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Subsurface Views

Sensors & Software Inc.

Practical Innovations

LMX100 and Conquest SL

As GPR matures, the technology reaches increasingly wider audiences. Sensors & Software GPR systems are steadily becoming more application-specific to meet their different needs. Two recent innovations from Sensors & Software are the LMX100 and Conquest SL.

LMX100

The LMX100 is a simple and affordable GPR targeting the needs of utility locators for quick, on-the-spot answers. Based on years of utility mapping experience, the LMX100 provides the optimal balance between good depth penetration and spatial resolution.

The high performance, 250 MHz bandwidth sensor is deployed on a light-weight, non-metallic, quick-assembly 4-wheeled cart with integrated odometer wheel, long life rechargeable 12V battery and recently-introduced full color Digital Video Logger (DVL). The user-interface was designed with simplicity in mind. Turn the system on and you can be surveying in seconds.

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From our customer's files

Helicopter GPR

The Canadian Coast Guard's Ice Operations Team, in collaboration with Environment Canada and NOAA/Great Lakes Environmental Research Laboratory (GLERL), measures ice thickness with GPR for ship navigation, prediction of spring breakup and ice rescues. GPR is usually deployed on the ice surface and pulled by hand, snowmobile or some other tow vehicle. Recently, the team tested airborne deployment of their GPR system.

Picture courtesy of Erin Clark, Environment Canada

Figure 1: *A Noggin 1000 GPR system is flown over lake ice near Midland, Ontario.*

Deploying the GPR from a helicopter allows data acquisition over larger areas and is safer than sending people onto the ice.

In February, the group ran a training exercise with a Noggin 1000 mounted underneath a helicopter to assess the viability of ice thickness measurements from the air (Figure 1).

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LMX100 and Conquest SL

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The operator can optimize the display image by changing displayed depth, gain and filtering at any time while surveying For example, if data are only displayed to a depth of 5 feet and you suspect that the target might be deeper at 6 feet , simply increase the Depth value to obtain data from deeper depths - no need to re-survey!

Similarly, changing the gain (amplification) or applying the filtering instantly updates the displayed data image. When a target is identified, pull the system backwards and the back-up indicator pinpoints the target position.

All these features built into the real-time embedded software make the LMX100 practical and easy to use.

Screen data can be recorded anytime – a single button push captures the current screen image. LMX ImageView software for PCs is used to display, print or export images to common graphics file formats like JPG and BMP. This allows images to be inserted into reports or saved for quality assurance.

The cost-effectiveness of the LMX100 means that a single GPR system does not have to be shared; every locating team can now carry a system on their truck.

Check out the LMX100 at www.gprlocates.com.
Contact Sensors & Software through our on-line distribution or your local dealer.

Conquest SL

The Conquest SL is more compact and lighter weight than our standard Conquest. Based on the newly introduced full color DVL 400 unit, the compact Conquest SL design makes deployment from ladders, scaffolds or in confined spaces straightforward. The system can be powered from 110/220 AC mains or a range of rechargeable 12 V battery packs.

Conquest SL retains all the capabilities that have made Conquest the preferred non-destructive imaging tool in the industry:

- Small, light-weight sensor head with integrated odometer wheel
- Line Scanning mode for reconnaissance surveys
- Grid Scanning mode for detailed mapping
- Integrated Power Cable Detection (PCD)
- Real-time locating of embedded objects
- On-site 3D imaging
- Drill Locator
- Saving data to a flash memory card for transfer to a PC
- PC-based data analysis with ConquestView and EKKO_View software.

Whatever your concrete imaging needs may be - cutting or coring, structural forensic investigations or as-built assessments, Conquest SL provides a full power GPR system in a compact package.

For more information contact our Application Specialists, or go to www.sensoft.ca/products/Conquest. ■

Helicopter GPR

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A warmer than average winter in Canada meant that there was little ice on the Great Lakes, but Midland Harbour, Ontario had enough ice for the experiments. The Noggin 1000 was pod-mounted and attached to the helicopter strut (Figure 2). Sample data in Figure 3 exhibits a strong reflection from the ground surface. Since the helicopter altitude varies during flight, the ground surface reflection appears to move up and down through the cross-section image. The second reflection, parallel to the ground surface reflection is the bottom of ice reflection. The time difference between these two reflections indicates the ice thickness. Deeper, weaker reflections parallel to the bottom of ice reflections are multiples.

