PAPER NINE

"WHAT'S NEXT ? - THE GPS TOTAL STATION THE NEXT SURVEYING TECHNOLOGY"

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What's Next ? - The GPS Total Station
The Next Surveying Technology

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Surveying equipment has been developing at a rapid rate over the last decade.The field surveyor has seen the introduction of high technology Electronic distance and angle measuring equipment ,data recording devices and the introduction of Global Positioning System products for most surveying applications.

Historically data capture was done by laborious methods requiring equipment that relied on optical and mechanical measurement of angles and distances.Field data capture was done in areas and locations that may have required major expeditions lasting months to survey now what would takes days or even hours.Data captured using these methods was then hand written in field notes for post processing of information and plan production.

Electronics were then introduced to the surveying profession bringing with them the ability to electronically record angles and distances in the field greatly reducing the time taken to acquire data.Data was and is currently recorded in either onboard or handheld data capture devices and these are then down loaded for post processing and plan production.Access to most locations has been improved and the length of time required to acquire and post process data had been reduced the lengthy expeditions of early surveyors

In both methods of data capture extensive post processing of data was required and if errors were made then return trips to the field were made to reacquire information and rectify any problems that may have occurred.

Global Positiong System surveying products were then introduced to the surveying community.Initially this technology was used for establishing Geodetic control over areas with little or no control or in applications where a network was established by conventional means and GPS was employed to check the results of the network.More comprehensive infill networks were then undertaken using GPS to improve the scope of the control networks.

Again, in the initial stages of the introduction of GPS, a comprehensive knowledge of the GPS system and post processing software put this technology in the realm of Geodesists and Government bodies who had the wherewithal and resources to cope with costs of acquiring equipment and the knowledge to operate it.

Inherent problems with loss of lock and the need to post process data put GPS technology in an area that the main stream surveyor had real need for the product,but the product was not able to cope with all the surveyors requirements.The real "Dream" of the surveyor was to have GPS in a position to provide real time,survey quality results with none of the inherent problems associated with GPS at a cost that would be obtainable to most surveyors and survey related organisations.

The equipment would have to cater for all aspects of a surveyors operation to include data capture , set out , control and the new mapping requirements being asked of many surveyors.

At the recent F.I.G conference in Melbourne, Australia , Trimble Navigation introduced the GPS Total Station,the next surveying technology.

One of the major hurdles to the use of GPS surveying equipment was the ability to solve for integers while moving.Results were suspect if loss of lock occurred in dynamic survey applications.Simple loss of lock could cause the acquisition of data for a major project to suffer in obtaining post processed results and often led to more field work to enable the surveyor to achieve their results.

In most instances this was probably still preferable to conventional data acquisition methods,but still increased costs for the surveyor and their end users.By solving for the integers while moving or "On The Fly" ,GPS surveying is now within the reach of most applications relating to tasks required of the modern surveyor.

Trimble Navigation elected to call their new technology the GPS Total Station as the equipment has been designed to emulate, where possible, the everyday surveying tasks that traditional total stations perform.

The system will allow for data capture ,as well as setting out, control work and many design functions.

Contrary to conventional understanding of what the term "Total Station " has come to mean to most surveyors,the equipment is not a GPS inside a total station housing.This equipment would be very expensive,very heavy, and consume far too much power to be a transportable and easy to use system.As the system performs the same tasks that traditional Total Stations do ,the GPS Total Station is another tool for the surveyor to use in acquiring data in the field to increase their productivity .The GPS Total Station will not do all tasks required of the modern day surveyor as the current optical/mechanical Total Stations do not perform all those relevant tasks either,be they operational or economic.

The GPS Total Station consists of several components.The main components of the system are a base station referenced over a control point, a communications system and a rover unit.Included is Trimmap ,a down loading and communications package with many functions.The base system consists of a receiver ,antenna system,communications link and cabling.The rover system comprises a receiver,bacpack,antenna system and communications unit.

The results are processed in real time to allow for correction of signals received in the rover system ,display for confirmation to the operator and recording for down loading into a CAD package.Probably the most important aspects of the system are in the real time processing technology,the hand held data capture device and the communications system.

To have a fully workable solution ,allowing for loss of lock and re acquisition of the integers to solve for the ambiguities and provide the required results, the system must use full parallel dual frequency,P-Code receivers.The system must have a robustness that allows for constant receipt of data from the satellites that is clear,clean and repeatable.The communications of the correction information over a radio link must be consistent and allow for maximum information to be transferred to include all data correction strings and quality control information.

