



Advanced 3-dimensional GPR image acquisition to detect an early Christian remains in Perugia (Italy)

Luciana Orlando

Sapienza University of Rome, Via Eudossiana 18, 00184, Rome, Italy,
luciana.orlando@uniroma1.it

At the present time, the St. Pietro church in Perugia (Italy), X century in age, is the result of a complex stratification of styles. In the left back of the main altar, at the depth from 0.5 to 3 meters, the rests of an early Christian temple was found in 1979. The archaeological excavations performed in 1981, discovered that the temple includes a circular apse and a corridor with 5 apsidal niches of the same dimensions. The roof of temple was cut to allow to build St. Pietro Church. Basing on the present knowledge the archaeologists suppose that below the church, others early Christian remains, could be present. These remains probably were in part destroyed to build the Christian church. Moreover it is known that there are tombs, Christian in age, dug in the church floor.

The objective of the work is to use geophysical methods to explore the church with the aim to detect any more early Christian remains present below the floor of the church. For this purpose GPR survey was carried out on the floor of the nave and of two side aisles of the church.

The study was planed taking care the quality of slices GPR images. This objective was followed mainly increasing the lateral cross-line sampling during the acquisition. To save time the data were acquired using an array of two antenna with peak frequencies of 200 and 600 MHz. The position of antenna was parallel one each other and spaced 0.35 m. They were moved in the same time along two parallel lines. The data were acquired with four channels each with the following configuration: transmitter and receiver 600 MHz frequency (channel 1), transmitter and receiver frequency 200 MHz

(channel 2); transmitter 200 MHz and receiver 600 MHz (channel 3) and transmitter 600 MHz and receiver 200 MHz (channel 4). Taking into account the reciprocal position of transmitter and receiver of each antenna this configuration allowed to survey three lines in the same time spaced about 0.17 m. The channel 3 and 4 have acquired profiles located at the same position, i.e. at the centre of array.

The area, about 20x27 m wide, was surveyed in x and y- directions with array lines spaced 0.5 m. The early Christian temple, because of it is located below the main altar it was investigated partially. The trace locations were obtained with an odometer; the in line sampling was 0.01m and the time sampling 0.105313ns. The survey was performed with the instrument of IDS Corporation.

The data were processed to obtain vertical profiles and 3D cubes. The data processing consisted of setting time zero, frequency analysis, band pass filter and Stolt migration. The diffraction hyperbola analysis gives electromagnetic velocity of about 0.09 m/ns.

The 3D cube was obtained for each channel and using the data of all four channels.

The analysis of data gives that the slices obtained from cube built using all four channels are of better quality respect the others which are built using single channel data.

We obtain that apart for the lateral resolution depending on frequency and depth of reflection it is important for a quality of image to perform data with a high lateral sampling.

The slices show anomalies about 1 m depth and 2x3m wide, referable to tombs and anomalies, about 1.8 m depth, rectangular in shape and side 45° rotated respect the St. Pietro church side.

The study has showed that a considerable improvement of the quality of data can be reached increasing the lateral sampling during the acquisition. To save time during the acquisition this can be obtained using an instrument equipped with an antenna array.