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Test site experiments with a reconfigurable stepped frequency GPR

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Abstract

In this contribution, some new possibilities offered by a reconfigurable stepped frequency GPR system are exposed. In particular, results achieved from a prototypal system achieved in two scientific test sites will be shown together with the results achieved in the same test sites with traditional systems. Moreover a novel technique for the rejection of undesired interferences is shown, with the use of interferences caused on purpose.

Key words
GPR, reconfigurable stepped frequency.

Introduction

A reconfigurable GPR system is meant as a GPR where some parameter can be changed vs. the frequency (if the system is stepped frequency) or vs. the time (if the system is pulsed) in a programmable way. The programming should then account for the conditions met in the scenario at hand [1]. Within the research project AITECH (http://www.aitechnet.com/ibam.html), the Institute for Archaeological and Monumental Heritage, together with the University of Florence and the IDS corporation have implemented a prototype, that has been used in sites of cultural interest in Italy [2], but also abroad in Norway and Malta.
The system is a stepped frequency GPR working in the frequency range 50-1000 MHz, and its reconfigurability consists in three properties. The first one is the fact that the length of the antennas can be modulated by the aperture and closure of two electronic switches present along the arms of the antennas, so that the antennas can become electrically (and electronically) longer or shorter, so becoming more suitable to radiate some frequencies rather than some other. In particular, the system can radiate three different bands in the comprehensive range between 50-1000 MHz, so being suitable for different depth range of the buried targets, and the three bands are gathered in a unique “going through” because for each measurement point the system can sweep the entire frequency range trhee times, one for each configuration of the switchres on the arms. The second property is the fact that the integration time of the harmonic components of the signal can be prolonged in a programmable way, so that (in particular) there is the possibility to reject undesired narrow band interferences without filtering the signal, namely without loosing part of the information contained in the signal. The third property is that the power can be modulated frequency by frequency. Indeed, we don’t know if this third property is a real advantage, but the first two have been already exploited showing some encouraging results.
At the conference, we will show the results achieved from two measurement campaign performed in two controlled site, namely the the test site of Hydrogeosite Laboratory, in Marsico Nuovo (Southern Italy), belonging to the Institute of Methodologies for Environmental Analysis of the Italian National Research Council [3] and the test site of Montelibretti, in central Italy, belonging to the Institute of Technologies Applied to Cultural Heritage of the National Research Council [4]. In both test sites, among other things, anomalies resembling features of archaeological or near surface interest have been predisposed, as a tomb, a paved road, an amphora, a statue, a buried chamber, a cylinder, a structure in opus coementicium. The test site of Montelibretti is outdoor, in an area of archaeological interest were the ancient population of the Sabini has left relevant testimonies. The test site of Hydrogeosite Laboratory is indoor, in a hat were a large pool (240m3) has been filled up with sand after burying the test targets. This test site is equipped also for hydrogeophysical experiments by means of a controlled hydraulic system for the progressive immission of water in the sand. Depth slices will be shown for both sites, as well as some tests for the mitigation of intereferences by means of the modulation of the integration time of the harmonic components of the signal. Some of the interferences have been artificially introduced by means of a second (pulsed) GPR system, radiating in the soil during the measurements.

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References

[1] R. Persico, G. Prisco, A Reconfigurative Approach for SF-GPR Prospecting, IEEE Trans. On Antennas and Prop., vol. 56, n.8, pp. 2673-2680, August 2008.
[2] R. Persico, M. Ciminale, L. Matera, A new reconfigurable stepped frequency GPR system, possibilities and issues; applications to two different Cultural Heritage Resources, Near Surface Geophysics, vol. 12, n. 6, pp. 793-801 (doi: 10.3997/1873-0604.2014035), December 2014.
[3] Capozzoli L., Caputi A., De Martino G., Giampaolo V., Luongo R., Perciante F., Rizzo E.,, Electrical and electromagnetic techniques applied to an archaeological framework reconstructed in laboratory, 8th International Workshop on Advanced Ground Penetrating Radar - IWAGPR 2015, Florence, Italy, 7-10 July, 2015.
[4] Bernabini M., Pettinelli E., Pierdicca N., Piro S., Versino L., 1992. Field experiments for characterization of GPR antenna and pulse propagation. Journal of Applied Geophysics, special issue on GPR Vol.33 (1995), pp 63-76.