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Optimised Radar to Find Every Utility in the Street

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Ground Characteristics Measurements Report

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EXECUTIVE SUMMARY

The objective of the ground characteristics measurement report is threefold:

1. estimating the average vertical propagation velocity and the attenuation coefficient based on reflection data acquired in the field with commercially available GPR;

2. characterizing soil samples in terms of their complex electric permittivity in the laboratory for samples taken from surface to 1 m depth;

3. determination of maximum detection depth of pipes and cables of different composition, located at various depths and in different types of soil.

The work to achieve these three goals has been carried out in two field sites and in a constructed test site. The locations have been chosen for difference in soil, in surface cover and control over the buried objects. The ground consisting of anthropogenic sand is characterized and sampled to the first metre of depth in two different seasons. Each of these samples is characterized in terms of complex electric permittivity in the frequency range of interest.

From the samples taken in the winter and in the summer, it was concluded that in the wet season water content does not increase with increasing depth, but water can be held up near the surface at high saturation levels, increasing the surface impedance considerably. This leads to reduced energy radiated into the ground resulting in decreased penetration and detection depth levels.

From the geotechnical characterization, grain size distribution maps have been constructed from which hydraulic conductivity estimates are generated. Several soil types were simulated in the laboratory set up and their geo-mechanical strength was determined with a handheld penetration test device (DCP), but no clear connection between the obtained failure strength and the electric parameters could be given.

From the data recorded in the winter it was found that relatively high water content occurred near the surface, which reduced the penetration depth and makes an average vertical velocity estimate from fixed offset data inaccurate. Present day surface GPR cannot detect plastic pipes of 3 cm diameter at a depth of 60 cm in such conditions. In the stone-covered test site only the larger pipes that have a large contrast in permittivity compared to the surrounding material in which they are embedded could be detected and only if there was no debris in the form of crushed stones in the near surface cover. Three different antennas were necessary to cover the band width from 100 MHz to 1.3 GHz. The data from the constructed test site was acquired with a GPR from IDS and will serve as comparison data to validate the progress made with the newly developed surface GPR in ORFEUS.

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