addition, the SmartAntenna can be removed from the SmartStation and used as a stand-alone RTK rover, achieving accuracies of 1 to 2 cm + 1 ppm using on the fly (OTF) initialization at ranges up to 30 km. The System 1200 SmartStation also incorporates the latest Bluetooth wireless technology for wireless communication to cell phones and DISTO laser distance meters, and connectivity to PDAs.

The entire system is operated via the total station TPS keyboard. All GPS and total station data is stored within the same job database on the same compact flash card. In the SmartStation design, it's this integrated base that allows GPS to operate fluidly with the TPS workflow.

Leica Geosystems' new System 1200 SmartStation mounts a SmartTrack dual-frequency GPS receiver directly on a TPS1200 total station.

"The GPS technology is as integral to the total station as it is in the in-car navigation system," Hurley says. "You don't have to know it's there or even how to use GPS–you simply have to ask for a position. The intelligent database understands the request, flips into a GPS unit, resolves the ambiguities and reverts back to a total station–with little or no operator interaction."

But how does it really work? Who really benefits from this embedded technology?

The Power of 2 to Create 1

The integrated, flexible and modular design of Leica's unique System 1200 SmartStation opens the door for significant productivity improvements for a wide range of topographic surveys in remote areas and boundary surveys in rural areas; as an integral part of stakeouts on construction sites; and in urban areas to support utility surveys. Within this one system, a surveyor has a total station and a GPS tool that operate as a single unit to solve most any survey job where the reference system is already defined.

Topographic Surveying

For those who regularly conduct topographic surveys in urban areas, satellite visibility can be a problem. Overhead canopy or local geography can limit the exclusive use of GPS to complete a survey. In many cases, GPS is used to establish control while total stations are used to complete the remaining areas. In many cases, given that a GPS reference station is operating in the vicinity (up to 50 km, achieving accuracies of 1 to 2 cm + 1 ppm with static initialization) and transmitting RTK corrections, RTK GPS can be used to establish control points.

With SmartStation, this survey would be conducted by setting up SmartStation in a convenient location and determining the coordinates with RTK GPS. A backsight would then be observed to a second unknown point, but is not yet coordinated. All necessary detail is observed from the current location before relocating to the second point. Because the backsight point doesn't have coordinates (yet), there would be no coordinates for these detail points. Once set up at the second point, its coordinates are now determined with SmartStation RTK GPS. The availability of this second coordinate then allows the system to automatically update all observations made from the first setup (after using the total station observation of distance between the two points as a check). After backsighting the first setup point from this second setup point, all detail observed from the second point can be immediately stored in the coordinate system created from the two GPS observations.

Hurley notes, "The early test trials using a two-man survey crew compared conventional survey versus those with SmartStation. These tests reflected an average 20 to 30 percent increase in productivity in topographic surveying when the SmartStation is used to eliminate traversing to establish control."

Boundary Surveying

Performing boundary surveying with a conventional total station often demands a time-consuming traverse. An open traverse would have too much risk of undetectable errors or blunders, and a closed traverse takes twice as long. Especially in difficult terrain, traversing is complicated and time-consuming. Once control has been introduced to the area, the boundary survey can continue by traversing around the boundary of the parcel and taking observations to boundary markers.

With GPS reference station data available, SmartStation can be set up at any convenient location close to a boundary marker. In an area where no permanent base station is available, the surveyor would set up a temporary base station on a control point. After determining an RTK GPS position with SmartStation, and observing a backsight to another suitably located point (known or unknown), observations to the boundary marker can be taken. SmartStation can then be taken to the next convenient location to continue the boundary survey.

Leica noted similar productivity increases in boundary surveying as in the topographic surveying during test trials of the SmartStation versus conventional survey methods.

Having positioned the SmartStation, the Smart Antenna is removed and transformed into an RTK rover.

Construction Site Stakeout

Construction sites normally include a large number of control points. However, these points are often obstructed by machinery and materials. In addition, control points are frequently damaged during construction activities, further hindering survey activities. Construction sites demand a high level of survey efficiency as designs are continually changing and many points need to be staked-out in a short period of time. GPS is often the tool of choice for construction site survey activities, and a GPS reference station is set up at the site office to provide RTK corrections for the site.

Stakeout activities using a total station on a construction site are often difficult and time-consuming. Sometimes, the total station is set up in a convenient location and a resection is conducted to determine station coordinates and orientation. At other times, conditions demand that traversing is conducted to transfer control to a convenient location where stakeout activities should take place. Under pressure, the extra time required to conduct a traverse is undesirable.

Using SmartStation, a location can be chosen that best suits the stakeout task at hand. A user sets up SmartStation and determines the station coordinates using RTK GPS, then simply backsights to any control point to determine orientation. Stakeout activities can then begin immediately.

Urban Area Utility Surveys

Utility companies rely on spatial databases to coordinate assets including manholes, covers, hydrants, and distribution boxes for water, gas and electricity. These features are often in locations where buildings and tree coverage prohibit the exclusive use of GPS to coordinate such features.

A total station provides an excellent tool to capture utilities, however, control points are often obstructed by traffic, parked vehicles and the like, rendering traversing likely. Whenever traversing is required, careful, often time-consuming reconnaissance needs to be conducted. Once traversing to the station location is complete, the total station is used to coordinate the utility features.

With SmartStation, no reconnaissance is required. A user sets up at any convenient location, determines station coordinates using RTK GPS and measures all features in the vicinity. If no control point is visible from the current location, the point used for a backsight is occupied with SmartStation and coordinated with RTK GPS. All measurements are automatically updated.

Advancing the Art

The integration of GPS and total station technology holds great potential for productivity improvements. For instance, in a comparison between conventional traversing and SmartStation on a topographic survey, one surveyor conducting tests found that surveying tasks were completed 20-30 percent faster using SmartStation while maintaining accuracy in both horizontal and vertical components. The time savings were achieved through reduced reconnaissance and eliminating a control traverse to propagate control to the survey area.

With the GPS integrated into the total station, this concept also reduces training. To use SmartStation, the surveyor does not need any specialized GPS know-how. In fact, RTK GPS positioning of the total station is achieved simply by the push of one button in the standard total station setup application. As RTK GPS reference station networks proliferate, it will become more likely that in many cases a surveyor will be within 50 km of a reference station and can dial-up and use SmartStation to determine accurate RTK GPS positioning with static initialization of the instrument.

While SmartStation is deriving an RTK position, the press of a single key allows a satellite tracking status to be viewed.

With SmartStation, surveyors no longer need to conduct extensive traversing, the equipment can be set up in a convenient location and the survey can begin immediately. If at least one point with known coordinates exists in the survey area, then as little as one SmartStation setup is needed that has intervisibility to the known point to complete the survey. If no known coordinates exist in the survey area, a minimum of two intervisible SmartStation setups would be required to complete the survey.

"This one integrated system has the ability to reduce a customer's operation costs through speeding the setup process and increasing setup flexibility," Hurley claims.

The SmartStation 1200 will be available this month.

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