GPR technology
Vol 3, No. 10
April 2007

Subsurface Views

Sensors & Software Inc.

Conquest now detects power cables

Conquest with PCD

In January, Sensors & Software Inc. introduced PCD, a new and powerful feature for the Conquest GPR concrete imaging system. The Power Cable Detection (PCD) capability enables Conquest users to detect electric current carrying cables embedded in or underneath the concrete while simultaneously conducting standard Conquest imaging (Figure 1 - pg. 2).

The PCD option uses an additional sensor inside the Conquest sensor head to detect the magnetic field generated by electrical currents moving along nearby wires.

PCD enhances the Conquest operator's ability to distinguish electrical cables from metallic reinforcing and other structural elements present in the concrete, reducing the risk of costly damage or injury when cutting or coring the concrete slab.

Collecting PCD data requires no additional effort by the Conquest operator; the PCD and GPR data are collected simultaneously. During data collection, the user can see the PCD profile (Figure 2 - pg. 2) and after grid scan collection and processing, can toggle between the GPR depth slice images and the PCD image (Figure 3 - pg. 2).

Figure 3 (pg. 2) shows the GPR depth slice and PCD image. In this case, the PCD image shows a strong response that does not

(continued on page 2)

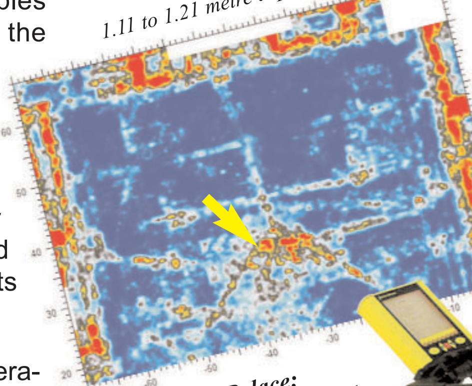
From our customer files:

GPR fit for a queen

In August, 2006, to mark the Queen's 80th birthday, the celebrated Time Team of England carried out archeological investigations on the grounds of Buckingham Palace and Windsor Castle. For the first time ever, archaeologists were permitted to excavate on the royal grounds.

As part of the geophysical investigation, the Time Team employed a Sensors & Software Noggin*plus* 250 SmartCart ground penetrating radar to locate historical features in the quadrangles, which are the open squares on the palace grounds.

1.11 to 1.21 metre depth slice

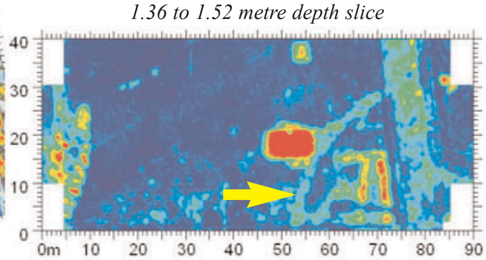


Buckingham Palace: *A triangular feature possibly due to a previous fountain.*

*Noggin*plus *250 SmartCart*

At Buckingham Palace, over 5 line miles of data were collected. Data were presented as a series of depth slices from the surface to 2 metres of depth. The GPR images defined utility services for the present-day palace and also identified numerous buried walls from earlier structures. Historical records suggest that these foundations are from the original Buckingham House, which was incorporated into the current Palace, as well as the two country houses that pre-dated it.

1.36 to 1.52 metre depth slice



Windsor Castle: *A curving anomaly later confirmed as the foundations of Edward III's Round Table building dating from 1344.*

Details can also be found on the Time Team web site. ■

In This Issue

Conquest with PCD (continued from page 1)

correspond to the orientation of the rebar in the GPR depth slice, but does correspond to a deeper embedded target, suspected to be an electrical conduit.

