April 2015

Subsurface Views

GPR Innovations: Hardware and Software

Vol 11, No. 42

Sensors & Software

FINDAR Speaks for Murder Victims

Sensors & Software's ground penetrating radar (GPR) systems hit the news recently in different parts of the world for forensic investigations:

- In Oklahoma, USA, the State Bureau of Investigation used FINDAR to discover the body of a woman missing for almost 3 years.
- Law enforcement in Sweden turned to a Sensors & Software GPR system to pinpoint the location of a murder victim's body.

Oklahoma, USA

With reports that the number of clandestine graves in Oklahoma was climbing, law enforcement officials decided to turn to technology for a solution. Oklahoma State Bureau of Investigation (OSBI) acquired a FINDAR GPR system (see photo below) to search for the burial location of homicide victims.

Previously OSBI relied on a highly trained forensic archeologist to decipher a victim's burial site. Now with minimal training, investigators can simply scan an area with FINDAR and locate hidden graves.

Samantha Weaver, a mother of two children, was last seen in June of 2012. After years of following leads the investigation narrowed and officials began to focus their attention on a particular property just outside of Shawnee, OK. A shed near the back of the property was of particular interest. The OSBI was called in and used their FINDAR to assist local law enforcement with the investigation.

FINDAR is a GPR designed by Sensors & Software Inc. for the express purpose of detecting buried forensic evidence. Law enforcement agencies in Canada, the USA and Europe were consulted during the design process resulting in advanced technology that is both powerful and easy to use.

OSBI officials surveyed the shed with FINDAR and were not disappointed. Under plywood and 3 feet of soil a body was discovered.

Beth Green, a trained GPR operator for OSBI said, "It's the most rewarding thing in the world. That is the whole reason why I'm in Law Enforcement, to help people and speak for people who cannot speak for themselves."

Finding the body after 3 years is a significant turn of events for the investigation into the death of the Shawnee mother and will hopefully lead to a quick arrest and conviction.

Pottawatomie County District Attorney was quick to state that, "Without that technology it's possible that we would not have found the remains."

(continued on page 2)

In this issue

The 3.2 x 4.2 meter grid was collected with GPR lines spaced every 0.1 m in both the X and Y directions; 76 lines with a total length of 276 meters. With a step size of 0.01 m , a time window of 20 ns (about 1 meter deep), and a time sampling interval of 0.1 ns, 27,620 traces and 5.5 million unique subsurface signal amplitude points were collected in about 30 minutes.

FINDAR Speaks for Murder Victims *(continued from page 1)*

Sweden

This story starts with a family quarrel some years ago. A 25 year old man started to have financial disagreements with a senior member of his family, a 63 year old lifelong entrepreneur.

When the older man disappeared, police first considered it an abduction but as time passed it became clear that it was likely a homicide. Evidence surfaced regarding the family feud and the police sought out the 25 year old man, but for two years he evaded police. When finally located, he was arrested as the main suspect in the murder case. However, police and prosecutors understood that without a body, the possibility of a conviction was reduced.

Eventually, the young man confessed to the murder and described to police where the body was buried. Unfortunately, the perpetrator's description of the burial location was too vague for an excavation to begin.

Investigators realized they needed more precise information so they could recover the body; they turned to a Sensors & Software's GPR system to survey the subsurface and pinpoint the burial. Officers said that they were relying on GPR to give them the rationale necessary to begin the excavation and quickly find the remains of the homicide victim.

Using a Noggin 500 GPR system (see left photo), a predecessor of FINDAR, the team carefully collected a grid of data in the area of interest. After analyzing the data, one area stood out.

The excavator operator was directed to the GPR target location and started digging, working slowly in cooperation with officers wielding shovels. Periodically a cadaver dog (dog trained to locate the scent of dead bodies) was allowed to jump into the hole. Though the GPR provided an indication of the depth of the body, the dog would serve as a secondary alert when they started getting close.

