GPR technology
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# Subsurface Views

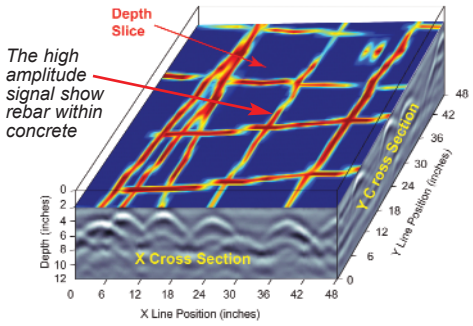
Sensors & Software Inc.

## GPR map generation - a whole new dimension!

## EKKO_Mapper 3

EKKO_Mapper 3 features an intuitive user interface, easier data loading and increased processing and display speed. Images are displayed quickly (in seconds or a few minutes) so users can now spend more time on data interpretation.

Depth slices show the average signal amplitude from all the data lines in the grid over a specified depth or time range. High or low amplitude signals that occur in several adjacent data lines can be tracked laterally within the depth slice. Scrolling up or down through a number of depth slices, from the surface to the maximum depth is a powerful way of interpreting local targets as well as those that extend horizontally and vertically.




*Relationship of the depth slices and cross-section images.*

EKKO_Mapper simultaneously displays plan and cross-section views. Users can instantly determine which reflector in the cross-section created a response in the depth slice view or vice versa.

*(continued on page 2)*

## Non-destructive evaluation of historic buildings

# Zuccari Palace - Rome

As buildings and structures age restoration and preventive maintenance becomes essential. Original construction details are often lost or never recorded. Prior maintenance activities are seldom well documented for many older structures. The result is a lack of knowledge to enable effective repairs and maintenance.

GPR provides a powerful means of investigating structures and gaining nondestructive insight on prior construction practice. Stone, wood and masonry materials are reasonably transparent to GPR signals. Voids, cracks and changes in water content can all create diagnostic signals on a GPR record.

The Zuccari Palace in Rome has been the object of intense repair work and is an excellent example of GPR use. The Palace, built in 1591, has vaulted ceilings carrying priceless frescos as shown in Figure 1.

GPR data were acquired in a room space above the vaulted ceilings. Parallel GPR survey lines were used to build up a cross-section view of the vault beneath. An example data set is shown in Figure 2 - pg.2.

