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Novel GPR data processing based on microwave tomography for in situ subsurface prospecting

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The possibility to exploit Ground Penetrating Radar (GPR) in space exploration is well recognized as it can be inferred by the research activity for Marsis and Moon subsurface exploration with low frequency sensors on satellite platforms and the development of GPR systems for in-situ prospecting. In particular, for the local and detailed inspection of the shallower layers of the subsoil, GPR appear as one of the most viable tools once technological constraints on the hardware are complied [1].

On the other hand, the other main limitation for GPR exploitation arises in the data processing. Usually, the result of the overall diagnostic procedure is a radargram where the echoes backscattered by the buried targets (interfaces, localized objects,..) are reported in terms of two way time. The techniques exploited to achieve the radargram have originated in the framework of the signal processing and thus little attention is due to the underlying physical phenomenon of the electromagnetic scattering. This makes it necessary the "interpretation" of the radargram in order to achieve information about the investigated scene and such a task is usually performed on the basis of the operator's expertise and on the a priori information.

To overcome the above limitations, microwave-tomography techniques have been developed in the last years. By recasting data processing as an inverse scattering problem [2,3] the procedure to obtain an image of the subsoil is performed in an automatic way and the interpretation of the image can be improved. In addition, since the microwave-tomography technique exploits a more refined model of the electromagnetic scattering phenomenon, the understanding of crucial aspects of the reconstruction algorithms

and of the achieved images at a much deeper interpretational level is possible [2].

The presentation will be concerned with the main features of the microwave tomographic techniques and a survey of the more recent results will be presented for both synthetic and real conditions in subsurface exploration.

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[2] 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.

[3] F. Soldovieri, G. Prisco , “Microwave tomography for Moon in-situ subsurface exploration via Ground Penetrating Radar”, Proc. of 9th ILEWG International Conference on Exploration and Utilisation of the Moon (ICEUM9/ILC2007), Sorrento, Italy, Oct. 2007.