At a depth of 1.5 meters the cadaver of the 63 year old entrepreneur was located. Forensic teams quickly set up a tent around the site and discreetly removed the body.

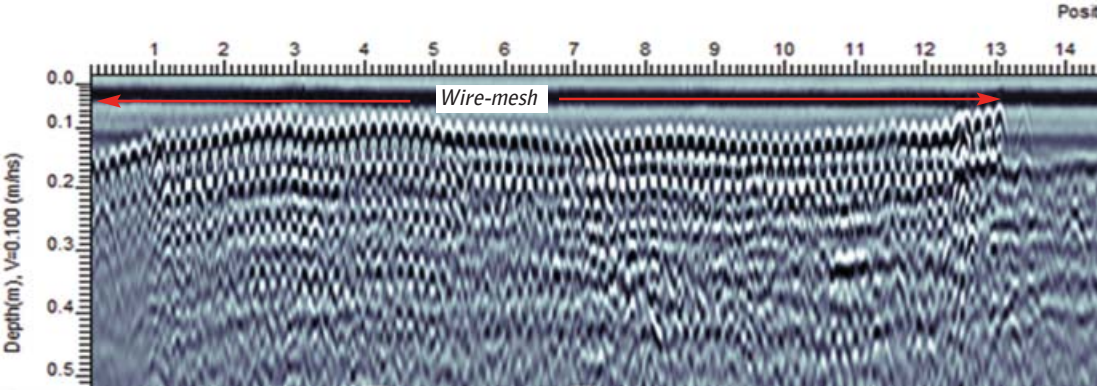
Murder trials without the physical evidence of a body are challenging for prosecutors. In this case, Sensors & Software's GPR system provided the key information, enabling the police to quickly locate the evidence that would lead to the prosecution of the perpetrator and bring this tragic family story to a just conclusion. ■

Videos: http://www.koco.com/news/osbi-buys-radar-to-find-human-remains-quickly-makes-discovery/31791268
http://www.koco.com/news/officials-investigating-after-human-remains-found-in-shawnee/31740032
Articles: http://newsok.com/authorities-find-human-remains-near-shawnee/article/5400509

You Never Know What You'll Find...

Noggin 1000 GPR systems are regularly used for shallow, high resolution imaging on and around building infrastructure, but sometimes, during a survey, you may find something totally unexpected...

During a recent GPR training course in Christchurch, New Zealand, everyone in the class, including the trainer, were shocked to find what was revealed by GPR. The class was learning how to set up and collect data with a Noggin 1000 system using the SmartHandle configuration (see photo on the left).



An empty warehouse near the training room was undergoing an extensive refurbishment after the severe earthquake that struck the area in 2011. The building owners allowed the class to use the open 20 x 30 meter warehouse area as a test site for the GPR training course.

The project started by collecting a few long reconnaissance lines across the floor in both directions to get a "feel" for the construction practice and reveal any large-scale anomalous areas (Figure 1). This showed that wire reinforcing mesh was present in less than half the floor. The line also revealed a strong hyperbolic response below the slab-on-grade concrete floor; initially interpreted at the time as a pipe or cable.

The next part of the training was grid collection so, based on what the reconnaissance lines had shown, a detailed grid survey was carried out over the "pipe"; a 3.2 x 4.2 meter (10.5 x13.8 foot) with a 10 cm (4 inch) line spacing was quickly chalked out on the floor and collected in about 30 minutes (see image on page 2).

The grid data were processed and visualized as a series of depth slices using the SliceView module in the EKKO_Project software. In seconds everyone realized that the "pipe" interpretation was not correct. The 0.40 meter depth slice (Figure 2a) revealed two parallel, linear objects crossing underneath the warehouse floor. Slicing deeper to 0.55 meters (Figure 2b) revealed linear features at equal intervals running between and perpendicular to the 2 parallel linear objects. Someone in the class suggested that it was a buried ladder until we used the SliceView Measure Tool to measure the width of the "ladder" at 1.15 meters and the distances between the "rungs" at 0.70 meters – an awfully large ladder!

