SUBSURFACE VIEWS

GPR INNOVATIONS
HARDWARE AND SOFTWARE

In this issue

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The new pulseEKKO – GPR with no limits

Before there was Noggin, Conquest, LMX or Rescue Radar, there was pulseEKKO. pulseEKKO systems are the initial GPRs designed and built by Sensors & Software. Discerning professionals around the world know of the superior performance and signal quality of the pulseEKKO brand.

A wide range of antenna frequencies are available for the pulseEKKO – from 12.5 to 1000 MHz - to cover every conceivable application for GPR: Antarctic ice sheets, glaciers, deep geology/stratigraphy, mining, geotechnical investigations, archaeology, forensics, utility detection, roads, bridges, and concrete.

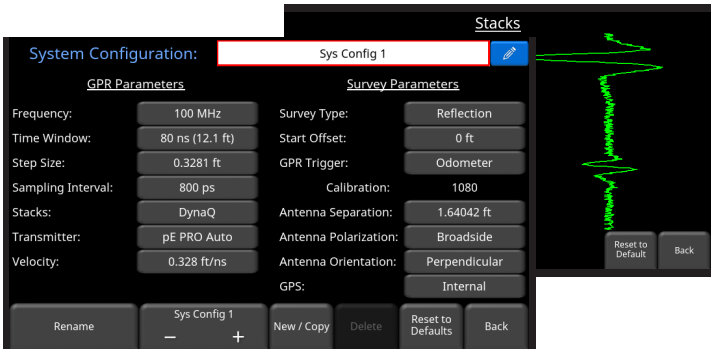
Further, pulseEKKO systems offer several deployment configurations – Full Bistatic, One-Man, SmartCart, SmartTow and SmartChariot to provide efficient data collection in any terrain, temperature and environment. The product evolved from the early days of GPR, when many of the data collection techniques we take for granted today were still being developed by Sensors & Software and other GPR pioneers. This required a GPR system with the flexibility to change any data collection parameter or deployment configuration to try something new – time window length, temporal sampling interval, step size, stacking and triggering.

Flexibility was also required to go beyond simple common-offset reflection data collection (the standard method for Noggin, Conquest and LMX) and change the antenna geometry for collection of Common-Mid-point (CMP, see the accompanying story), Wide Angle Reflection and Refraction (WARR), cross polarization, borehole, transillumination and multi-channel surveys. Today's pulseEKKO still retains this flexibility; this sets it apart from any other GPR system in the world and makes it the system of choice for GPR professionals.

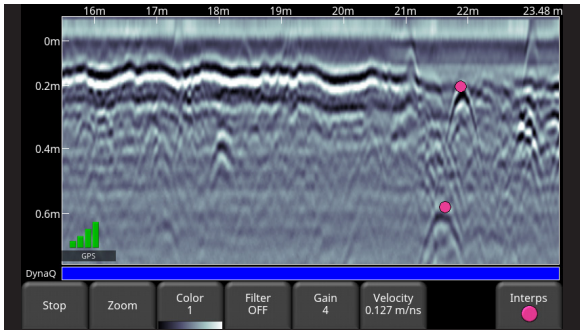
After more than 30 years of innovation, pulseEKKO systems continue to improve. The latest evolution of pulseEKKO – the DVL-500P data logger – has many features to make GPR surveys easier and your time in the field more efficient.

Sensors & Software

User interface: The new user interface makes setting up surveys simple. All survey parameters are available from a single screen. Many parameter screens show a graphic or animation to help explain their purpose; a mini training course right on the screen. Once the survey parameters are setup, enter a name and save the configuration for future surveys. Multiple system configurations can be saved, allowing users to easily switch between them while collecting data.

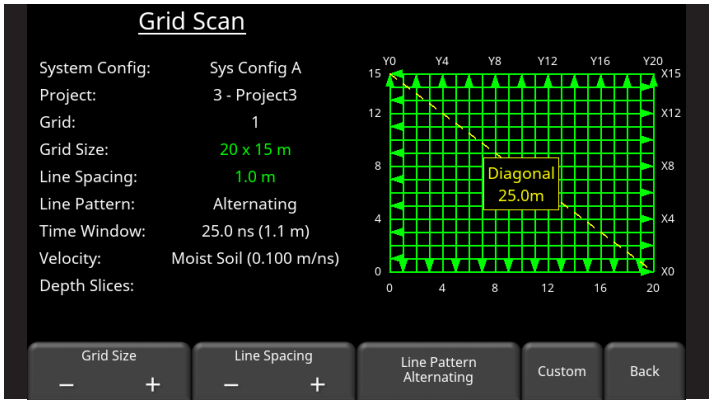


Line Scans: Easily optimize the Line Scan image on the DVL screen: change the color palette, gain or background subtraction filter without affecting the raw data. Further, zoom in to see a feature and zoom out to see the big picture – all while still collecting data!