Since GPR signals travel through the air at the speed of light (0.3 m/ns or 0.984 ft/ns), the GPR can be used as a radar altimeter. Plotting a "Depth" scale using a velocity of 0.30 m/ns in the EKKO_View software, the traditional GPR depth axis measures the helicopter altitudes (Figure 3). The helicopter height mostly varied from 6.5 to 10 m along the test line. At the beginning of the line the helicopter was too high: the travel time to the ice surface was greater than the GPR recording window (Figure 3).

Airborne GPR data needs to be compensated for platform elevation to help detect and evaluate subsurface targets. In this case, the surface reflector is a flat surface, making this process easier. Elevation compensation was achieved using the EKKO_Interp software, to extract the Noggin height above the ground, and the EKKO_View Deluxe software, to apply topographic correction (Figure 4).

The compensated data show ice thickness is uniform. Augered boreholes confirmed the ice to be around 29 cm thick with an ice velocity of 0.16 m/ns.

Simply put, the data are spectacular. Ice thickness around 0.3 meters (Figure 4) was measured at helicopter heights up to 23 meters! The success of these measurements is helped by the smoothness of the ice. With no surface roughness to scatter away the GPR signals, maximum signal penetration was achieved. In some situations, a layer of snow may be present, adding a further reflecting horizon; such cases have been successfully addressed in the past.

While all ice environments will not be as simple as this example (sea ice may contain brine that can present a challenge for GPR signal penetration), the experiments show that helicopter GPR can be a valuable addition to the Coast Guard's equipment arsenal.

Story courtesy of the Canadian Coast Guard, Environment Canada, NOAA/GLERL. ■

Picture courtesy of George Leshkevich, NOAA/GLERL

Figure 2: *A Noggin 1000 is housed in an external pod. The operator observes and records the Noggin data while in flight using a DVL.*

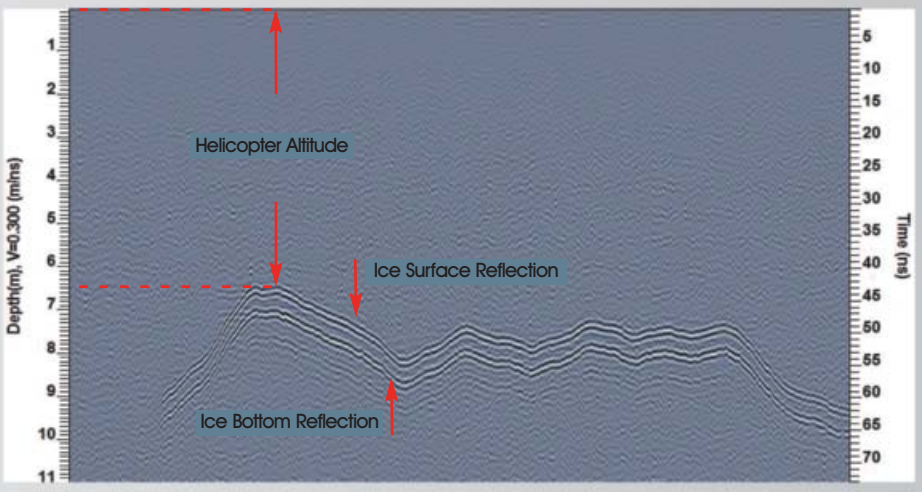


Figure 3: *Example helicopter-borne GPR data. The data show the ice surface reflection undulating up and down as the helicopter height varies - the GPR acts like a radar altimeter. The goal, however, is to see beneath the surface. The ice bottom reflection is clearly visible.*

