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Subsurface Views

Sensors & Software Inc.

Revolution in GPR Networking

Along comes SPIDAR

SPIDAR is a family of devices that enables networking of GPR systems for a wide variety of existing and new applications. SPIDAR allows networking together any number of Noggin and pulseEKKO PRO GPR units to create virtually any multi-channel GPR deployment imaginable.

The flexible SPIDAR architecture provides the capacity to address any application requiring simultaneous GPR data acquisition such as:

- Spatially distributed arrays at the same frequency for continuous mapping in real time (Figure 1).
- Multiple frequency arrays for concurrent mapping to varying depths (Figures 3 and 5).
- Multiple polarization arrays for extracting complex target geometry (Figure 4).
- Remote controlled, OEM and robotic applications.

Architecture

SPIDAR uses a tree-like architecture as depicted in Figure 2.

Conceptually, a computer sits at the top of the structure and communicates via Ethernet to one or more GPR systems.

Noggin and pulseEKKO PRO GPR systems are network-enabled using a SPIDAR device called a Network Interface Controller (NIC), a microprocessor-based module that provides complete access and control over a GPR unit. The NIC communicates with the world via Ethernet.

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Figure 1: Seven Noggin 1000 systems for quickly mapping large areas of concrete. This configuration can easily cover 5000 square feet (465 sq. m) per hour with lines every 4 inches (0.1m). Anytime during data acquisition, the current data can be opened in EKKO_Mapper and depth slices displayed.

In this issue

Along comes SPIDAR

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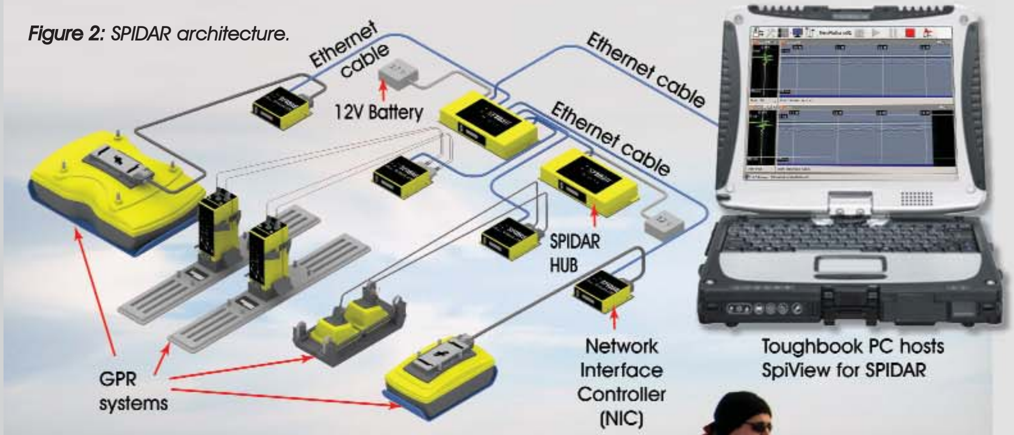
Figure 2: SPIDAR architecture.