Finally someone suggested it looked like railroad tracks with ties between them. Sure enough, the measurements were consistent with the gauge of New Zealand railroad tracks. A couple of minutes later, a computer-savvy student hopped on the internet and found an old map in the Christchurch archives that showed a railroad track had once run through the area (Figure 3).

Once the interpretation of railroad track was made, a few other pieces of the puzzle fell into place. Not noticed initially during the data collection, but discovered after closer inspection of the reconnaissance lines, is the wire mesh-like response beside the strong "pipe" hyperbola. This mesh pattern can also be seen in the 40 cm depth slice (Figure 2a). The mesh seems to be related to the railroad track, perhaps the concrete platform it rests on.

The complete railway track, both rails and ties is visible by plotting the grid data in 3D (Figure 4).

This survey just goes to show that, while many applications for GPR are routine (looking for buried pipes, cables and rebar), every now and then you find something you were not expecting. These situations are fun and exciting as they ignite the secret desire we all have to be detectives or archaeologists, and fill us with a strong sense of discovering the unknown. ■

Story and Data Courtesy of Lord Civil, Christchurch, NZ

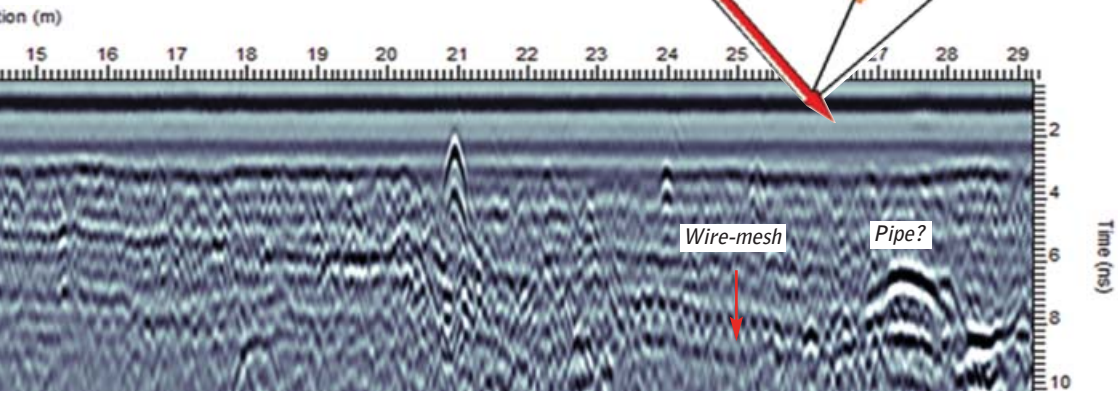


Figure 1: A reconnaissance line across the concrete warehouse floor shows wire mesh reinforcing stops after 13 meters and a strong deep hyperbolic response at 27.5 meters; initially interpreted as a pipe below the concrete. A wire mesh response is visible to the left of the "pipe".