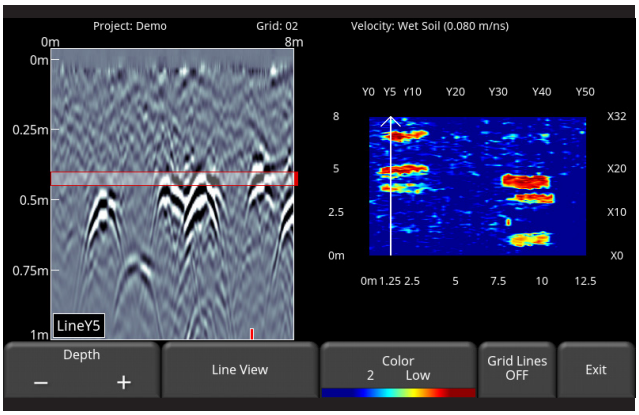


Field interpretations: If a feature of interest is found, add a field interpretation by touching the screen. A colored dot appears at the location and the GPS coordinates are saved. Change the field nterpretation color to highlight different features.

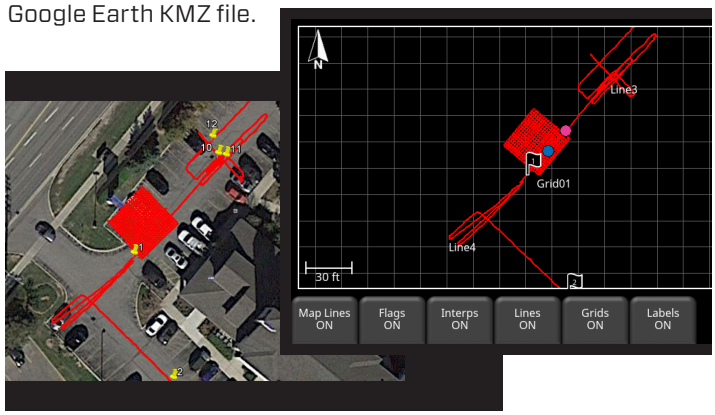
Grid Scans: The user interface makes it easy to set up and collect a grid of data. Select the grid size; square or rectangular. Set the line spacing and line direction. Use the on-screen automatic hypotenuse calculation to assist with accurate grid setup. The user interface guides you through grid collection evne around obstacles; indicating where you should start the next line and the line direction. The Auto-stop uses the odometer distance to automatically stop the grid line.



Depth slicing: When grid collection is complete (or even partially complete) use Slice View to generate depth slices in the field and then slice up and down to different depth and look for targets.



Map View: The Map View screen displays a plan view of the GPR survey based on GPS. It shows the paths of GPR lines and grids, as well as any field interpretations and fiducials/ flags added to the data during data collection. This is a very powerful tool for seeing the spatial relationship of subsurface features of interest. MapView features are also saved to a Google Earth KMZ file.