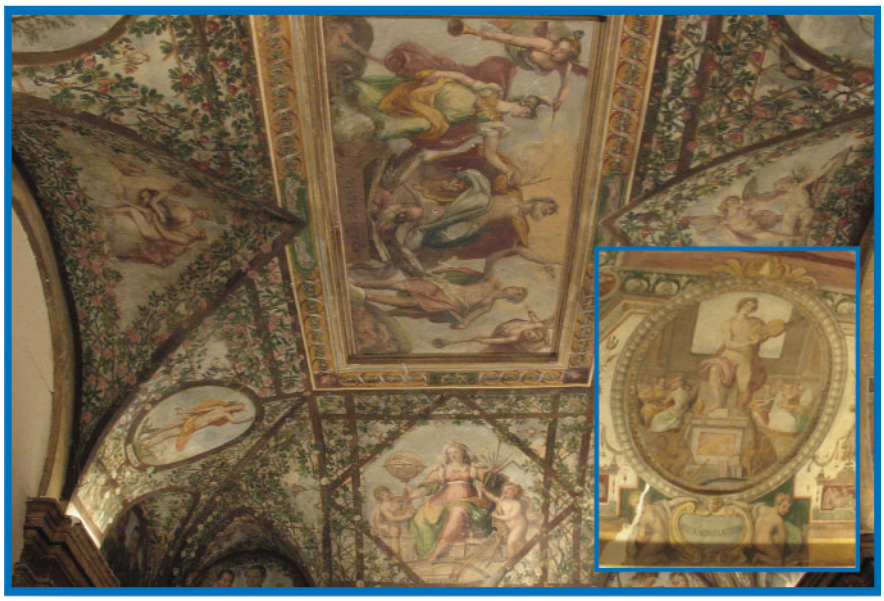


***Figure 1:*** *Fresco on vaulted ceiling in Zuccari Palace, Rome.*

*(continued on page 2)*

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# Zuccari Palace Rome

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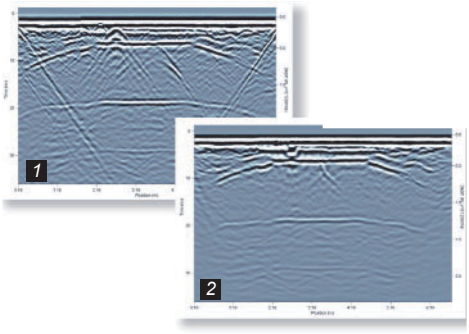



***Figure 2:*** *An initial GPR cross-section before (1) and after (2) migration processing to minimize diffraction traces and localize responses.*

Figure 3 shows a series of cross-sections that allow the internal structure to be visualized. The GPR measurements provided:

- *key structural boundaries in the vaulted ceiling,*
- *locations and nature of prior maintenance work, and*
- *a means to extrapolate localized intrusive endoscopic observations.*

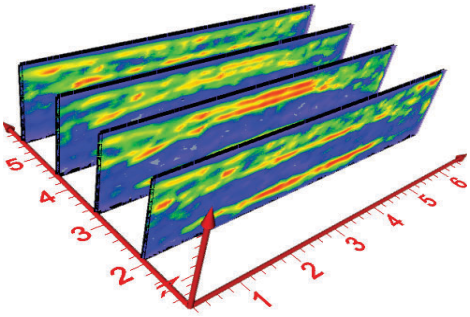


***Figure 3:*** *3D slice view of vaulted ceiling cross-section created with EKKO_Mapper 3 and Voxler visualization.*

Armed with this type of comprehensive information, the engineering teams can define preventative maintenance programs for keeping the valuable structure intact for posterity.

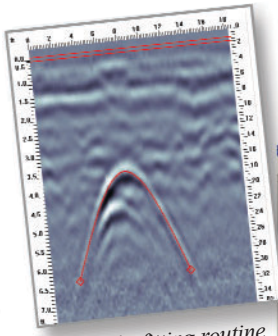
*We thank Elena Pettinelli, F Graziano from the University of Rome and R. Ginanni Coorradini from the Centre of Research Studies, Rome for this interesting contribution to Subsurface Views.* ■

# EKKO_Mapper 3

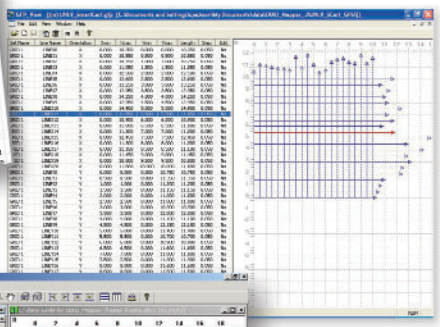
(continued from page 1)

Scrolling through the X and Y cross-sections or depth slices "animates" the images, allowing data interpretation.

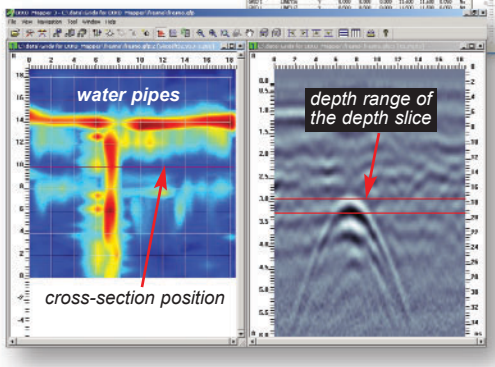
An on-screen tape measure gives the distance between targets.



