Editor’s Note…

We spend much time in this Newsletter talking about instrument hardware and measurement features - range, accuracy, angles and distances, etc.

This month we bring you an article on a software feature that really sets the TPS1100 Professional Series instrument apart. GeoBASIC allows the user to develop his or her own onboard software solutions, making the TPS1100 a tool with infinite possibilities.

Kevin Grist has worked for Leica Geosystems in Spain for many years. They have achieved monumental success with the development of “Avance” an on-board GeoBASIC solution tailor-made for the Spanish market. With all his experience he was the perfect person to write this article – Thank you Kevin!

Anna

TPS1100 Professional Series

TPS1100 – The world’s most versatile total station

The introduction of the TPS1100 series of total stations opened up a whole new range of measurement applications due to advances in instrument hardware. The combination of reflectorless distance measurement technology and automatic target recognition enabled TPS1100 users to benefit from a true ‘all-round’ measurement sensor.

However, it is perhaps the instrument software that allows the TPS1100 series to be called the worlds most versatile total station. The TPS1100 concept allows the user to customise each instrument according to needs. There are no less than three different methods of tailoring a TPS1100 instrument to the individual preferences of each user:

Personalised Code Lists allow the user to adapt the data collected with the sensor to be 100% compatible with their mapping or CAD system.

The TPS Configuration tool allows a completely new interface to be designed according to the needs of each user or application.

And last, but by no means least, the GeoBASIC program development environment allows an infinite variety of application programs to be developed. The remainder of this article will concentrate on the GeoBASIC Integrated Development Environment (IDE) and the possibilities that this environment offers to a TPS1100 user.

What is GeoBASIC?

GeoBASIC is a programming language for developing onboard applications for TPS1100 total stations. The core language appears similar to today’s common Windows™ BASIC dialects such as Visual Basic™, therefore it is easy to learn and use.

However, GeoBASIC’s main power lies in its ability to use many of the existing instrument subsystems and dialogs. The developer can call an appropri-
ate built-in function for setting parameters, measuring, geodetic calculations, and many other tasks.

With these tools at hand, the programmer can quickly build sophisticated geodetic applications.

**The GeoBASIC IDE**

The GeoBASIC IDE is made up of the following components:

**GB Studio**: GBStudio is a development environment that includes a source editor, compiler, project manager and a source level debugger.

The user interface is similar to that of other Windows™ development environments and thus allows rapid debugging of programs.

**TPS1100 Simulator**: The simulator reproduces the behaviour of a TPS1100 instrument, thus eliminating the need to have an instrument on-hand during program development. Given that it is not necessary to load the program onto the instrument, the code-compile-test cycle can be carried out quickly and easily.

**On-Line Documentation**: GB Studio is delivered with a comprehensive on-line reference guide in addition to sample applications and detailed descriptions of the Geobasic programming process.

**What are the differences between BASIC and Geo-BASIC?**

The main differences between a standard BASIC language and GeoBASIC are due to the origin of the language as a development tool for survey applications. These differences include:

**Predefined data structures**: GeoBASIC includes a set of pre-defined structured types (strings, arrays, and structures). The definitions of such predefined types are implemented in the GeoBASIC compiler and are accessible to the programmer as any other defined types. For example, the predefined type used to store an instrument station is defined as follows:

```
TYPE TMC_STATION_Type
dE0 AS Double   'easting co-ordinate
dN0  AS Double       'northing co-ordinate
dH0 AS Double       'height co-ordinate
dHi    AS Double         'instrument height
END TMC_STATION_Type
```

Other pre-defined types allow the manipulation of measurements, instrument corrections, offsets, and point data.

**Automatic unit handling**: One of the problems of writing applications that will be used in different countries, is that the units of measurement used often change. This problem is solved using GeoBASIC since all programs are developed using SI units. When the user changes a measurement unit in the instrument configuration, the screen output from the GeoBASIC program changes automatically without the programmer having to intervene.

**Multi-language support**: GeoBASIC programs can be translated to an infinite number of languages using a simple translation tool.

**Pre-defined dialogs**: In order to minimise the code needed for the programming of repetitive tasks such as the user interface, GeoBASIC includes a series of pre-defined dialogs, such as the standard measurement dialog, that a programmer can call with a few lines of code.

**Geodesy Maths Functions**: One of the most appealing GeoBASIC features for survey application developers are the GeoMath functions. With one line of code, the programmer can call a vast library of functions for all sorts of geometric calculations. These functions range from the very simple:
GM_CalcAziAndDist( 
StationPt AS GM_Point_Type, 
TargetPt AS GM_Point_Type, 
dAzi AS Double, 
dDist AS Double, 
dStdvAzi AS Double, 
dStdvDist AS Double ) 

for calculating azimuth and distance between two points, to the somewhat more complex:

GM_CalcClothCoord( byVal 
dTau AS Double, 
dX AS Double, 
dY AS Double ) 

for calculating a co-ordinate on the unitary clothoide.