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Color touchscreen

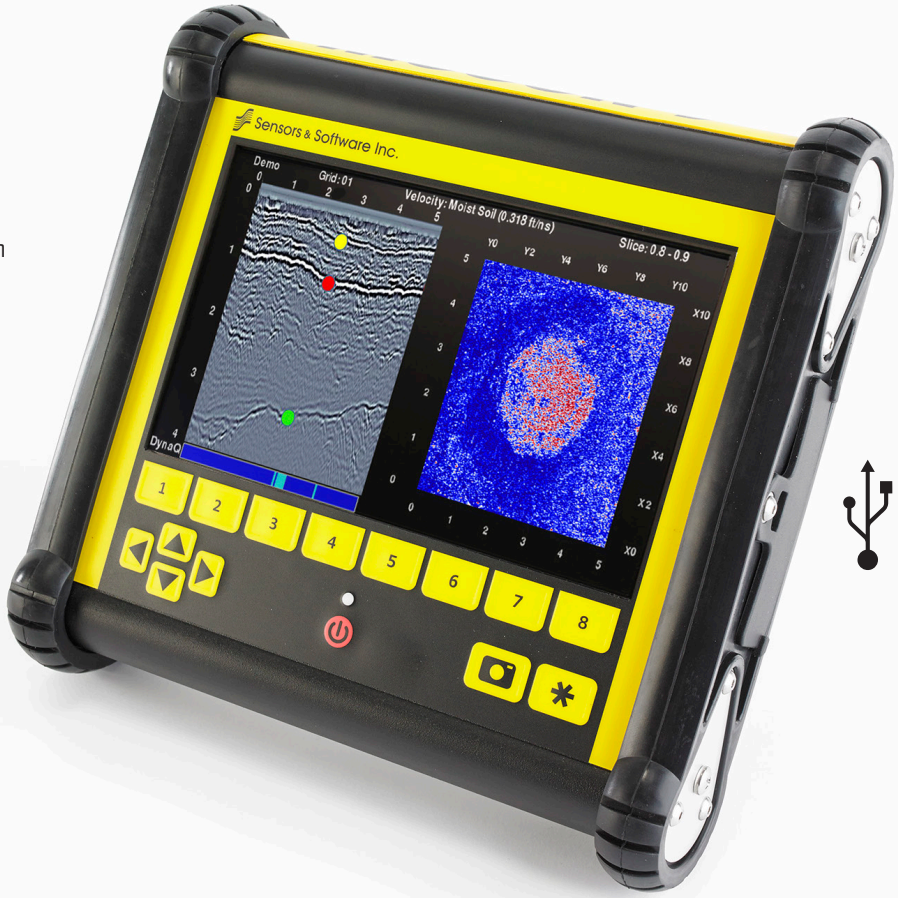
The new DVL-500P screen makes accessing the user interface easier - even when wearing gloves. If using the touch screen is not desired, the DVL also has buttons to access all menu options.

Internal GPS

The internal GPS is used to geo-reference GPR screen captures and grids. The internal GPS is about as accurate as the GPS in your Smartphone or your car - it provides the approximate position of a GPR survey on the Earth – useful for many reconnaissance surveys. When more positional accuracy is required, the DVL-500P accommodates an external GPS.

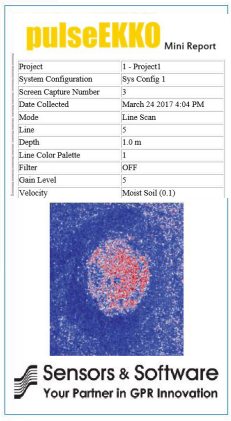
Bluetooth

The DVL Bluetooth capability is used to trigger data collection when an odometer wheel is impractical, for example, during a full bistatic survey across rough terrain or in highly vegetated areas. When collecting data with a 2-person crew, the Bluetooth trigger allows either person – the person carrying the DVL or the person at the antennas - to trigger the data trace collection.



USB port

With a USB port on the DVL-500P, use a USB-memory stick to quickly copy data from the DVL to a PC for plotting, editing, processing, interpreting and reporting using the EKKO_Project software.


pulseEKKO Mini Report

Project	1 - Project1
System Configuration	Sys Config 1
Screen Capture Number	3
Date Collected	March 24 2017 4:04 PM
Mode	Line Scan
Line	5
Depth	1.0 m
Line Color Palette	1
Filter	OFF
Gain Level	5
Velocity	Moist Soil (0.1)

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Wi-Fi

Connect to a network using the Wi-Fi and e-mail a mini report, consisting of a data image and the data collection parameters, from the field – very useful to get a quick answer to customers or to get feedback from a colleague before continuing with the survey.

Compatibility

The new DVL-500P is compatible with most pulseEKKO PRO components – transmitters, receivers, antennas, odometers, and is still compatible with pulseEKKO 100 transmitters.

The addition of the feature-rich DVL-500P to the pulseEKKO system truly creates a GPR system with no limits. Contact our Sales Department at sales@sensoft.ca to inquire about acquiring or upgrading a pulseEKKO system.

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LMX200 and Subsurface Utility Engineering

A California city planned installation of a new water line with the alignment crossing several busy intersections. Extensive buried infrastructure existed beneath the intersections but the accuracy of existing as-built drawings was in question. To verify the drawings and obtain the precise position and depth of these utilities to plan the water line route, the City used the SUE (Subsurface Utility Engineering) process. SUE is an ASCE standard practice designed for gathering accurate utility location information to reduce the risk of damages and minimize unplanned redesigns during construction.