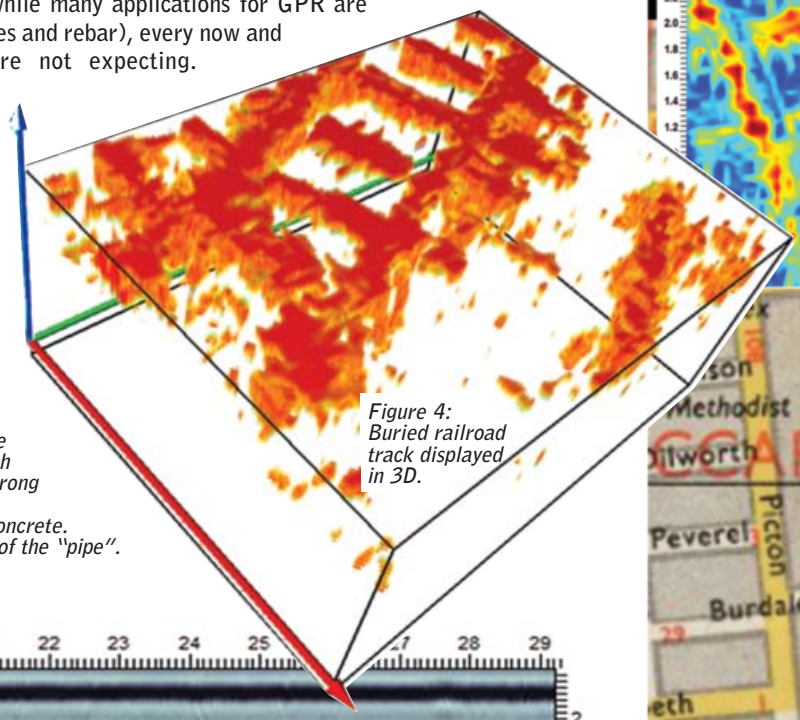


Figure 4: Buried railroad track displayed in 3D.

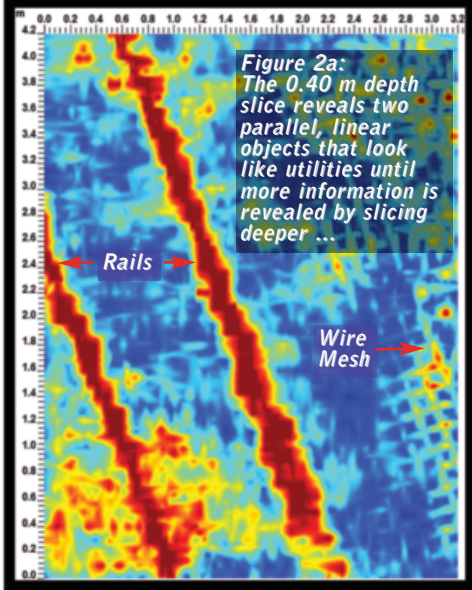


Figure 2a: The 0.40 m depth slice reveals two parallel, linear objects that look like utilities until more information is revealed by slicing deeper ...

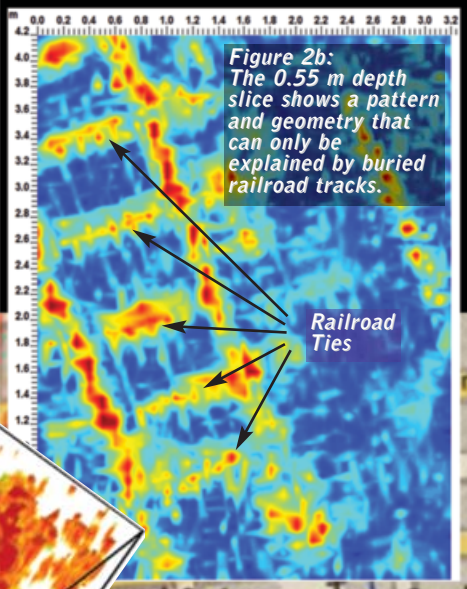
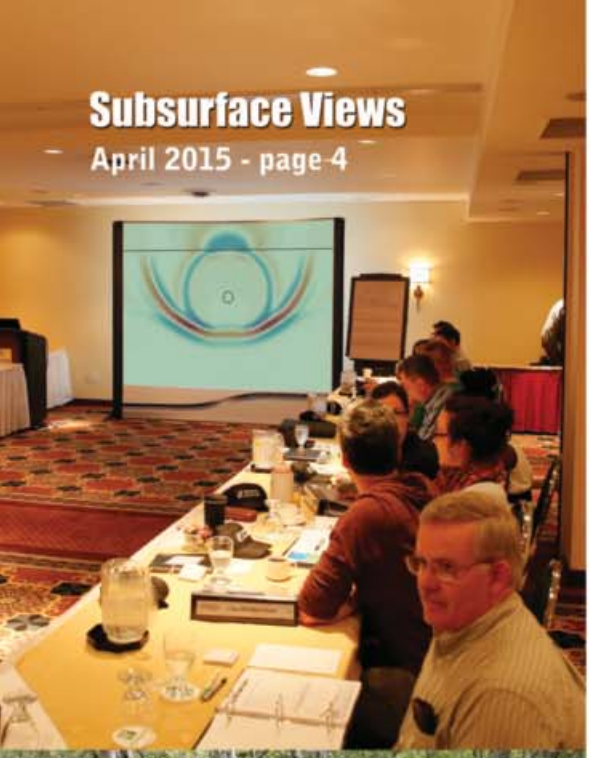