Instrument control functions: As with the GeoMaths functions, the programmer can also control the instrument sub-systems using pre-defined functions. These functions range from aiming a motorized instrument to a specific horizontal and vertical angle to changing the prism constant or turning on the instrument guide-light.

In addition to these differences between a standard BASIC implementation and GeoBASIC, GeoBASIC also allows the modular development of programs meaning that code can be reused between applications.

Application Examples

The range of applications that can be written within the GeoBASIC IDE is infinite. The following examples show that the possibilities of GeoBASIC are only limited by the developers imagination!

Graphical User Interface: Survey data in numerical form is often difficult to interpret, especially in the field. Using GeoBASIC’s graphics capabilities, complicated numerical data can be displayed in an easily understandable form. In this example, a theoretical road cross-section is displayed on the screen. To stakeout a point on the cross-section, the user only has to select the desired chainage and the point to stakeout with the arrow keys and then press the ‘CONT’ key. Road stakeout has never been so easy!

A completely new user interface: It is sometimes the case that a user may have a large fleet of survey instruments and a standard survey methodology that has been used for many years. In this case the survey sensor must adapt itself to the needs of the user, an ideal example for using GeoBASIC.

One such a case is the Dutch cadastral institute. This institute issued a tender to buy total stations in which it was specified that the user interface and operation of the selected instrument should be identical to the existing instrument fleet.

A GeoBASIC application was developed that not only replicated the user interface of the existing instruments but also offered the advantages of automatic target recognition and motorization. Needless to say Leica Geosystems won the first tender for 65 instruments and a second tender for over 200 more.

Think laterally and innovate!: One of the most annoying problems for today’s surveyor, armed with an array of high-technology solutions for most tasks, is having to measure the height of the instrument with a tape measure. Thanks to GeoBASIC, reflectorless measurement technology and a prism pole, this problem is now a thing of the past. A GeoBASIC program has been written that measures the vertical angle (α), and the slope distance (D_s) to a point on the prism pole. The measured point on the prism pole, is located at a known distance from the point of the pole (h_c), which in turn is placed on the station point. With this measurement data the height of the instrument axis (H) can be calculated using the formula shown. Simple!
Summary

GeoBASIC is a powerful programming environment that is simple to use and tailored to the needs of on-board survey applications. The GeoBASIC IDE takes advantage of the in-built survey functionality of TPS1100 total stations thus simplifying the programmers task.

The range of applications that can be written in GeoBASIC is infinite, being limited only by the imagination of the programmer.

If you are a programmer, take the plunge and try the GeoBASIC programming experience. If not, get in touch with your local Leica dealer to find out how your ideas can be made into a GeoBASIC reality.

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News

A new version of Leica Survey Office 2.0 was released last month. It includes a modernized user interface and a number of new features. The major new features are:

- **General**
  - More than 4 COM ports are supported
  - Instrument series can now be selected instead of the instrument type

- **Data Exchange Manager**
  - Communication to the instrument is only established when needed
  - Printing from file viewer is now possible

- **Coordinate Editor**
  - Point Codes and Attributes 1-8 are now supported
  - User definable column display for the spreadsheet
  - Saving coordinates to GS18
  - Saving coordinates to tab-separated ASCII files
  - Decimal recognition within the ASCII Import Wizard is now independent of the decimal separator setting of the operating system
  - Printing of files is now improved

- **Codelist Manager**
  - Codelists can now be opened and saved via standard Windows dialogs
  - Entry of choicelist items improved

- **Software Upload**
  - New easy-to-use Software Installation Wizard for TPS1100, RCS1100 and TPS1000

- **Format Manager**
  - Problems with editing variables under Windows 2000 solved

- **Configuration Manager**
  - TPS Setup program is now named Configuration Manager

Operating Systems: Windows 95/98/Me and Windows NT/2000/XP
Languages: Leica Survey Office 2.0 is available in the following 10 languages: English, German, Italian, Spanish, French, Norwegian, Finnish, Polish, Chinese, and Japanese.
Internet Download: Leica Survey Office 2.0 can be downloaded from the Leica Geosystems Web page:

Publishing

If you have an article you would like published in TPS News 2002 which may be of interest to other readers, please contact Anna McKenzie at Anna.McKenzie@leica-geosystems.com

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