SUE level B calls for use of geophysical methods to verify the horizontal and vertical positions of buried utilities. Knowing that ground penetrating radar (GPR) could locate metallic, non-metallic and abandoned utilities, the city's project team contacted Sensors & Software for a product demonstration.

An LMX200 GPR system was used for this trial. The LMX200 is a professional level GPR system that provides for both real-time and post-survey display and analysis of buried targets. Operators can add interpretations to the LMX200 screen in real-time, and download the data from the unit; using an integrated GPS (global positioning system), interpretations are quickly transferred to engineering reports and geo-referenced digital maps ready for integration into CAD and GIS systems. This seamless information flow makes the LMX200 GPR system ideal for use in SUE; information collected in the field is used for design or updating existing drawings.

Figure 1: LMX200 at the intersection, following collection of a line scan

The city's project team collected test data in the middle of an intersection; this required traffic control for safe access to the area. Three parallel lines of data were collected in Line Scan mode starting from the same base line. GPR targets were marked out in real-time using field interpretations (color-coded dots placed at the apex of the hyperbolas (inverted V's) on the screen) with associated position and depth information.

Data were downloaded into the EKKO_Project software, Sensors & Software's unique PC software used to organize and process collected data, as well as generate reports and output data in various third party system file formats. Since a GPS system was integrated with the GPR, the MapView window of EKKO_Project displays the path travelled, as well as the field interpretations. This information can be overlaid on a site image to help provide the perspective of where the data were collected and correlate with ancillary site data and surface features; in this case a Google Earth image was used. Using MapView, the user can quickly see the spatial relationship of GPR targets and use the long linear character of pipe and cable features to help classify the target types (Figure 2).

Using the LineView module in EKKO_Project, multiple GPR lines are easily viewed at the same time. In this case, lines 2 and 3 were displayed horizontally to enable comparison of responses. This allows the user to confirm that hyperbolas at the adjacent positions have a similar shape and depth. Combined with the MapView image (Figure 2), it is clear that all features show up on both lines and are indeed linear targets running through the intersection.

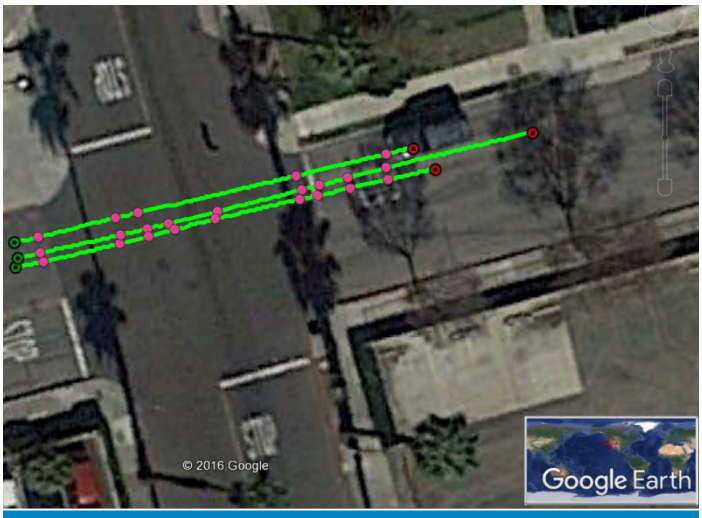

Figure 2: EKKO_Project MapView showing Line Scan locations & interpretations on Google Earth

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The interpretation information can also be viewed in Google Earth, exported into CAD drawings or output directly from the GPR as a CSV file with complete depth and geo-referenced position information. Using EKKO_Project, screen images were quickly captured and inserted into a PDF document called the GPR Summary Report, allowing instant results to be shared from each intersection investigated. This case example shows how GPR can be deployed rapidly and provide high quality data; following a standard workflow results in high quality, Level B SUE outcomes.

Using GPR, the City obtained the information needed to design their new water line installation to avoid existing utilities. This approach not only prevented possible costly damage to existing infrastructure, but it also allowed optimization of the new installation with minimized costs and surface disruptions. Further, the digital records are available for future projects in the same area. Incorporating the LMX200 to carry out SUE for the city's water line installation provided many benefits and the approach will be an integral component of future City projects.

