A New Total Station Tracking GPS Satellites in a Network RTK Infrastructure Perspective

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SUMMARY

There is no doubt that GPS has introduced a disruptive change in the way we are surveying. A surveyor can today rivals in term of precision positioning with his geodesist colleague as they are using the same technology. There is no more need for dense control networks; the GPS Reference Station infrastructures have substituted the passive network concept to the new active one.

An ongoing trend is engaged to shortcut systematically the surveying process. With the integration of GPS and total station technologies we are assisting today a new paradigm shift. Wireless modems, Internet and number crunching servers are now replacing the conventional geodetic control points the RTK-DGPS corrections are now considered as the basis product for new profitable services articulated within different business models.

More alone on the field than yesterday, the surveyor is now only focus to survey!

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1. MOTIVATION

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2. SURVEYING METHODOLOGY

Traditionally, surveyors use angle measured with theodolites and distance measured with a steel band or Electronic Distance Measurement (EDM) device to propagate coordinates from one point to another using the technique of traversing. The Total Station simplified the procedure of traversing by integrating the EDM into the theodolite and reading all measurements digitally.

The introduction of satellite positioning systems has provided the surveyor with an additional measurement technology to perform survey tasks. GPS, in particular real-time kinematic (RTK) GPS, provides surveyors with an efficient tool to conduct their survey activities. Although RTK GPS is now widely used, there are still many surveyors who do not benefit from GPS technology because of a perception of complexity and expense.

Despite many advantages, surveying using only total stations or GPS has disadvantages. Surveying with a total station, unlike GPS surveying, is not disadvantaged by overhead obstructions; however, it is restricted to measurements between inter-visible points. Often control points are located distant to the survey area, and traversing with a total station to propagate the control is a time consuming task. For this reason, GPS is frequently used to bring control to the survey site before continuing the survey with a total station in areas with overhead obstruction that limit the use of GPS. This procedure is a two steps approach that requires multiple set-up's on pints, one with GPS and then again with a total station.

3. THE INTEGRATION OF GPS AND TOTAL STATION TECHNOLOGIES

The idea of combining GPS and total stations is not new. Stansell [1983] predicted that by the year 2000 that surveyors would combine conventional survey equipments and GPS as an integral part of every survey job.

With the recent release of SmartStation from Leica Geosystems, the world's first integration of GPS and total stations is commercially available.

However, to achieve centimetre accuracy compatible with the total station positioning accuracy, GPS observations received at a rover side must be combined with those received and transmit simultaneously from one GPS receiver acting as a local reference station set-up on a control point. Transformation of coordinates obtained in the GPS datum, the WGS84, into the existing control point's reference frame, is also a part of the process just mandatory in order to deliver useful results.

4. GPS REFERENCE STATION NETWORK

In many regions, the availability of a GPS reference station network means that surveyors can utilize RTK GPS without the need to set-up their own local reference station. They simply enter the field, dial-in to a GPS reference station network infrastructure en begin RTK GPS surveying.

GPS Reference station networks are increasing in popularity as many government agencies have found it more economically viable to invest in GPS reference station networks rather than maintaining ground control. In addition, many private companies have seen the opportunities in setting-up reference station networks and selling the data to an increasing number of users.

The motivation behind using multiple reference stations for GPS corrections is to model and correct for distance-dependent errors that reduce the accuracy of conventional RTK positions in proportion to the distance from a rover to its nearest reference station.

In its role as industry leader in precision GPS, Leica Geosystems has been for many years actively researching and promoting network RTK solutions and working towards an industry standard for network RTK corrections. It is in this role that Leica Geosystems has developed and driven the Master-Auxiliary Concept (MAC), the future of networked RTK and the basis for the new RTCM 3.0 network correction message standard.

The Master-Auxiliary Concept overcomes all of the weakness of the previous approaches (VRS and FKP) that have been used until now by giving the GPS rover the capability to derive the maximum benefit from the information provided by a reference station network even over a broadcast (one way) communication medium.

In conjunction with this new standard, Leica Geosystems has recently released the Leica GPS Spider v2.0 software with its revolutionary new network RTK module SpiderNet, which draws on the latest zero-difference processing techniques to take the Master-Auxiliary Concept (MAX and ***i***MAX) to the maximum reliability, performance, flexibility and security.

5. A NEW WAY TO DESIGN A REFERENCE STATION NETWORK

The primary objective of any surveyor is to survey a project in the most efficient way to increase his profitability and fulfil the increasing request for collecting 3D digital accurate information.

The SmartStation introduces a dramatic shortcut in field operations by combining GPS and total station advantages into a single instrument. But this advantage supposes that GPS Reference Station corrections are available in the vicinity of the equipment.

Instead of setting up a GPS Reference Station network to first cover an entire area like a city, a region or even a country or a nation, the flexibility of the new generation of GPS RTK Network software solution allows the project leader to build himself that infrastructure in a more adaptive, sequential and suitable way.

We can then imagine that some surveying organizations working with or without overlap on the same area will decide to join their effort and build together a largest Reference Station Network in a cooperative basis. It should also be a third party company who wishes to generate new services based on that technology that want to take the initiative to provide the RTK corrections service to those surveying organizations by negotiating the access to their existing data streams.

6. CONCLUSIONS

SmartStation is the world's first commercially available true integration of GPS and total station technology. SmartStation removes the need of traversing to propagate coordinates from distant control points by providing RTK GPS positioning of the total station.

To use SmartStation, the surveyor does not need any specialist GPS know-how, RTK GPS positioning of the total station is achieved simply by the push of one button in the standard total station set-up application.

The proliferation of GPS reference station networks means that in many cases a surveyor is within 50km of a reference station and hence dial-up and use SmartStation to determine accurate RTK GPS positioning of the instrument.

The new Leica GPS Spider v2.0 software and its SpiderNet module provides standard RTCM 3.0 network corrections to both RTK GPS rovers and the new SmartStation, delivering the ultimate accuracy compatible with centimetre performance allowing the integration of GPS and total station technologies.

This new combination of sensors and software is now changing drastically the way we are surveying.

BIOGRAPHICAL NOTES

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