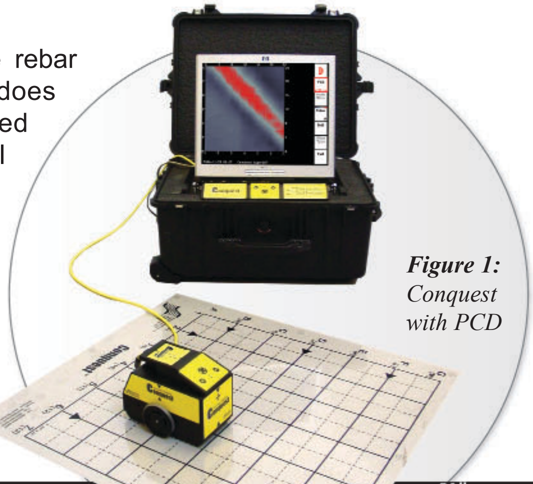


Figure 1: Conquest with PCD

The magnetic field generated can be simple or highly complex depending on several factors including the current strength, wire separation distance, the amount of twist in the wires and the depth of the wires.

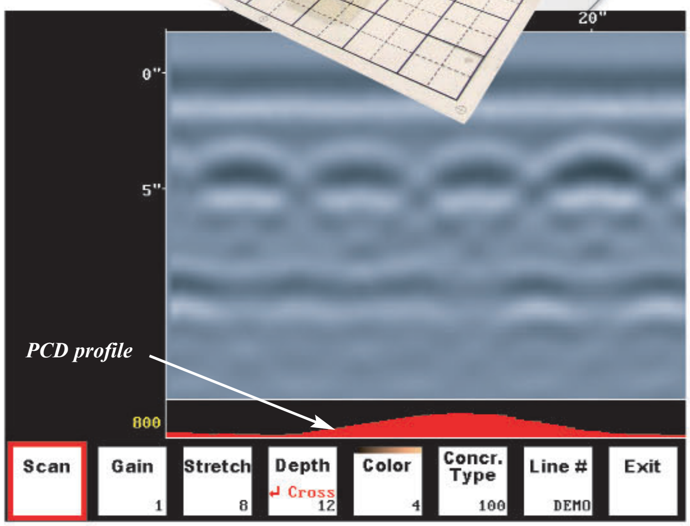


Figure 2: *The user can see the PCD profile during data collection.*

The PCD sensor is now an option on all new Conquest systems. Customers who have purchased a new Conquest system in the past year can upgrade their Conquest sensor head. Contact Sensors & Software to confirm if your system can be upgraded.

A new release of the ConquestView software supports the use of PCD images. The images in Figure 3 show the results from using the updated ConquestView.

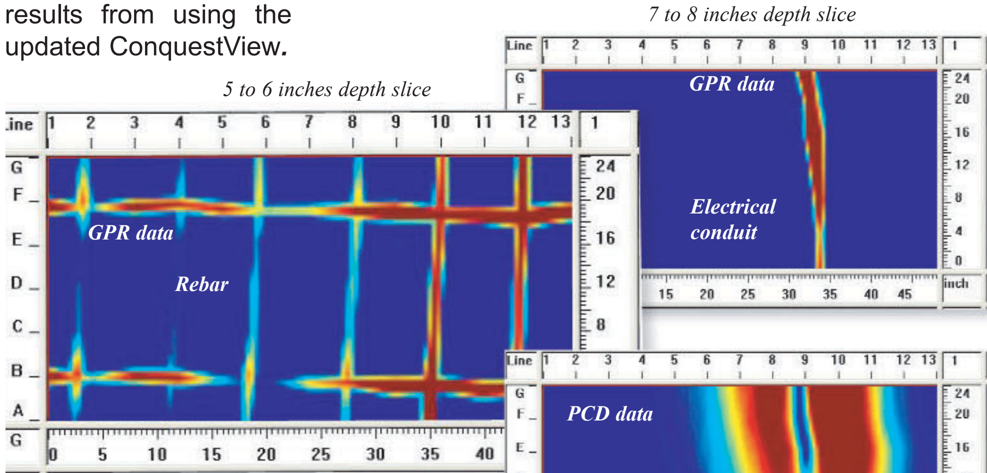


Figure 3:
Toggling between the GPR depth slice images and the PCD image. An embedded target, suspected to be an electrical conduit, correlates with the PCD image. ■

SEG award

Sensors & Software Inc. was honoured last October at the Society of Exploration Geophysicists' annual meeting in New Orleans. The company's principals received the Cecil Green Enterprise Award in recognition of their courage, ingenuity and achievement in developing a product "recognized as a distinct and worthy contribution to the industry". ■

Subsurface Views
Sensors & Software Inc.

