Geophysical Research Abstracts,
Vol. 10, EGU2008-A-05374, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-05374
EGU General Assembly 2008

Microwave tomography for GPR data processing in near surface and structures diagnostics

F. Soldovieri, G. Prisco

Institute for Electromagnetic Sensing of the Environment, National Research Council, Via Diocleziano 328, 80124, Napoli, Italy

The inspection of the shallower layers of the subsoil and of the structures via GPR technique is well-assessed as shown in many study-cases. Indeed, the GPR is one of the most feasible and friendly instrumentation to sound the inner status of the subsoil since it allows to perform measurements over large areas with in very fast way. Despite of the widespread exploitation of the GPR, many difficulties arise in achieving reliable and easily interpretable images, especially when no a priori information is available as for example arise in the case of historical heritages for which the knowledge of the constructive modalities and materials of the structure are missed.

A possible answer to the above cited difficulties resides in the development and the exploitation of microwave tomography algorithms [1], based on more refined electromagnetic scattering model with respect to the ones usually adopted in the classic radaristic approach. The overall aim is to provide accurate and reliable “images” of the investigated structure in order to detect, localize and possibly determine the extent and the geometrical features of the embedded objects.

In this framework, the adoption of linear models of the electromagnetic scattering appears very convenient for practical and theoretical reasons. First, the linear inversion algorithms are numerically efficient thus allowing to investigate domains large in terms of the probing wavelength in a quasi real- time also in the case of 3D case. The adoption of the linear model also permits to achieve the robustness of the solution algorithms with respect to the uncertainties in the parameters of the measurement configuration and on the investigated scenario. From a theoretical point of view, the linear

models allow further advantages such as: the absence of the false solutions (a question to be arisen in non linear inverse problems); the exploitation of well known regularization tools for achieving a stable solution of the problem; the possibility to analyze the reconstruction performances of the algorithm once the measurement configuration and the properties of the host medium are known.

Here we will present the main features and the reconstruction results in realistic conditions of a linear inversion algorithm based on the Born approximation. This model is useful when penetrable objects are under investigations. As well known, the Born Approximation is used to solve the forward problem, that is the determination of the scattered field from a known object under the hypothesis of weak scatterer, i.e. an object whose dielectric permittivity is slightly different from the one of the host medium and whose extent is small in term of probing wavelength. Differently, for the inverse scattering problem, the above hypotheses can be relaxed at the cost to renounce to a "quantitative reconstruction" of the object. In fact, as already shown by results in realistic conditions [2, 3], the adoption of a Born model inversion scheme allows to detect, to localize and to determine the geometry of the object also in the case of not weak scattering objects.

1. R. Persico, R. Bernini, F. Soldovieri, "The role of the measurement configuration in inverse scattering from buried objects under the Born approximation", IEEE Trans. Antennas and Propagation, vol. 53, no.6, pp. 1875-1887, June 2005.

2. F. Soldovieri, J. Hugenschmidt, R. Persico and G. Leone, "A linear inverse scattering algorithm for realistic GPR applications", Near Surface Geophysics, vol. 5, no. 1, pp. 29-42, February 2007.

3. L. Orlando, F. Soldovieri, "Two different approaches for georadar data processing: a case study in archaeological prospecting", in print on Journal of Applied Geophysics.