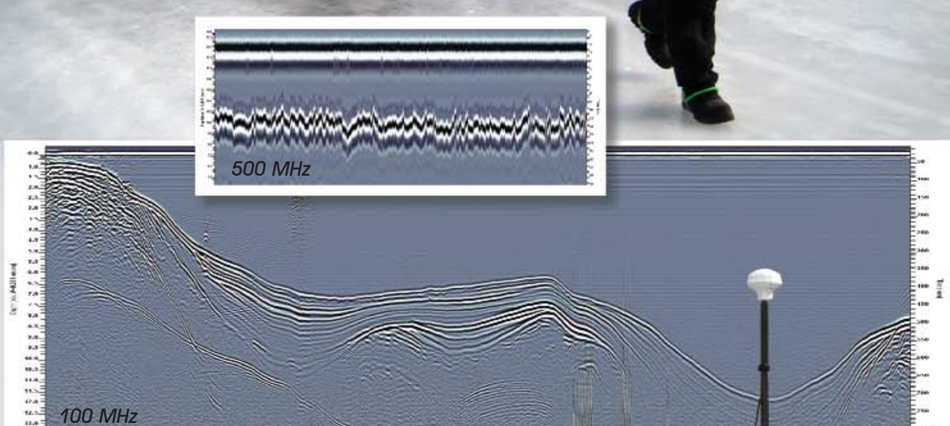


Figure 3: 100/500 MHz pulseEKKO PRO systems connected wirelessly to the PC. The 500 MHz transducers measure ice thickness and the 100 MHz antennas are used for lake bathymetry and imaging into the sub-bottom.

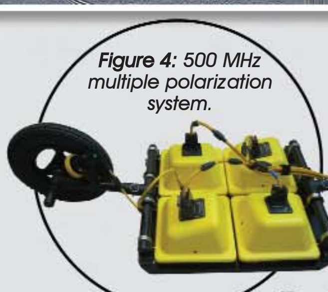


Figure 4: 500 MHz multiple polarization system.

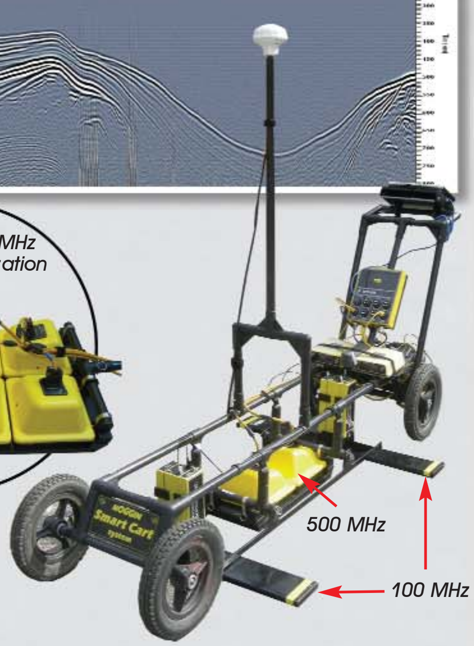


Figure 5: Modified SmartCart with pulseEKKO PRO 100 MHz antennas for deep sounding and 500 MHz transducers for shallow, high resolution imaging.

When a multiplicity of NICs must operate together simultaneously, a SPIDAR HUB is used to coordinate communications, manage power and synchronize positioning for the NICs and their associated GPR units. Each HUB supports up to four NICs; additional HUBs can be connected together enabling an unlimited number of NICs and GPR systems. A common battery powers the HUBs, NICs and the higher frequency (> 200 MHz) GPR systems.

The interconnection of peripherals such as odometers, beeper/triggers, GPS and laser tracking units or additional geophysical sensors is very easy with the SPIDAR architecture.

Speed

SPIDAR is different than other multi-channel GPR systems that multiplex the data and slow data acquisition by dividing the maximum sampling rate between multiple channels. With the SPIDAR architecture, full concurrent data acquisition occurs; the data rate for each system is constant. Data volume just increases as the number of channels increases.

Configurations

The standard SmartCart (Figure 5) and similar platforms can be used with SPIDAR systems. The diversity of configurations generally requires some type of customized deployment platform.

Learn More

Our Applications Specialists can provide advice on how you might design a platform to mobilize the system. New customers can build a GPR system for their specific application. The modular nature of SPIDAR means that existing customers can build on their existing Noggin and pulseEKKO PRO GPR systems for enhanced capability or create a new, advanced system to address specific application requirements.

The applications for SPIDAR are unlimited. This is just the beginning… ■

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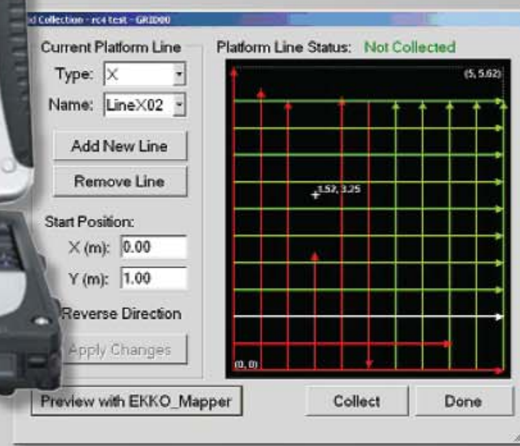
SpiView for SPIDAR

SpiView screen showing the data from 2 Noggin 1000 systems collecting data simultaneously.