"Tips" is back!

Polarity - a review and an example

The concept of GPR signal polarity was discussed in our January 2001 newsletter. The focus was to make GPR users aware of the fact polarity could be diagnostic in interpretation (see Figures 1 and 2).

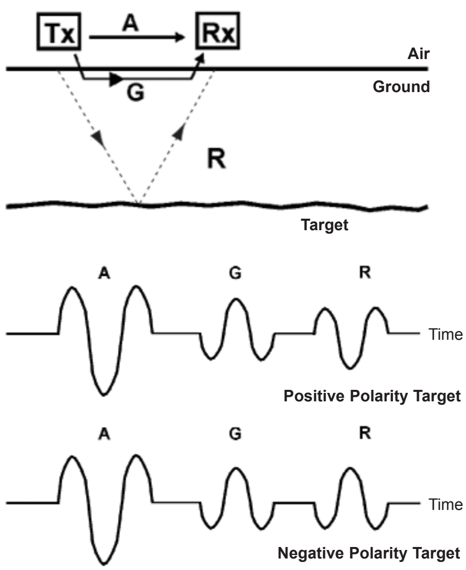
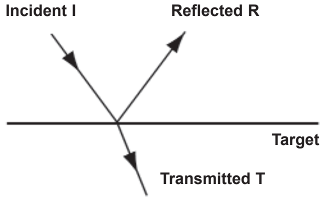


Figure 1: *When GPR measurements are made, at least three events will normally be observed: the direct air wave A, the direct ground wave G and a reflected signal R. Two idealized radar traces displayed here show the polarity of the wavelets.*