Figure 2b: The 0.55 m depth slice shows a pattern and geometry that can only be explained by buried railroad tracks.

Figure 3: A 1958 map of Christchurch shows the area now under the warehouse once had a railroad track; consistent with what the GPR grid survey discovered.



Sensors & Software

subsurface imaging solutions

www.sensoft.ca sales@sensoft.ca 905-624-8909

Sensors & Software's 3-Day GPR Course

Sensors & Software's 3-Day GPR Course has been running annually since 1998, with over 400 student graduates. In 2014 for the first time ever, we ran the course twice, in May and October, to accommodate the demand. Interest for advanced training is increasing as the use of GPR becomes more commonplace.

Day 1 delves into GPR theory but in a way that is understandable, even for people who view themselves as non-technical. The rest of the course brings the theory to reality; Day 2 is a full day out in the field, collecting data with a variety GPR systems and configurations, spanning a wide range of frequencies and resolutions while Day 3 sees every student in front of a computer analyzing the data collected the previous day. People graduating from the course have a solid understanding of the applications and limits of GPR including instrument performance, proper survey design and data acquisition techniques, insight into data analysis and processing, data presentation options and report generation. Most important, graduates leave with more confidence in their data interpretation skills and awareness of how to avoid common pitfalls.

Here are some of the comments from past courses:

The course was excellent-good teachers, great slides, good course notes, useful field and lab exercises. Mr.C

I think it was a great program and well worth the time …good job packing a tremendous amount of information in just three days. Thanks for the great three days! Mr. Jones

I enjoyed the course and found it very, very helpful. I was made to feel very comfortable and welcomed. Ms. Y

A well organized course and more importantly, it was great fun. Keep up the good work! Mr. P

For more information about the course or to join us this May,
go to http://www.sensoft.ca/Support/Training.aspx#3DayGPRShortCourse ■

Technical Papers

1. **Effect of Wood Log Shape on Moisture Content Measurement Using GPR**
   15th International Conference on Ground Penetrating Radar, GPR2014, Brussels, Belgium
   By: Redman J.D., Hans G., Diamanti N. - 2014

2. **GPR Emissions and Regulatory Limits**
   15th International Conference on Ground Penetrating Radar, GPR2014, Brussels, Belgium
   By: Annan A.P., Diamanti N., Redman J.D. - 2014

Free GPR Workshops

Concrete Scanning & Utility Locating

Toronto - April 29, 2015
Sandman Signature Mississauga Inn

Vancouver - May 12, 2015
Executive Suites Hotel & Conference Centre Burnaby

Calgary - May 14, 2015
Hampton Inn by Hilton Calgary Airport North

GPR Courses

Noggin and Conquest GPR Courses

Mississauga, ON
Noggin: May 4, 2015
Conquest: May 5 2015

Visit www.conquest100.com
to learn more about concrete scanning

See us at ...

ACE 2015 - Booth # 463

American Waterworks Association
Anaheim, CA
June 7 - 10, 2015
http://www.awwa.org/