Grid collection in SpiView for SPIDAR.

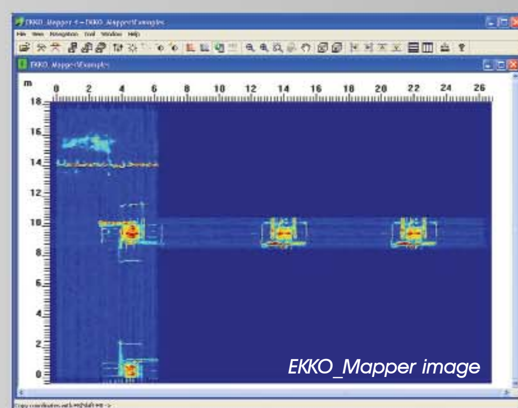
SpiView for SPIDAR is PC-based software that provides the command and control of the GPR network.

SpiView defines a "platform" as a network of GPR units that move in a coordinated fashion with common positioning control. The platform definition includes the relative position of every GPR system in the network as well as peripheral devices used during data acquisition such as the odometer and GPS. SpiView provides the ability to set up, save and re-call platform configurations. During data acquisition, SpiView displays one window for each GPR system. The user can also open any window in Full Screen mode to take a closer look at the data collected by that particular GPR. Individual GPR data files are stored in standard Sensors & Software DT1 files.

SpiView makes collecting grid data easy. The software indicates collected and uncollected lines. The user can add new lines, reverse line directions and easily position lines around obstructions in the survey area.

SpiView provides powerful real-time data analysis and imaging capabilities. Grid files can be previewed with EKKO_Mapper anytime during grid data collection. The operator can open the current grid in EKKO_Mapper and move up and down through the depth slice images.

To learn more on SpiView contact our Application Specialists. ■

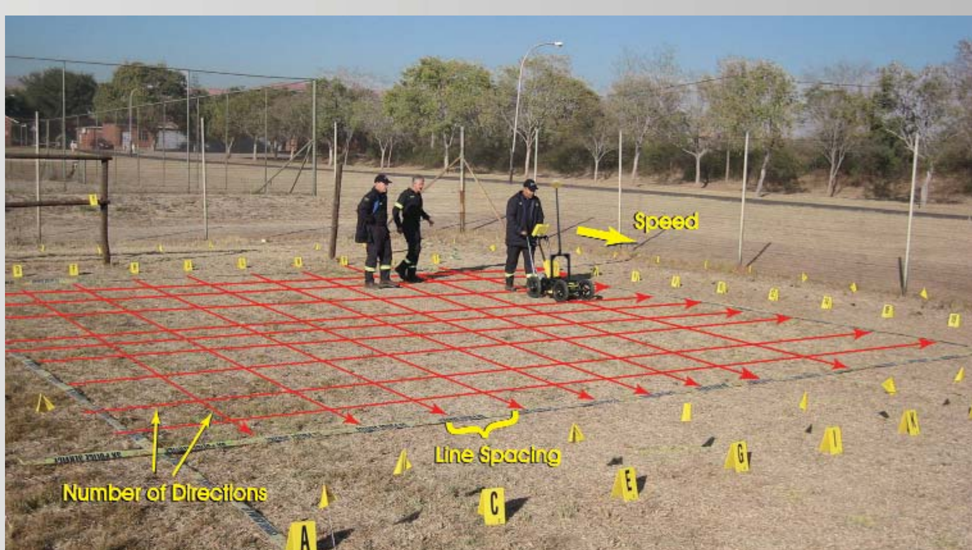


Ask-the-Expert

What is an easy formula for calculating how long a GPR survey over a specific area will take?

