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Microwave Tomography enhanced GPR surveys in Centaur's Domus - Regio IV of Pompeii

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The archaeological area of Pompeii (Naples, Italy) is worldwide known as one of the most remarkable examples of a Roman Empire town. However, the origins of this famous city are prior to the Roman age (I a sec. a. C.) and there is a huge archeological interest in discovering housing structures as well as decorations and objects which are dated back to the Sannitic age (III sec a.C.). In this framework, Ground Penetrating Radar is a useful technique, which allows not only to quickly characterize underground scenarios and then properly plan the excavation campaigns, but also to image ancient structures which are buried in sites where stratigraphic assays are not viable. Aim of this communication is to present some results concerning the processing of GPR data gathered at the Centaur's Domus – Regio IV of Pompeii. This is a Roman Domus formed by three housing units, having double atrium and double peristyle and located between Mercury's street and Fauno's alley.
Previous excavation campaigns have led to discover Sannitic structures in the most ancient of the three units forming the Domus. Therefore, to properly plan the stratigraphic assays, which were carried out in the other two units of the Domus at October 2010, GPR surveys were done by exploiting a GPR Ris-K2 system equipped with 200MHz and 600 MHz shielded antennas. Since a key issue is to provide images which are stable with respect to measurement noise and uncertainties on the scenario as well as minimally dependent on the end-user's interpretation, the acquired multi-bistatic data scans were processed by means of a microwave tomographic approach [1]. The adopted imaging strategy exploits the Born approximation to model the electromagnetic scattering phenomenon, in the frequency domain, and achieves a regularized solution of the linear ill-posed inverse scattering problem by means of the Truncated Singular Value Decomposition of the integral operator, which relates the unknown electric contrast to the measured data. A time gating procedure was also adopted to remove the direct wave due to the air soil interface [2].
The images of the reconstructed electric contrast provided by the microwave tomography approach and the subsequent excavations have led to find several draining water ducts and to unearth an ancient wall in the area denoted, in the Domus map, by the street number 5. Moreover, based on a three-dimensional reconstruction of the electric contrast and the expertise of the archaeological team, the presence of a Sannitic wall has been hypothesized in the area of the Domus named Cubicolo 3. This is a housing structure of the Roman age, where stratigraphic assays are not viable due to the presence of well preserved decorations on the floor and on the surrounding walls.

[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 on Antennas Propag., Vol. 53, No. 6, pp. 1875-1887, Jun 2005.
[2] F. Soldovieri, J. Hugenschmidt, R. Persico, G. Leone, "A Linear Inverse Scattering Algorithm for Realistic GPR Applications," Near Surface Geophysics, Vol. 5, No. 1, pp. 29-42, Feb. 2007.