GPR technology
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Subsurface Views

Sensors & Software Inc.

Software: New GPS features

EKKO_Mapper V4

EKKO_Mapper now has more mapping power. Depth slices and cross-sections are easily displayed, with GPS and depth slices exported to Google Earth!

Using the GFP_Edit utility program that accompanies EKKO_Mapper V4, global positions in Latitude/Longitude or UTM can be added to the GPR Grid (GFP) file. There are two ways to add GPS to the grid data:

- using GPS acquired during data collection of the grid or
- adding global positions later.

GPS collected during GPR Survey

If GPS data were acquired during the GPR grid survey (Figure 1 - page 2), GPS positions are added to each GPR line using the GFP_Edit program. The GPS position of the grid is determined by a best-fit calculation of the GPR grid lines to the GPS data (Figure 2 - page 2).

GFP_Edit displays both the GPR grid lines and the raw GPS lines to provide a visualization of the accuracy of the GPS positions. "Whiskers" indicate the accuracy of the GPS line compared to the GPR line (Figure 2 - page 2); the longer the whisker, the poorer the GPS accuracy.

Many people are surprised at the inaccuracy of their low to moderately-priced GPS, despite the best-case claims of GPS manufacturers. The best-fit calculation provides the most accurate placement of the grid in global coordinates so even relatively poor

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Noggin SmartCart reveals:

Viking Royalty in Norway

The archaeological prospection unit of the Swedish National Heritage Board recently conducted a GPR survey on behalf of the Midgard Historic Center and Vestfold County administration in southern Norway. The Center is located next to Borre National Park, home to the Borre mound cemetery and known for its exceptional collection of burial mounds dating to the early Viking age. Seven large and twenty five smaller mounds and one cairn are found in the area.

Noggin SmartCart surveying in the field just outside Borre park for a Viking longhouse.

The search for a settlement and buildings related to the grave mounds had been fruitless until archaeologist Terje Gansum, head of the Midgard Historic Center, decided to invest in a GPR survey to investigate a topographic low area just outside the boundary of the park. He speculated that a large house could have once been located at this site and that the elevation change is caused by a so-called house terrace.

The site is located in a flat field covered with shallow vegetation.The weather had been dry and windy, resulting in good humidity contrasts in the topsoil which contains relatively little clay. The survey was conducted using a Noggin^{plus} 500 MHz GPR system mounted on a SmartCart. Within an afternoon and the following morning an area measuring 100 m x 25 m was surveyed at a 0.25 m line spacing with 0.05 m trace spacing (step size) along 50 m profile lines.