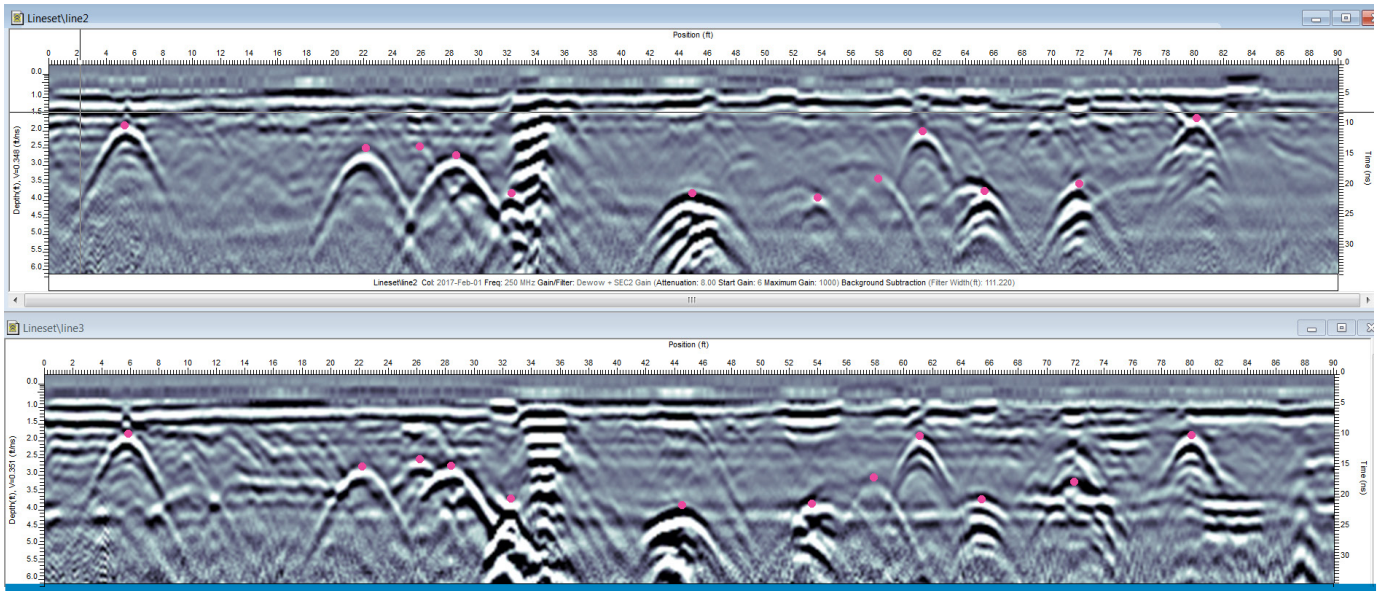

Figure 3: Lines 2 and Line 3 aligned vertically to ensure that the targets are linear features that run across the intersection.

TIPS: CMP surveys using the DVL-500P

One of the advanced surveys that can be conducted with a bistatic GPR system like the pulseEKKO (see accompanying story), is a Common Mid-Point survey. A CMP survey provides a simple way of measuring GPR velocity in the ground or other material; critical information for determining the depth of a target.

The velocity measurement relies on incrementally changing the antenna separation to increase the signal path length from the GPR transmitter to the GPR receiver over a mid-point reflector. For accurate velocities, CMP surveys are best performed in an area with one or more horizontal reflectors. The new pulseEKKO DVL 500P contains a number of features to make collecting CMP surveys quick and efficient.

