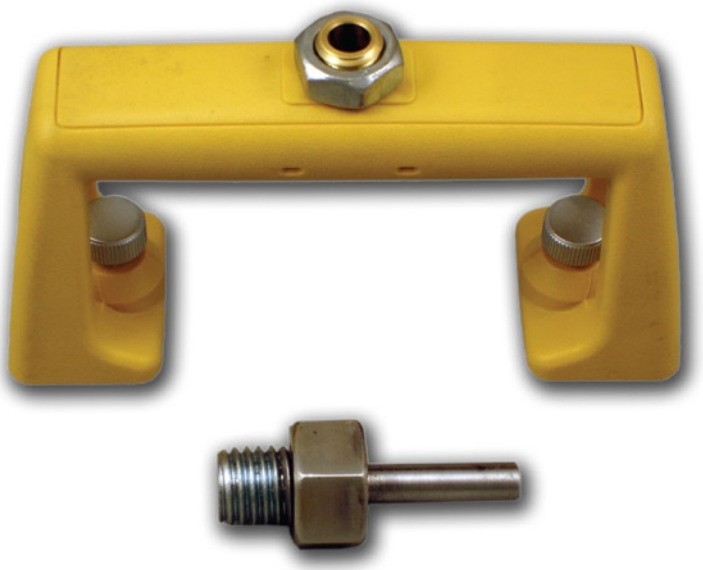

THE TOTALIZER

MAKES YOUR TOTAL STATION COMPLETE

Like many surveyors, I have been following the evolution of GPS for many years (actually more than I care to admit) and constantly looking for ways to make it work for me. My first regular usage was for navigation when I installed a Garmin unit in my airplane in 1991. But surveying turned out to be another story.

In rural Virginia in the Shenandoah Valley it has been difficult for a small surveying and engineering firm to justify the expense of the training and equipment given the constraints that GPS has placed on it by time, geography, foliage, etc. However, I finally took the plunge in early 2006 and bought a complete Trimble set-up and started using it whenever and wherever it seemed the thing to do, but it certainly wasn't paying for itself and spent many days on the shelf. There had to be a way to use it more.

The Germ of an Idea

For several years I had been dreaming of a total station with an integrated GPS unit. I spoke to many dealer and manufacturer reps at shows, and generally played games in my mind. Leica came out with a combined unit several years ago, but I just couldn't see how that unit would solve my needs.

Shortly after acquiring the Trimble equipment, I heard about a new data processing service that NGS was offering called OPUS-RS (On-line Positioning User Service-Rapid Static) that was offering geodetic positioning with as little as 15 minutes of dual frequency data. Now, maybe we had something that we could use in conjunction with our normal angle and distance data acquired with a total station. But in order to make use of this service, it still required hauling around the GPS equipment, making set-ups that

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could then be used by the total station, etc. It still seemed kind of cumbersome.

For a small company where efficiency is essential, we couldn't afford to be taking a lot of extra time making additional set-ups and waiting for GPS data to be collected. On the other hand, we were getting to the point where we couldn't afford not to be making use of the equipment. But then, as they say, the lightbulb lit up. I needed a set-up that would allow us to gather GPS data with little or no extra effort on the part of the crew.

One of the first things I knew about the Trimble equipment (and most all other current equipment) is that the antenna was phase-centered so antenna orientation was of no consideration. But could the antenna be rotated while collecting data and not cause problems? The dealer said yes. I knew that for collecting data to be processed through OPUS or OPUS-RS, all you had to do was turn the unit on and then turn it off. You don't even need a controller because every time the GPS unit cycles on/off it creates a new data file. Maybe I had something that could work.

Getting it Made

After dreaming up the idea and making some crude sketches, I was off to the survey equipment supplier, hardware store, and a machine shop. I purchased an extra Topcon handle so that in the event of a mistake, I would not be without the use of the total station. At the hardware store I purchased a 5/8 x 11 bolt and nut that could be machined down. Then it was on to a machine shop that regularly does oddball projects for me where I described what I was trying to do. I left my sketches with them, and returned a couple of days later to pick up the modified handle and the "Totalizer" pictured in the photograph. It's even better than expected and works very nicely – just as planned.

System Requirements

There are two major system requirements for this idea to work. First, and most important, is to have a GPS unit with a phase-centered antenna. This is critical because the electronic center of the antenna must stay in one location as it is being rotated when collecting data. A further help here for simplicity of operation is to have a GPS receiver that does not require a controller to operate it. A simple on/off switch makes life very easy.

The second requirement is to have a total station that the GPS unit may be mounted atop with the GPS unit centered over the station point. In the example shown here, the handle of a Topcon 3003 contains no parts essential to the operation of the total station and it was a simple matter to drill a hole in the handle and mount a brass bushing. Contrasting that, for instance, with a Topcon 3B which I have used for many years, the 3B has batteries in the handle and you would not be able to drill it for the bushing. It would be much more difficult to rig up a mount on this type of handle.

> "...every job I perform is now oriented on the appropriate State Plane Coordinate System, and we have elevations without having to look for a bench mark..."

One other thing that needs to be mentioned here is that your general areas of operation need to be in locales where OPUS-RS meets operational criteria. You can read about these on the NGS website to evaluate for your location and needs, or see the April 2007 issue of *The American Surveyor* for an article by Dan Martin.

Procedures and Quality Control

The procedures are utterly simple. After the instrument is set up, leveled, and centered, the instrument man sets the GPS unit on top of the total station, turns the unit on, does his angle and distance work, and then turns the unit off. He should also have a small notebook in his pocket to record at which station he gathered data, the start time, the stop time, and the HI of the instrument. That's it.

Back in the office after a 24-hour wait, the OPUS-RS data is uploaded to NGS and generally within two minutes, a 3D position is returned along with quality indicators and statistical data that I have yet to fully comprehend, but that only means it is time for another seminar. This is all well and good, but some people are reporting problems with getting bogus data with OPUS even though everything else looks good. So how do we overcome this?

Remember, while we are collecting the GPS data, we are also turning traditional angles and distances to other traverse stations and sideshots. In the course of doing that work we also have to measure the height of instrument, so determining the height of the GPS is only a matter of adding the distance from center of instrument to GPS antenna to the instrument height. You can then compute your traverse by fitting it to the GPS positions (two or more) and you not only are confirming the relationships of the GPS positions, but also making sure that your angles and distances are good. In fact, you don't even need a closed-loop traverse anymore because the GPS positions can confirm the validity of your open-ended traverse.

The results of a little extra work means that every job I perform is now oriented on the appropriate State Plane Coordinate System, and we have elevations without having to look for a bench mark that might be miles away.

Final Thoughts

While it is going to take a lot of experience to be totally convinced that this system is going to be as useful as hoped, I do believe that this may have helped solve the problem of using GPS on a regular basis in an area where GPS can be difficult and problematic. Time will tell, but 10 and 20 years from now it will be much easier to re-establish ourselves on old jobs, and retracement of today's work will be simplified.

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