An impulse to use 3D GPR technology

ImpulseRadar provides an overview of the 3D GPR data management process, highlighting benefits and improvements compared to 2D systems.

The 3D ground penetrating radar (GPR) systems offer users a higher level of confidence when interpreting results. The density of collected data means a single pass is all that is required to obtain the high-quality 3D information of the line surveyed.

ImpulseRadar Chief Technical Officer Bernth Johansson says, combined with the synchronisation of accurate positional data, each survey line, or 'swath', can be precisely aligned to adjacent swaths, optimising the data gathering process for efficient subsurface mapping.

"Those new to 3D GPR systems – or arrays, as they're commonly known – may think that array data means more of the same thing. While this is partly true, there are other details, which, if considered, may ease the data management process through its different stages," says Mr Johansson.

3D GPR data positioning

ImpulseRadar explains positioning is one of the most significant talking points concerning the collection of 3D GPR data, as the use of high precision RTK-GPS is the most convenient and efficient positioning method and therefore takes preference over the use of total stations.

"However, this convenience becomes ineffective in areas where the signal is interrupted, such as by tree cover, tall buildings, or other overhead obstacles," says Mr Johansson.

"Ultimately, it is the survey environment itself that determines the positioning method to use. In context, only RTK-fix is sufficient, and any loss of fix will cause extra work in data management."

When using GPR data, it is sometimes possible to salvage a project with poor positioning; however, if it is a large project with a high percentage of positioning errors, Mr Johansson says it may be more economical to re-survey with better positioning.

"If you don't have adequate control over the positioning process, it makes little sense to deploy to the field for data collection; even with the best planning, a real-world project could contain data that is less than optimal," he says.

Mr Johansson advises that when dealing with the data volumes from a modern 3D GPR array system, it is advisable to get rid of problematic data as early as possible.

Data import and pre-processing

Before loading data into processing software, the quality control and quality assurance of the data is essential, with users needing practical tools to support the proper selection and management of quality data imports.

"Given the reliance on accurate positioning data, a key element in the data import process is the clean-up of the geometry – the positioning – associated with the raw data files," says Mr Johansson.

As processing radar data takes up a large portion of computer memory and can slow operations down, the cleaning up of data can save not only memory space, but also significant time compared to loading a large amount of compromised data.

Mr Johansson says despite best efforts though, there may be occasions when there are gaps or areas not covered by radar data.

"In such instances, the software must offer some ability to fill such gaps or empty spaces by either interpolating data from adjacent points, or by applying regularisation. Regardless of the theoretical function employed, if the empty spaces are too big, no software can fix it, and those areas will be useless for interpretation," he says.

Migration and post-processing

When using 2D GPR data, those familiar with the system understand that buried features and objects produce reflections in the radar data. Operators learn to recognise such hyperbolic shapes, which helps them mark out the position of utility lines and other targets.

Contrarily, with 3D GPR data, these hyperbolic anomalies are collapsed into points through a known velocity and a mathematical algorithm using a technique called "migration".

Mr Johansson says the migration procedure excels in visualising targets in the top view as, when working with interpretation, it is the view most utilised.

"However, there is no deep expertise needed for applying it correctly when using modern and interactive software like ImpulseRadar's Condor system because the process is simple, swift and intuitive," he says.

By following a few simple guidelines, operators can see resulting data that is significantly more straightforward to interpret than ordinary 2D GPR data, therefore eliminating the ambiguities.

The task of interpretation

"Interpretation is the most time-consuming step in managing 3D GPR data and a real bottleneck for operators, where the right choice of processing software can make a considerable difference," says Mr Johansson.

Although the most common when it comes to interpreting 3D GPR data, Mr Johansson says top views are not that useful for the precise picking of target depths. Instead, their strength lies in giving the user an overview and the perception of the target layouts.

"Having 3D data at hand provides a user with the ability to view any 2D cut in that data volume. If those cuts are made properly, then picking a target in the 2D view – combined with views and picks in the top view – makes the process more accurate," he says.

In a complex project where a screen can quickly become cluttered and confusing, the software must support an effective workflow and practical tools must be easily accessible for navigating through the data to manage the views and the interpretation features.

ImpulseRadar technology

Condor is the latest 3D GPR processing and visualisation software designed to support the ImpulseRadar Raptor 3D GPR solution. Due to a streamlined data management process, the operator does not need to be a processing data expert to be capable of using it, says ImpulseRadar Director of Business Development Brian Wright.

"The combination of a cutting-edge 3D GPR array solution like Raptor and modern 3D processing software such as Condor removes many of the ambiguities often faced by users of simpler 2D systems, as well as conventional 3D GPR systems," says Mr Wright.

"The dense and high-quality data capabilities of Raptor, combined with the speed of data acquisition and data management and processing, makes it possible to efficiently view the subsurface from any direction and thereby secure a reliable interpretation from which to make informed decisions." •

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