Geophysical Research Abstracts
Vol. 17, EGU2015-10038, 2015
EGU General Assembly 2015

Comparison of air-launched and ground-coupled configurations of SFCW GPR in time, frequency and wavelet domain

Ellen Van De Vijver, Jan De Pue, Wim Cornelis, and Marc Van Meirvenne
Department of Soil Management, Ghent University, Gent, Belgium (ervdevij.VanDeVijver@UGent.be)

A stepped frequency continuous wave (SFCW) ground penetrating radar (GPR) system produces waveforms consisting of a sequence of sine waves with linearly increasing frequency. By adopting a wide frequency bandwidth, SFCW GPR systems offer an optimal resolution at each achievable measurement depth. Furthermore, these systems anticipate an improved penetration depth and signal-to-noise ratio (SNR) as compared to time-domain impulse GPRs, because energy is focused in one single frequency at a time and the phase and amplitude of the reflected signal is recorded for each discrete frequency step. However, the search for the optimal practical implementation of SFCW GPR technology to fulfil these theoretical advantages is still ongoing.
In this study we compare the performance of a SFCW GPR system for air-launched and ground-coupled antenna configurations. The first is represented by a 3d-Radar Geoscope GS3F system operated with a V1213 antenna array. This array contains 7 transmitting and 7 receiving antennae resulting in 13 measurement channels at a spacing of 0.075 m and providing a total scan width of 0.975 m. The ground-coupled configuration is represented by 3d-Radar's latest-generation SFCW system, GeoScope Mk IV, operated with a DXG1212 antenna array. With 6 transmitting and 5 receiving antennae this array provides 12 measurement channels and an effective scan width of 0.9 m. Both systems were tested on several sites representative of various application environments, including a test site with different road specimens (Belgian Road Research Centre) and two test areas in different agricultural fields in Flanders, Belgium. For each test, data acquisition was performed using the full available frequency bandwidth of the systems (50 to 3000 MHz). Other acquisition parameters such as the frequency step and dwell time were varied in different tests. Analyzing the data of the different tests in time, frequency and wavelet domain allows to evaluate different performance aspects of the air-launched and ground-coupled configurations such as acquisition speed, measurement resolution, SNR and penetration depth. Based on this analysis, we highlight the advantages and disadvantages of the different SFCW GPR configurations in different application environments.

The authors thank Colette Grégoire and Carl Van Geem of the Belgian Road Research Centre for the collaboration on the road test site. This work is a contribution to COST Action TU1208 "Civil Engineering Applications of Ground Penetrating Radar".