Geophysical Research Abstracts
Vol. 16, EGU2014-10547, 2014
EGU General Assembly 2014

Implementation of a synthetic imaging technique for GPR non-destructive testing

Alessandro Galli (1), Davide Comite (1), Ilaria Catapano (2), and Francesco Soldovieri (2)

(1) Department of Information Engineering, Electronics and Telecommunications (DIET) - "Sapienza" University of Rome, Rome, Italy, (2) Institute of Electromagnetic Sensing of the Environment (IREA) - "National Research Council" (CNR), Naples, Italy

As is well known, Ground Penetrating Radar (GPR) is employed in many civil, geophysical, space applications to image hidden targets in various operative conditions. The accuracy and the efficiency of such technique is strongly related from one side to the amount and quality of the 'direct' scattering data that can be gathered by monostatic or bistatic equipment, and from the other side to the soundness of the inversion algorithm used to process GPR data in order to obtain reliable images of the inner features of the probed scenario.

Based on a well-established frequency-domain microwave tomographic approach already developed and tested by some of the Authors, the present work analyzes the possibility of improving the imaging accuracy by using a fully-numerical data processing capable of accounting for the field radiated by a real antenna. Based on the implementation of a 'synthetic setup', which analyzes the scenario under test through an electromagnetic CAD tool (CST Microwave Studio), it has been possible to acquire the spatial distribution both of the incident field and of the scattered one in a numerical form (in time and in frequency domains), gathered in a suitable grid of points in the two-dimensional or three-dimensional regions of interest.

This 'synthetic approach' presents various significant advantages with respect to the standard formulations, allowing for a more accurate target reconstruction in connection with a 'realistic' knowledge of the illumination (i.e. the incident field) in the inversion procedure. Moreover, the approach is extremely flexible and efficient, allowing for testing of a wide variety of GPR configurations, considering different antenna systems and signal waveforms that can actually be used in practice.

A number of tests are performed, emphasizing the distinctive features of this numerical procedure. Various imaging examples are discussed considering target reconstruction in operative configurations, with GPR systems placed on a ground interface to detect various buried scatterers for particularly critical cases (target size comparable to the operative wavelengths with antennas in near-field conditions).