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In This Issue

EKKO_Mapper V4 *(continued from page 1)*

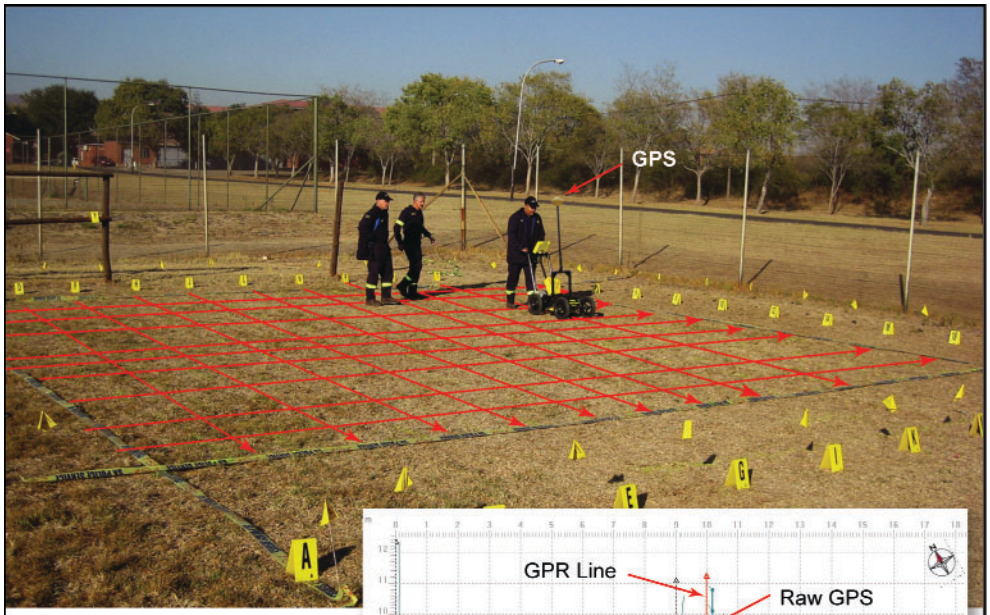


Figure 1: *Collecting a grid with GPS.*

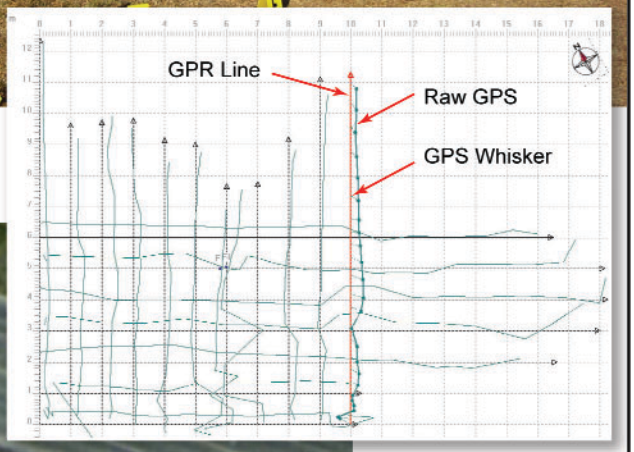


Figure 2: *GFP_Edit calculates a "best-fit"of the raw GPS data to the GPR grid lines and displays the difference with "whiskers".*

Figure 3: *Depth slice displayed in Google Earth. The Global Position of a GPR grid can be determined using Google Earth*

Slice(m)	X(m)	Y(m)	Latitude	Longitude	Easting	Northing	UTM Zone
0.400-0.450	9.933	1.507	53.2792728 N	9.0571937 W	496186.51	5903339.58	29U
0.400-0.450	9.532	2.019	53.2792786 N	9.0571949 W	496186.43	5903340.22	29U
0.400-0.450	8.522	3.015	53.2792909 N	9.0572003 W	496186.08	5903341.6	29U
0.350-0.400	7.996	3.513	53.2792972 N	9.0572032 W	496185.88	5903342.29	29U
0.350-0.400	7.526	4.01	53.2793032 N	9.0572055 W	496185.73	5903342.96	29U
0.350-0.400	7.028	4.55	53.2793097 N	9.0572077 W	496185.58	5903343.68	29U
0.350-0.400	6.53	4.992	53.2793154 N	9.0572107 W	496185.38	5903344.32	29U

Figure 4: *Positional information of targets in the GPR data are easily exported to Excel and other file types.*

GPS data should provide reasonable positioning of the grid.

Adding Global Coordinates in Post-Processing

Global coordinates can be added to grids even if simultaneous GPS was not collected during data acquisition. If two GPS positions in or near the grid are known or one GPS position and the Y-axis heading, the GPS locations for all the lines in the grid can be calculated.

One way of getting global (GPS) coordinates is using Google Earth. If the grid location can be found on Google Earth, the Global position (in Latitude/Longitude or UTM) can be extracted and entered into GFP_Edit (Figure 3).

Global coordinates may also be available from government maps of the grid area or from a hand-held GPS.

More Export Options

EKKO_Mapper V4 also offers more exporting options. When EKKO_Mapper V4 opens a grid (GFP) file with added GPS, the GPS data are displayed on the Status Bar as the mouse cursor is moved over the depth slices and cross-sections. The positions of targets in the depth slice or cross section are saved to the clipboard by placing the mouse cursor on them and then pressing the F8 key. This makes it very easy to paste significant points into an Excel spreadsheet, Word document or other files (Figure 4).

As well as exporting depth slice data to Comma Separated Values (CSV) files, depth slices can now be exported to Surfer GRD files, 3D HDF data files and Google Earth KMZ files.

When depth slices are saved to a Google Earth KMZ file, Google Earth is automatically launched (if available) and "flies" to the location of the grid. The depth slice is superimposed over the ground image (Figure 3). The user can select slice images from different depths.

For more information about EKKO_Mapper V4 or to request a trial version, contact us. ■

Subsurface Views
Sensors & Software Inc.

Viking Royalty in Norway

(continued from page 1)

Using a trace stacking factor of 4 and a time window of 99 ns, a total of 203 profile sections (over 10 km) were recorded under almost perfect survey conditions.