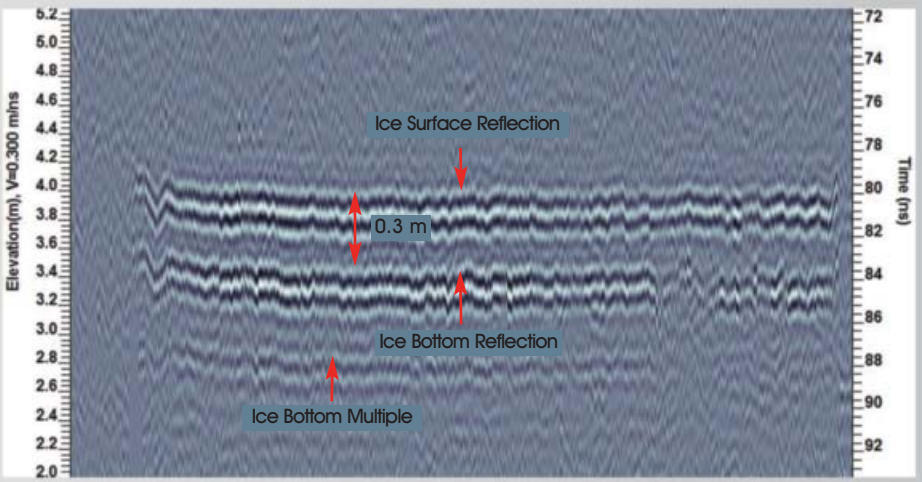


Figure 4: *Example of data compensated for helicopter height variations.*

Technical Papers & Notes

1. Impulse Radar Applied to Ice Thickness Measurements and Freshwater Bathymetry; Resource Geophysics and Geochemistry Division; 1977
   By: A.P. Annan, J.L. Davis **ref 439**

See us at ...

GPR 2012
Shanghai, China
June 4 - 8, 2012
www.gpr2012.org

Locate Rodeo 2012
Atlanta, GA
August 2 - 4, 2012
www.locaterodeo.com

Upcoming GPR courses & workshops

One Day Noggin® Short Course

July 9, 2012

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

One Day Conquest™ Short Course

July 10, 2012

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

Imaging Concrete with GPR workshops - May 16, 2012 - Vancouver, BC
- August 14, 2012 - Washington, DC

3 Day GPR short course

July 18 - 20, 2012 - Mississauga, ON

Our annual 3 Day course is an intensive course covering GPR theory, case studies, survey techniques, data processing and interpretation. A practical day in the field is part of the course.

Interested? Contact us early as space is limited.

training@sensoft.ca

Ask-the-Expert

How much power does my GPR transmit?

With many diverse vested interests, variation in standards, and differing terminology, providing simple answers on GPR power is difficult and, if taken out of context, creates major issues for GPR users and vendors.

GPR units create electromagnetic waves across the "radio" frequency range. Depending on system design and use, a GPR can have energy in the 1 MHz to 5000 MHz range. Creation of such radio signals thus causes alarm bells to go off in many places.

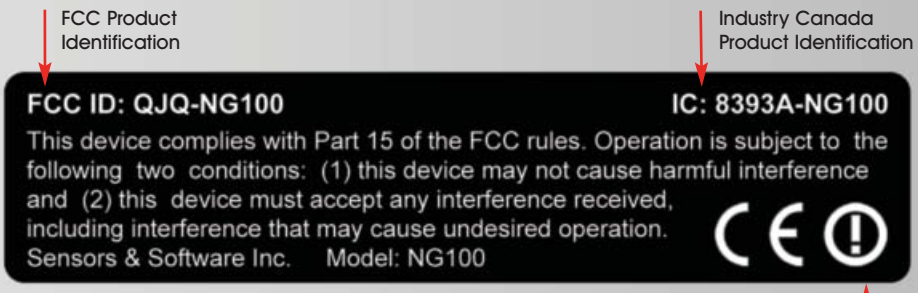
The three common alarm sources are:

- Spectrum regulators who make money for governments by selling the exclusive right to use parts of the spectrum.
- Spectrum owners who want to protect their rights.
- Parties with health and safety concerns (often other arms of government).

Complexity arises further since most regulations are for "narrow band" use and have different meaning to what UWB GPR users may interpret.

Perhaps the simplest way for GPR users and others to gain comfort that GPR is safe for use is to realize that:

- Most jurisdictions now have regulatory guidelines for GPR devices - see details at www.sensoft.ca/Regulatory-Documents
- Responsible equipment vendors build products in accordance with these regulations.



Example product label addressing regulatory mandates.

One should look for appropriate labels, messaging in manuals and Declarations of Conformity.

Needless to say, there are groups that ignore adherence to regulations through ignorance or willful disregard. On this, we can only say - buyer beware, and do your due diligence on checking the equipment certifications and user limitations. Regulations often require equipment registration on government lists and websites, so independent verification is available. ■