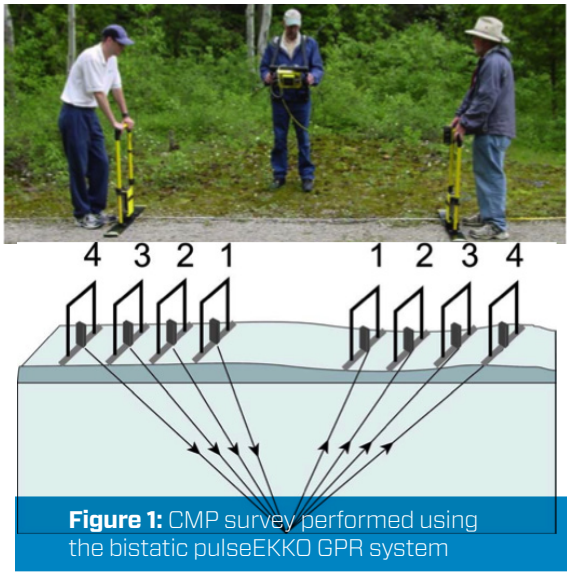

Figure 1: CMP survey performed using the bistatic pulseEKKO GPR system

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- The new, customizable System Configuration menu allows users to set up and save hardware and survey parameters. If you frequently collect CMP data, creating a System Configuration for your CMP surveys is a good idea.
- The **Start Offset Position** setting defines the location of the center point of the CMP survey. If you are collecting a CMP along a previously-collected reflection line, the Start Offset Position can be set to the position on the reflection line.
- During data collection, the Transmitter & Receiver positions are indicated relative to the Start Offset Position; making it much easier to position the transmitter and receiver at the correct position along the tape before collecting the next trace. (Figure 2)
- Once the CMP survey is complete, users can take advantage of the DVL-500P's display capabilities to perform a preliminary analysis of the move out velocities at different times using the Hyperbola Velocity Calibration tool. (Figure 3)

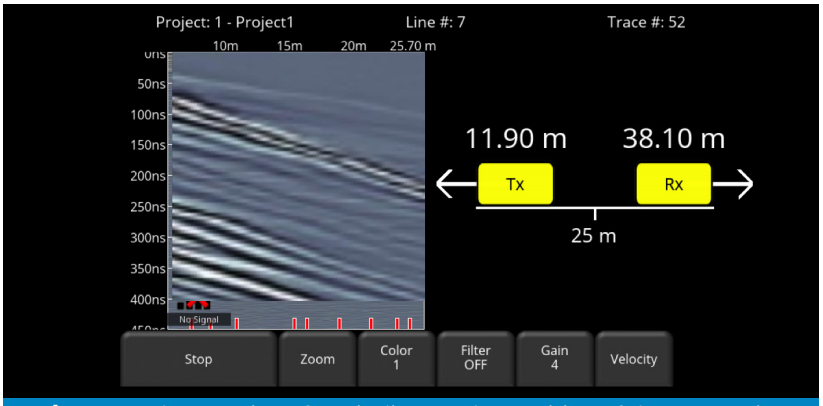

Figure 2: The user interface indicates the position of the Transmitter and Receiver on the measuring tape during data collection

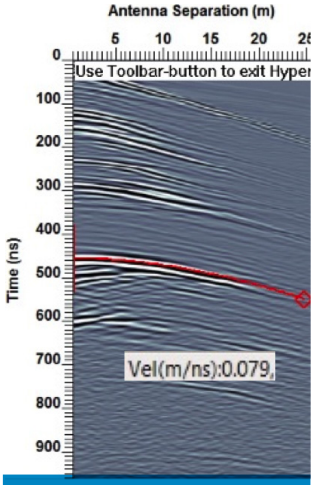

Figure 3: Analyze velocity in the field

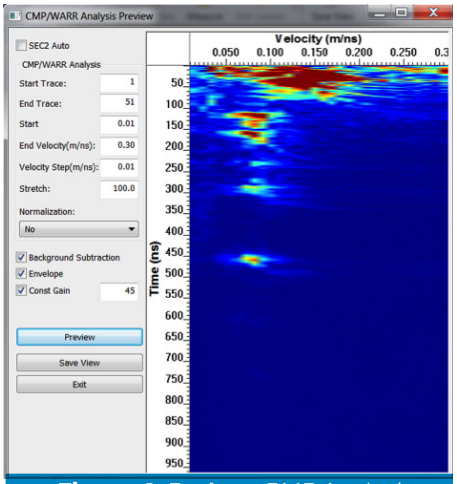

Figure 4: Perform CMP Analysis easily in EKKO_Project

Export the data to a PC and use the CMP Analysis function in the EKKO_Project software for further analysis (Figure 4, Processing module required).
For additional information on how to collect CMP surveys, contact our sales department at sales@sensoft.ca

Upcoming Courses/Webinars

Subsurface Imaging with GPR course, Mississauga, ON, Canada - May 8, 2017

Concrete Scanning with GPR course, Mississauga, ON, Canada - May 9, 2017

New Features of EKKO_Project V5 Analysis Software Webinar - May 10, 2017

3 Day GPR course, Mississauga, ON, Canada - May 31 to June 2, 2017

Upcoming Tradeshows

9th International Workshop on Advanced Ground Penetrating Radar IWAGPR, Edinburg, Scotland - 28-30 June, 2017

Iinternational Construction and Utility Equipment Exposition, Louisville, KY, USA - October 3 to October 5, 2017

Geological Society of America Convention (GSA), Seattle, WA, USA - October 22 to October 25, 2017

American Geophysical Union, New Orleans, LA, USA - December 11 to December 15, 2017

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