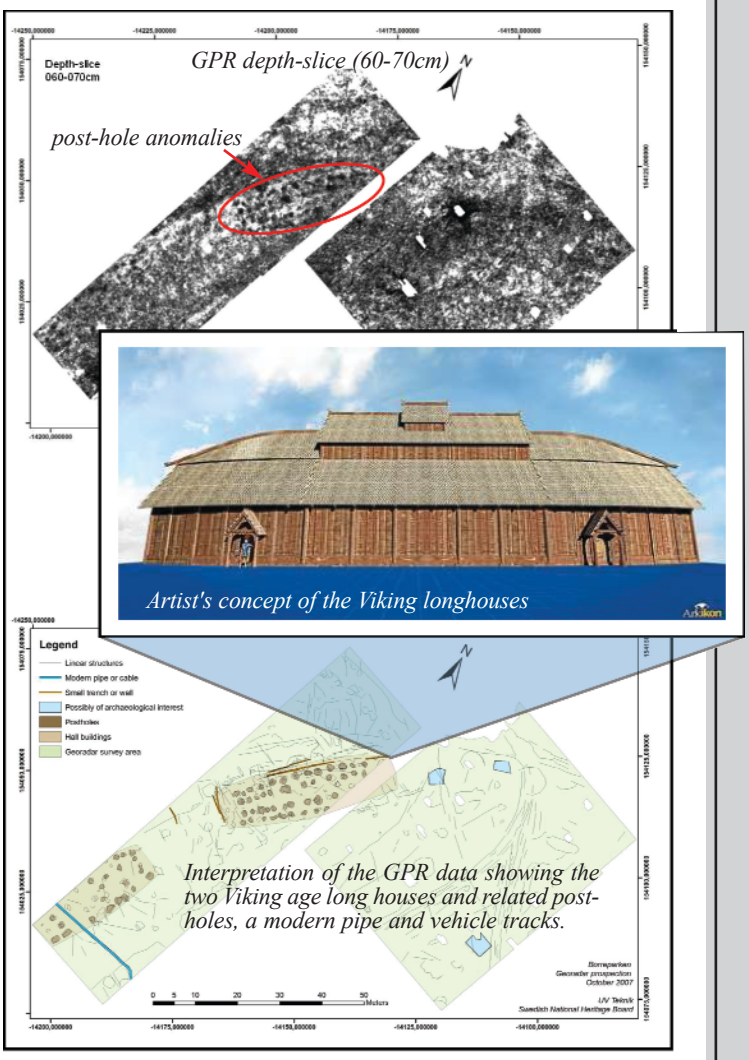
When the data was processed and the first depth slices appeared on the monitor, the results were surprising. Below the diffuse reflection pattern of the approximately 35 cm thick plough layer, the clear anomalies caused by the postholes of two early Viking age long houses became visible. Between 50 and 60 large anomalies (70cm - 120cm diameter) indicate the former location of large wooden postholes which, during the early Viking age, formed two impressive longhouses. The outer rows of postholes are bent like the sides of a boat while the inner rows of postholes indicate where the roof bearing posts had been located. These longhouses have a length of about 40-50 m, were 12 m wide in the centre and presumably up to 13 m high. They are considered to have been the precursors for the Norwegian wooden stave churches.

While the postholes appear as dark anomalies, we can see reflections of stones deeper down in the postholes. Faint linear anomalies indicated outer walls and subdivisions in the hall buildings as well as entrance areas.

The new discovery is the most exciting Viking-age find in the area since a Viking ship was discovered nearby over 150 years ago, and may rewrite Viking history. The large hall buildings are believed to have belonged to a royal power center at Borre, which has so far only been known as a cemetery.

Many exciting new discoveries are likely to be made at this site, both with high-resolution GPR measurements and through targeted archaeological excavations.

Story and images courtesy of Immo Trinks, Swedish National Heritage Board. ■



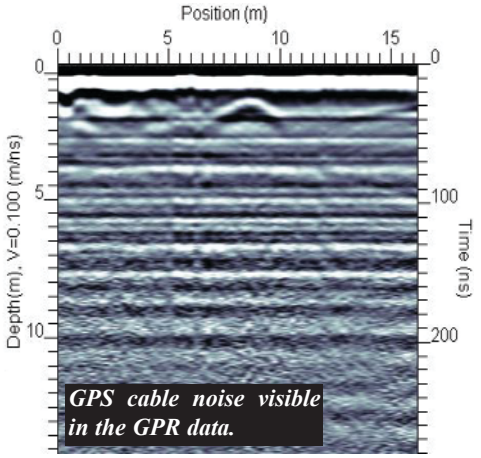
Ask-the-Expert

Will the metal in my steel-toed boots affect my GPR data?

Small bits of metal around the GPR system, like the metal in your boots or belt buckle, do not typically affect the GPR data. In fact, the SmartCart used with our pulseEKKO PRO and Noggin products contains several metal parts including axles, screws and pins.