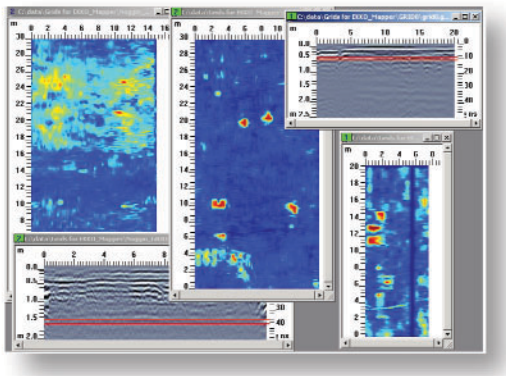
*Hyperbola-fitting routine to extract velocity.*



*GFP _View GUI with grid lines tabulated and presented in plan map form.*




*Depth slice and cross-section images are viewed simultaneously.*



*Multiple depth slice and cross-section windows can be opened at once. Windows can be from the same grid or different grids.*

EKKO_Mapper uses the new GFP (GPR Files and Processing) file concept which defines data grids. Conquest and pulseEKKO PRO systems automatically generate these files and Noggin$^{plus}$ systems will soon follow. The GFP_View utility program (for creating GFP files for older grid data) accompanies the EKKO_Mapper software.

Once a GFP file is loaded, the only input parameter required is the velocity. Velocity can be estimated using the available hyperbola-fitting routine.

Depth slice and cross-section images can be fine-tuned by adjusting the color, gain, contrast, sensitivity, amplitude equalization, resolution, depth limit and depth slice thickness. Images can be printed or saved to a variety of image formats.

The EKKO_Mapper data display is very flexible. There is no limit to the size of the grid that can be processed and displayed. Several windows from the same grid can be displayed at once or different grids can be processed and displayed together in separate windows.

While EKKO_Mapper automatically generates images with an optimized data processing stream, advanced users can modify the processing on depth slices or cross-sections. It is possible to eliminate all processing and use EKKO_Mapper as a visualization tool for grid data processed in other GPR data processing software like EKKO_View Deluxe.

Grid data can be exported to a 3D file format for easy export into 3D visualization software like Golden Software's Voxler program (available as an option with EKKO_Mapper).

*New EKKO_Mapper is now shipping. Contact our sales department to purchase or to obtain a trial version.* ■

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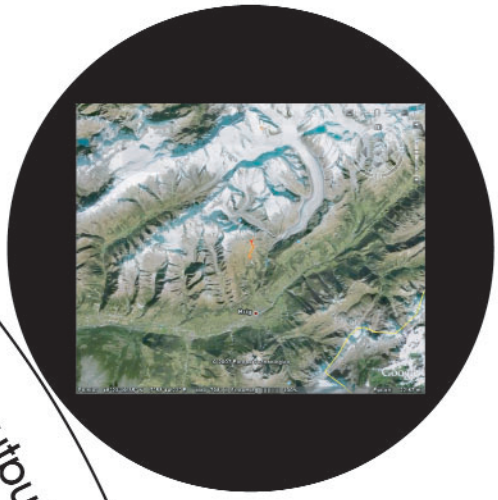
"Tips"

# Google Earth and GPR

QuickMap includes Google Earth output files



Some of our customers are creating visually striking images by super-imposing large-scale GPR surveys on Google Earth images.

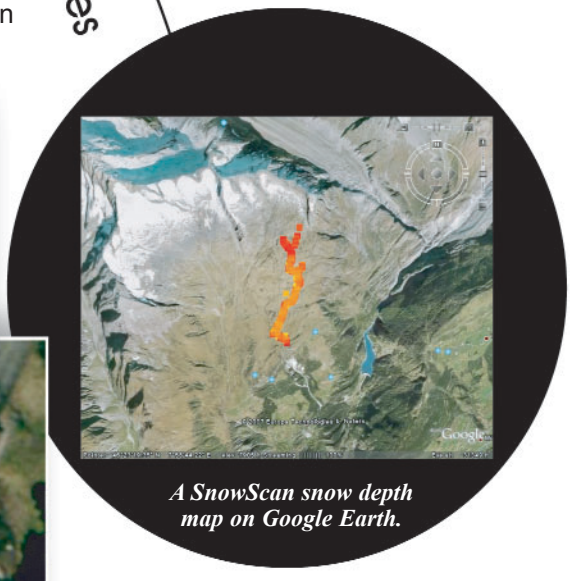
SnowScan, which creates snow depth maps using a Noggin GPR and GPS for positioning, is especially suited to this type of display.

