

The detectability of archaeological structures beneath the soil using the ground penetrating radar technique

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Introduction

The traditional excavation tools applied to Archaeology (i.e. trowels, shovels, bulldozers, etc.) produce, generally, a fast and invasive reconstruction of the ancient past. The geophysical instruments, instead, seem to go in the opposite direction giving, rapidly and non-destructively, geo-archaeological information. Survey information gathered using non-invasive methods contributes to the creation of site strategies, conservation, preservation and, if necessary, accurate location of excavation and restoration units, without destructive testing methods, also in well-known archaeological sites [1]-[3].

In particular, Ground Penetrating Radar (GPR) has, recently, become the most important physical technique in archaeological investigations, allowing the detection of targets with both very high vertical and horizontal resolution, and has been successfully applied both to archaeological and diagnostic purposes in historical and monumental sites [4].

Materials and Methods

GPR configuration, antenna frequency and survey modality can be different, depending on the scope of the measurements, the nature of the site or the type of targets.

Two-dimensional (2D) time/depth slices and radargrams should be generated and integrated with information obtained from other buried or similar artifacts to provide age, structure and context of the surveyed sites (Fig. 1).

In the present work, we present three case-histories on well-known Roman archaeological sites in Rome (Italy), in which GPR technique has been successfully used. To obtain 2D maps of the explored area, a bistatic GPR (Noggin Plus and Pulse Ekko pro, Sensors & Software, Inc.), equipped with 250MHz and 500MHz antennas, was applied, acquiring data along several parallel profiles, in reflection mode with a same sampling interval of 0.02m and different time windows.

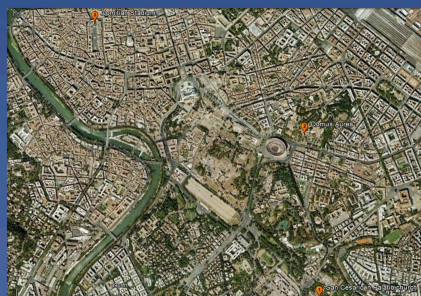


Fig. 2: Localisation of the three archaeological Roman sites in Rome (Italy): San Cesario in palatio Church, Domus Aurea and Domitian Stadium.

Results and Discussion

The GPR results reveal the presence of similar circular anomalies in all the investigated archaeological sites in Rome (Italy). In particular, in the Domus Aurea, in the Domitian Stadium, and in the San Cesario in Palatio church (Fig. 2), the processing of the GPR data highlights not only the presence of Roman circular bases/insoles of pillars not yet brought to the light, but also their structural disposition and geometry.

Site 1: San Cesario in Palatio church.

After collecting a GPR grid in both directions (X and Y) outside the church, three clear anomalies are visible both on the Y radargrams

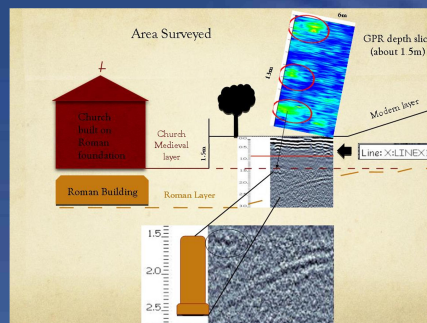


Fig. 3: A schematic reconstruction of the anomalies clearly visible both in the radargrams and in the depth-slices at about 1.5m beneath the soil.



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and on the GPR depth-slice at a depth of approximately 1.5m. These anomalies are probably the remains of three columns in the subsurface leaning the entrance of a Roman Bath (which is partially visible downstairs in the church).

Moreover, in the X radargrams it is possible to recognize the presence of a well-defined anomaly close to a curve event (which is probably due to a geological nature). (Fig. 3).

Site 2: Domus Aurea

In the radargrams, extracted from the Y grids acquired in a room inside the Domus Aurea, the presence of two strong sub-horizontal reflectors is evident at the same depth of about 0.65m, equally spaced, probably due to some Roman insoles/bases of pillars or columns.

Figure 4 illustrates the overlap of a GPR depth-slice on this area, confirming the previous hypothesis.

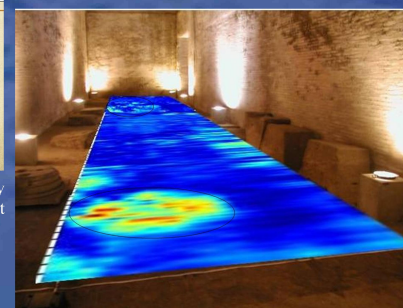


Fig. 4: The GPR depth-slice in which is clear the presence of two circular Roman column bases.

Site 3: Domitian Stadium.

In this archaeological site, the GPR acquired several single lines and a grid. Both the radargrams and the depth-slices put in evidence the presence of clear anomalies due to insoles and pillars not completely brought to the light and partially covered by modern concrete (Fig. 5).

Conclusion

These three examples show that GPR technique is a valid support which, in exhaustive way, can underline the unexpected presence of ancient structures beneath the soil, also in well-known archaeological sites.

- References
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Fig. 5: The summary of the GPR measurements and the depth-slice (about 1m depth) with the evident anomalies due to Roman insoles and columns.

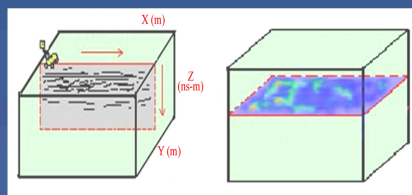


Fig. 1: Schematic reconstruction of radargrams and time/depth slices using GPR multi-profile acquisition.