This is a relevant question for any contractor offering GPR services but it is difficult to answer because there are several variables in the calculation.

The most important variable is the data collection speed on the terrain in the survey area. Obviously data collection on a smooth concrete floor, parking lot or groomed golf course is much faster than rough, rocky ground, hilly areas or going through heavy bush.



Surveying an area in a grid.

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Technical Papers & Notes

1. **Using CompactFlash Cards with Capacities Larger than 2 GB with DVL III and Conquest.**
   By: Sensors & Software Inc. Technical Staff
   2008 **ref 389**

2. **Efficient and flexible TPS based 3-D GPR surveying: An archaeological case study.**
   Proceedings of the 12th International Conference on Ground Penetrating Radar, June 16-19, 2008, Birmingham, UK
   By: J. Tronicke, U Böniger
   2008 **ref 394**

See us at ...

AGU Fall Meeting
San Francisco, CA
December 15 - 18, 2009
http://www.agu.org/meetings/fm09/

World of Concrete
Las Vegas, NV
February 1 - 5, 2010
http://www.worldofconcrete.com

CGA 2010
San Diego, CA
March 2 - 4, 2010
http://excavationsafetyonline.com/

CSDA Convention & Technical Fair
San Diego, CA
March 2 - 7, 2010
http://www.csda.org

Upcoming GPR courses

One Day Noggin® Short Course
November 2, 2009
January 11, 2010

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

One Day Conquest™ Course
November 3, 2009
January 12, 2010

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

Imaging Concrete with GPR - November 20, 2009 - New York, NY
- December 1, 2009 - Miami, FL

Ask-the-Expert

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In a smooth area, SmartCart data can be collected at a walking pace: 5000 meters (16,400 feet) per hour is not at all unreasonable. To be very conservative and to take into account the fact that data collection involves stopping lines and moving the GPR to the start of the next line, one third that distance per hour (1500 m/hr or 5000 ft/hr) is probably more reasonable for typical productivity.

Once you can get an approximate speed value, the time to cover an area now depends on how close your GPR survey lines are. Line spacing is normally dependent on frequency and the size and shape of the target. To detect small targets, ideally, you want to collect GPR data like you are cutting your lawn; line spacing should be about the same distance as the length of your GPR antenna.

For example, when scanning concrete for rebar using a 1000 MHz antenna, lines should be every 4 inches (0.1 m) for complete coverage. Using a 250 MHz system for utility-locating requires lines every 1.5 feet (0.5 m) and using lower frequency 100 MHz antennas for deeper geological sounding would have lines every 3 feet (1 m).

Increasing the line spacing reduces the time to cover the area but there are risks. Lines must be close enough so that the target will appear on at least one or two lines. You don't want to have the line spacing so far apart that you miss a target between the lines.

You also need to decide if you are collecting GPR lines in one direction (X only) or both directions (X and Y) to cover the area. Collecting data in both X and Y offers more complete coverage but obviously takes twice as long. So the formula would be:

Time = (area x #directions) / (line spacing x speed)

Speed would be in distance units (feet or metres) per hour.

Example 1: The time required to scan a 10,000 square foot area with both X and Y lines using a 1000 MHz system at a line spacing of 4 inches (0.33 feet) at a speed of 5000 feet per hour would be:

(10,000 x 2) / (0.33 x 5000) = 12 hours

At a line spacing of every 2 feet, the area could be covered much faster:

(10,000 x 2) / (2 x 5000) = 2 hours

Example 2: The time required to scan an acre (43,560 square feet) with both X and Y lines using a 250 MHz system at a line spacing of 1.5 feet (0.5 m) at a speed of 5000 feet per hour would be:

(43,560 x 2) / (1.5 x 5000) = 11.6 hours

As the accompanying story about SPIDAR illustrates, systems with multiple GPR antennas increase area coverage and decrease data collection time by collecting several parallel lines in a wide swath. ■