To simplify this process for every customer who collects GPR data with GPS, our QuickMap software now includes Google Earth output files for any map image. The capabilities of QuickMap have been expanded from displaying SnowScan and Ice Profiling maps to include time and depth slices exported from EKKO_View Deluxe, fiducial maps and simple GPS location files.

*Image courtesy of RoadMap GPR Services.*

***RoadMap GPR Services*** *uses Noggin GPR systems to scan and report on the structure of roads and bridge decks. They regularly plot the position of their surveys on Google Earth.*

*These images, presented in reports to clients, help to present GPR data in a manner that is easily understood.*



***A SnowScan snow depth map on Google Earth.***

*Amplitude depth slice image generated from EKKO_View Deluxe displayed on Google Earth.* ■

# Recent Technical Papers

1. Concrete inspection with GPR - Advances in Analysis.
   By: A.P. Annan, J.D. Redman, T.De Souza, 2006 ***ref 362***
2. High Speed Ground-Coupled GPR for Road & Bridge Inspection.
   By: A.P. Annan, J.D. Redman, 2006 ***ref 363***
3. GPR studies in the Piano di Pezza area of the Ovindoli-Pezza fault, central Apennines, Italy: Extending palaeoseismic trench investigations with high-resolution GPR profiling, Near Surface Geophysics, 2006, 147-153.
   By: Chris J. Jewell, Charles Bristow, 2006 ***ref 364***
4. EMMA - A Geophysical Training and Educational Tool for Electromagnetic Modeling and Analysis, JEEG, Vol 7, No. 2, June 2002, p 57-68.
   By: Esben Auken, Lars Nebel, Kurt Sorensen, Morten Breiner, Louise Pellerin, Niels B. Christensen, 2002 ***ref 366***

# Upcoming GPR courses

**One Day Noggin® Short Course**
**September 10, 2007**
**November 5, 2007**

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

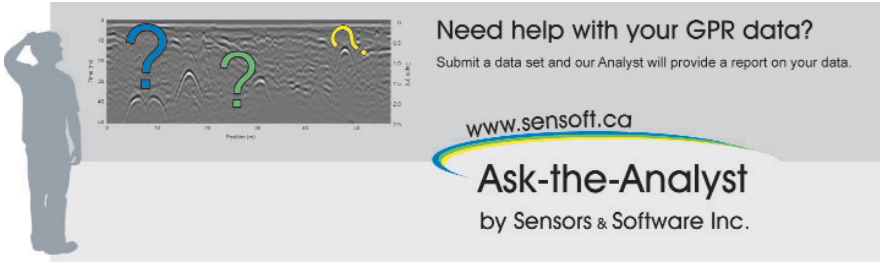
**One Day Conquest™ Course**
**September 11, 2007**
**November 6, 2007**

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

# Information Request

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

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




# See us at ...

**Locate Rodeo**
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August 2 - 4, 2007
www.locaterodeo.com

**2007 Pipeline Safety Conference**
Virginia Beach, VA
August 21 - 23, 2007
www.scc.virginia.gov/division/urs/pipe

**APWA**
San Antonio, TX
September 9 - 12, 2007
www.apwa.net/Meetings/Congress/2007

**Exploration 07**
Toronto, ON
September 9 - 12, 2007
www.exploration07.com

**IHEEP**
Albany, NY
September 16 - 20, 2007
www.nysdot.gov/portal/page/portal/iheep-2007

**NRWA**
Philadelphia, PA
September 23 - 25, 2007
www.nrwa.org

**SEG**
San Antonio, TX
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