Trimble Navigation use the cross correlation technique under encryption that allows for continuity of results while this system function is operating.

The survey uses three methods of initialisation.The first has been in use for over two years and uses initialisation with a short or known baseline.If lock on the satellites is lost then the surveyor must return to a previously surveyed point and reacquire and continue on.This technique was OK for some applications,mainly in resource,mining or localised engineering surveying applications,but held some major problem for a lot of dynamic applications.One of the major benefits of this system was that it only requires single frequency receivers and therefore the cost can be kept down.

The other two techniques relate to true "On The Fly " surveying techniques.Initialisation while static,and true initialisation while mobile.Each has the ability to reacquire the integers and solve for ambiguities whithout returning to a known point.Each also uses a different processing technique to achieve this.

Initialisation while static requires the user to hold the rover antenna still,much like a prism must be for an optical Total Station,and once lock is reacquired move off and continue the survey operation.This usually takes between ten and fifty seconds depending on conditions at the time of survey.In all methods of GPS Toatal Station surveying basic GPS Surveying techniques must be adhered to and a working knowledge of the GPS system is assumed.

Initialisation while on the "Fly" acheives the same result but can be done in a dynamic situation such as in an aircraft or boat.Accuracies achievable by GPS Total station depend on the type of receiver purchased but are generally in the area of +/- 1 cm + 2ppm horizontal and +/- 2cm + 2 ppm vertical.

The real operational benefits here are that the surveyor can see ,through the handheld data capture device, the accuracy and precision of the measurement prior to recording the information into the data collector.This ensures that not only is the measurement recorded,but the QA information is recorded for later use if necessary.

It must be noted that the system is designed for use up to ten kilometres from the base.The reasons for this are in the initialisation process and geodetic anomalies that can occur over this distance.Longer baselines can be recorded internally and then post processed by conventional methods if necessary.

One of the crucial links in any differential system is the radio link.To ensure that data transmission maintains continuity and was durable,Trimble Navigation spent large amounts on R & D to research what the best possible radio link would be.This not only included the type of radio, but performance as well.As a result of this survey ,Trimble elected to manufacture their own radio system and have called these the Trimtalk series.A two receiver system comes with three radios ,one base transmitter, one repeater and one mobile reciever.The radios are fully interchangable and can be used for other differential applications.They are a spread spectrum radio with a range of 10 Kilometres with a repeater.Being designed and manufactured by Trimble ensures the user has to deal with only one manufacturer for warranty or damaged radios.

It must be noted that the system is only designed for initialisation over this distance due to the constraints of the geoid model for working in real time, to achieve the specified accuracies. In the selection of any real time system a proper analysis of the radio requirements should be undertaken.Most survey supply companies will be able to access a large range of communication products and if the user is uncertain of the capabilities of the communications system then a demonstration should be organised.

The third most notable feature of the system is the data collection device called the TDC1.This thoroughbred of data collectors has over twenty new survey functions to enable the field surveyor to complete their tasks more efficiently.

The unit is offered in two modes,basic and advanced.The basic mode offers the user a simple interface without all the technical GPS terminology for everyday uses such as pit pick ups and setouts,detail surveys and other basic topographic surveys.

The advanced mode allows for use of more comprehensive functions to be accessed and allow for manipulation of parameters to get better performance from the system.The unit has the ability to do infield Skyplots for satellite location when taking measurements to determine if obstructions will affect the readings.

The unit has many functions to numerous to mention including intersection routines,stake out line - grade and offset,stake out arc,stake out slope ,stake out DTM,stake out point navigation with delta northings and eastings.The stake out DTM feature is a function that allows for setout points anywhere within the perimeter of the DTM.

The system is able to work in any datum and the system offers the ability to enter in information for three and seven point datum transformations from the WGS84 spheroid to the local datum.This function allows for the surveyor to setup on any locally surveyed point and perform their survey with confidence that the GPS measurements will work in the local datum.

GPS Total Station is "What's Next " in up and coming survey equipment technology. The applications for this technology in Papua New Guinea with its varied geographical and cultural conditions are many.The ability to perform customary land definitions in "Real Time " in conjunction with traditional land owners ,and the ability to also record attributes for Geograhic information Systems concurrently will allow the surveyor to expand their horizons.As the horizon for surveyors looks to expand,so to does survey equipment technology offer the surveyor of the future the ability to handle "What's Next."