Reflection coefficient

$$R = \frac{Z_{target} - Z_{ground}}{Z_{target} + Z_{ground}}$$

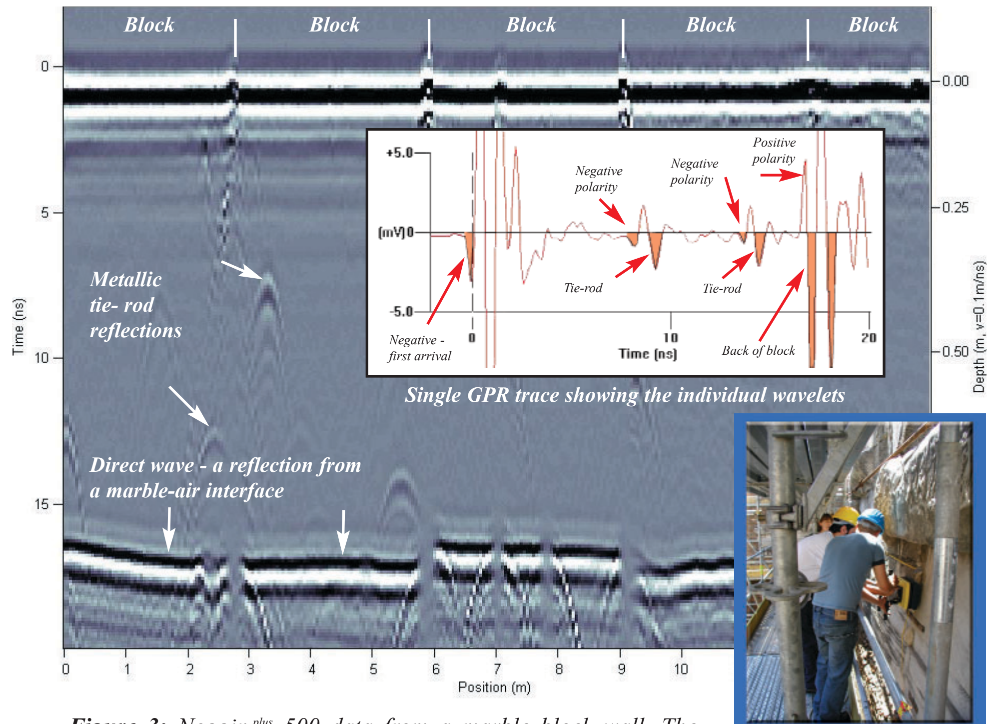
For a dielectric target

$$R = \frac{\sqrt{K_{target}} - \sqrt{K}}{\sqrt{K_{target}} + \sqrt{K}}$$

Special case of metal target

$Z_{target} = 0, \; R = -1$

Figure 2: *When a signal is incident on a target, the reflected signal polarity is dictated by the change in impedance between the target and the host ground.*



Noggin plus 500 profiling of a marble block wall

Figure 3: *Noggin plus 500 data from a marble block wall. The superimposed trace shows the wavelets from two metal tie-rods and the marble-air interface.*

That issue of "Tips" prompted a number of questions and comments. The most common question was how does one know what is positive and what is negative.

A reference is needed since data alone can be ambiguous. The first arrival direct wave is commonly used as a reference - unfortunately this can be misleading. Noggin plus 500 data obtained from a marble building preservation project illustrate the problem.

The data in Figure 3 show the response from the marble block structure. The direct wave, a reflection from a marble-air interface (positive polarity) and scattering from two metallic tie-rods (negative polarity) are visible on a selected superimposed trace.

This example reinforces the need to be systematic when determining signal polarity. Many users assume the first arrival indicates positive polarity. This is not necessarily true. With shielded antennas tightly coupled to the ground, the first visible arrival can be the direct ground wave since the direct airwave may be eliminated by antenna shielding. Since the direct ground wave is actually negative polarity, assuming it to be the positive reference polarity will result in incorrect polarity assignments.

In order to use polarity, GPR users need to establish standard operational procedures. The best way to confirm polarity is to measure the system response over a known target. For systems with separately moveable antennas, make sure that the antenna orientation remains the same while surveying.

In summary, polarity can provide diagnostic information but practice and care must be used to exploit it. ■

Recent Technical Papers

1. Laboratory investigations into the electromagnetic properties of magnetite/silica mixtures as Martian soil simulants, Journal of Geophysics Research, Vol. 110.
By: Pettinelli, E., Vannaroni, G., Cereti, A., Pisani, A.R., Paolucci, F., Del Vento, D., Dolfi, D., Riccioli, S., Bella, F.,
2005 ***ref 357***
2. Four dimensional mapping of tracer channelization in subhorizontal bedrock fractures using surface ground penetrating radar, Geophysical Research Letters, Vol. 32, L04401.
By: Talley, J., Baker, G.S., Becker, M.W., Beyrle, N.,
2005 ***ref 358***
3. Golf Course Applications of Near-Surface Geopysical Methods: A Case Study,
Journal of Environmental Engineering Geophysics, Vol. 10, Issue. 1, pp. 1-20.
By: Allred, B.J., Redman, J.D., McCoy, E.L., Taylor, R.S.,
2005 ***ref 359***
4. Virtual outcrop models of petroleum reservoir analogues: a review of the current state-of-the-art, First Break, Vol. 24, pp. 33-42.
By: Pringle J.K, Howell J.A, Hodgetts D, Westerman A.R, Hodgson D.M,
2006 ***ref 361***

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www.post-tensioning.org

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May 16 - 19, 2007
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Our Conquest™ courses are offered to anyone interested in learning more about our concrete imaging instrument.

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