Reliable Road Layer Profile Measurement

This application note describes how to assess road layer profiles using subsurface ground penetrating radar.

Challenge

Modern roads consist of multiple layers of different materials and it is often required to determine the layers' depths and to plot a layer profile.

To plot road layer profiles, it is important to collect high quality data and to assign different material properties to the different layers. It is also important that data processing and layer visualization can be done in an efficient and reliable way.

Efficient solutions

The Proceq GS8000 is a portable, digital subsurface mapping system that consists of a Stepped Frequency Continuous Wave (SFCW) Ground Penetrating Radar (GPR). The GPR antenna offers an ultra wide bandwidth, enabling layers at various depths to be mapped with high resolution.

The GPR antenna communicates wirelessly to an iPad and an intuitive app is used for data collection, processing, and visualization. For this road layer profile measurement, data was collected in a straight line of ~35m length, with the GPR antenna coupled to the ground (no air gap). For rough surfaces, the GS8000 antenna can be lifted, but this is not necessary on flat surfaces.

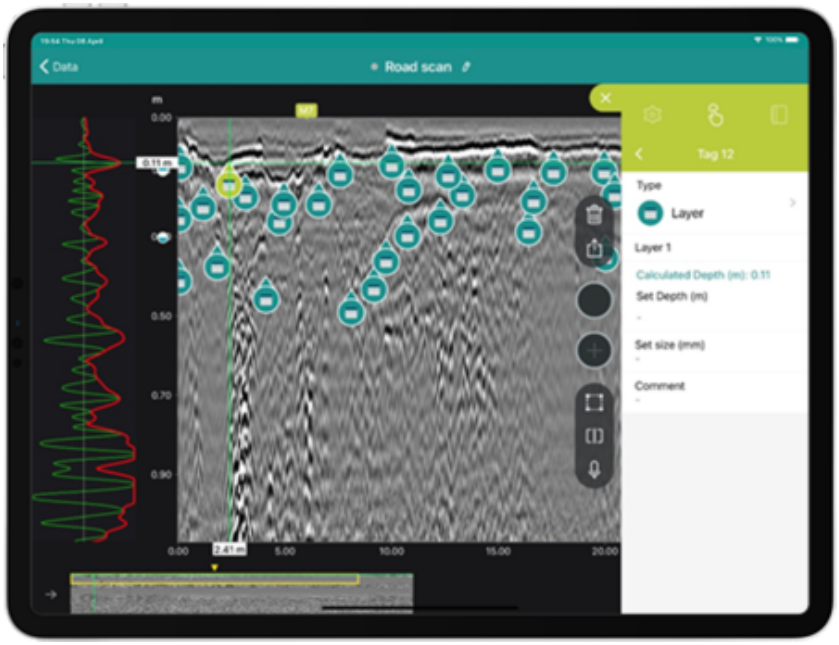


Image showing raw data on Proceq GS app, with several tags marking the interfaces between layers at many intervals along the scan.

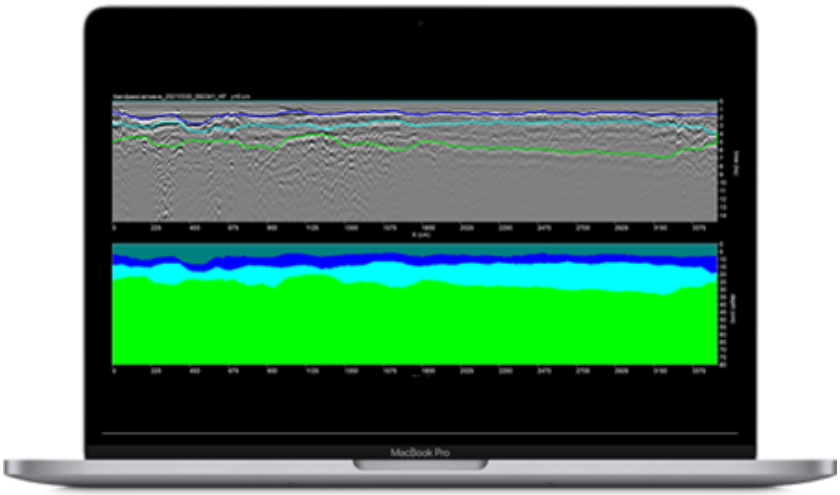
Three features of the Proceq GPR Subsurface (GS) app were used to efficiently process the data:

1. The multi-layer feature was used to set the correct dielectric constant for the different layers. The dielectric constant, and hence the speed of the radio waves, varies with material type, so it is important to adjust the dielectric constant for each layer. This is done with a few clicks on the app.
2. Tagging was used to identify layer interfaces at regular intervals along the scan length. This is very easy to do on the iPad touchscreen. The A-scan view can be used to identify the exact depth of the interface.
3. An HTML report was exported from the app. This report contains all the parameters of the survey and the horizontal (scan) position and depth of all the tags. Any spreadsheet software e.g., Microsoft Excel can be used to plot these positions and visualize the layers.

Advanced data analysis

Alternatively, advanced users can opt to use GPR SLICE PC post-processing software. The Proceq GPR Subsurface (GS) app is used to collect the data, and this is exported in SEG-Y format. The data is imported into GPR SLICE and the different dielectric constants can be set. The ‘Horizon detection’ function is then used to automatically pick out the different layers.

In summary, there are two options for visualizing road layers with data collected from the Proceq GS8000. The first option is suitable for all users, including beginners and requires only the Proceq GS app and usual spreadsheet software. The second option is more suited to advanced users and requires the GS app and GPR SLICE PC software. This option enables automatic plotting of profile layers so is recommended when there are vast quantities of measurement data to be analyzed. With both options, successful layer detection is guaranteed by the high-quality data obtained with the SFCW antenna.



The same GS8000 data processed on GPR-SLICE PC software, using Horizon Detection function. The different road layers are shown in blue, cyan and green.