



Detectability of underground electrical cables junction with a ground penetrating radar: electromagnetic simulation and experimental measurements

Xiang Liu, mohammed serhir, abelin kameni, marc lambert, and lionel pichon

Group of electrical engineering, Paris (GeePs), UMR 8507 CNRS, CentraleSupélec, Univ. Paris Sud, UPMC, Univ. Paris Saclay 11 rue Joliot-Curie, 91192 Gif-Sur-Yvette, France

For a company like Electricity De France (EDF), being able to detect accurately using non-destructive methods the position of the buried junction between two underground cables is a crucial issue. The junction is the linking part where most maintenance operations are carried out. The challenge of this work is to conduct a feasibility study to confirm or deny the relevance of Ground Penetrating Radar (GPR) to detect these buried junctions in their actual environment against clutter. Indeed, the cables are buried in inhomogeneous medium at around 80cm deep.

To do this, the study is conducted in a numerical environment. We use the 3D simulation software CST MWS to model a GPR scenario. In this simulation, we place the already optimized bowtie antennas operating in the frequency band [0.5 GHz – 3 GHz] in front of wet soil (dispersive) and dry soil where the underground cable is placed at 80cm deep.

We collect the amplitude and phase of the reflected waves in order to detect the contrast provoked by the geometric dimensions variation of the cable [1] (diameter of the cable is 48mm and the diameter of the junction 74mm). The use of an ultra-wideband antenna is necessary to reconcile resolution and penetration of electromagnetic waves in the medium to be characterized. We focus on the performance of the GPR method according to the characteristics of the surrounding medium in which the electric cables are buried, the polarization of the Tx and Rx antennas.

The experimental measurement collected in the EDF site will be presented. The measured data are processed using the clutter reduction method based on digital filtering [2]. We aim at showing that using the developed bowtie antennas that the GPR technique is well adapted for the cable junction localization even in cluttered environment.

References

[1] D. J. Daniels, "Surface-Penetrating Radar", London, IEE 1996.

[2] Potin, D.; Duflos, E.; Vanheeghe, P., "Landmines Ground-Penetrating Radar Signal Enhancement by Digital Filtering," in Geoscience and Remote Sensing, IEEE Transactions on , vol.44, no.9, pp.2393-2406, Sept. 2006 .