Longer metal wires and objects with lengths similar in length to the antennas may in fact be a problem if they are parallel to the antennas or are close to or touching the antennas, transmitter or receiver. In this case signals can leak from the GPR system onto the metal item producing noise visible in the GPR data. Unshielded, low frequency antennas are especially susceptible to nearby metal wires and cables.

The cabling associated with a GPS receiver is a common problem. The cable should have RF loading added,



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Technical Papers

1. Joint time-frequency analysis of GPR data over layered sequences, The Leading Edge - Special Section: Near-Surface Geophysics, November '08 Issue, Page 1454 -1460
By: S. Guha, S. Kruse, P. Wang
2008 ***ref 386***

2. A Comparison of Electrical Resistivity, Ground Penetrating Radar and Seismic Refraction Results at a River Terrace Site, Journal of Environmental & Engineering Geophysics, Volume 13, Issue 4, pp. 325-333
By: M. Hirsch, L.R. Bentley, P. Dietrich
2008 ***ref 388***

Upcoming GPR courses

One Day Noggin® Short Course
September 14, 2009
November 2, 2009

Our Noggin® short courses are offered throughout the year to anyone interested in learning more about GPR and subsurface imaging.

One Day Conquest™ Course
September 15, 2009
November 3, 2009

Our Conquest™ courses are offered to anyone interested in learning more about our concrete imaging instrument.

Imaging Concrete with GPR - September 29, 2009 - Mississauga, ON
- October 14, 2009 - Chicago, IL

See us at ...

OSP EXPO 2009
Minneapolis, MN
September 2 - 3, 2009
http://www.ospmag.com/expo/

ICUEE 2009
Louisville, KY
October 6 - 8, 2009
http://www.icuee.com/index.asp

GSA 2009
Portland, OR
October 18 - 21, 2009
http://www.geosociety.org/

ASNT Fall Conference
Columbus, OH
October 19 - 23, 2009
http://www.asnt.org/

Information Request

Please check off information required below and fax or Email back:

- ☐ pulseEKKO® PRO
- ☐ Conquest™
- ☐ ConquestView
- ☐ Noggin® Systems
- ☐ OEM Noggin*plus*
- ☐ RoadMap™
- ☐ Rental Information
- ☐ EKKO_Mapper
- ☐ EKKO_View
- ☐ 3 Day GPR Short Course
- ☐ 1 Day Noggin® Short Course
- ☐ 1 Day Conquest™ Short Course
- ☐ Imaging Concrete with GPR workshops
- ☐ Other (please specify)

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Ask-the-Expert

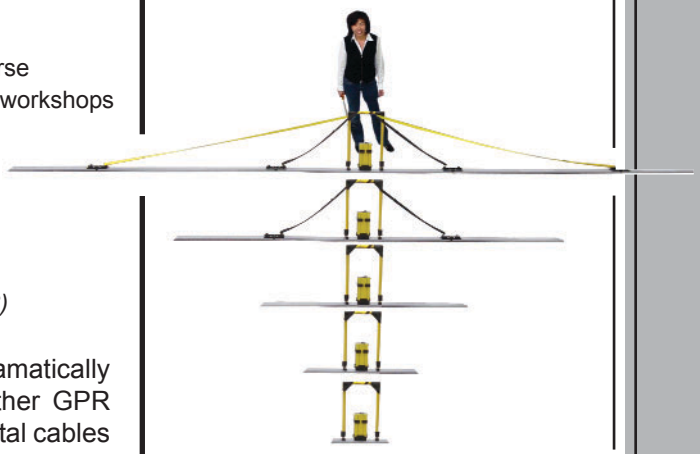
(continued from page 3)

excess cable tightly coiled and be run directly from the GPS receiver to the DVL, making sure it does not drape near the GPR electronics or antennas. The GPR power and odometer cables should also be kept away from the GPR transmitter, receiver and antennas.

Noise from metal cables is why Sensors & Software's innovation of using fibre optic cables for low frequency data collection dramatically improved data quality. Other GPR systems relied on long metal cables which produced strong, unwanted artifacts in the data.

Higher frequency antennas (above 200 MHz) are shielded so nearby metal is less of an issue but it is always good field practice to keep metal as far away as possible. ■

NEW pulseEKKO dipole antennas



- Ability to survive the toughest and most extreme environments
- A rigid yet flexible, more durable material for longer life
- Improved module interconnect for 25 and 12.5 MHz
- Improved quick-release handle and support mechanics

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