



Design and testing of Ground Penetrating Radar equipment dedicated for civil engineering applications: ongoing activities in Working Group 1 of COST Action TU1208

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This work aims at presenting the ongoing research activities carried out in Working Group 1 “Novel GPR instrumentation” of the COST (European COoperation in Science and Technology) Action TU1208 “Civil Engineering Applications of Ground Penetrating Radar” (www.GPRadar.eu).

The principal goal of the COST Action TU1208 is to exchange and increase scientific-technical knowledge and experience of GPR techniques in civil engineering, simultaneously promoting throughout Europe the effective use of this safe and non-destructive technique in the monitoring of infrastructures and structures.

Working Group 1 (WG1) of the Action focuses on the development of innovative GPR equipment dedicated for civil engineering applications. It includes three Projects. Project 1.1 is focused on the “Design, realisation and optimisation of innovative GPR equipment for the monitoring of critical transport infrastructures and buildings, and for the sensing of underground utilities and voids.” Project 1.2 is concerned with the “Development and definition of advanced testing, calibration and stability procedures and protocols, for GPR equipment.” Project 1.3 deals with the “Design, modelling and optimisation of GPR antennas.”

During the first year of the Action, WG1 Members coordinated between themselves to address the state of the art and open problems in the scientific fields identified by the above-mentioned Projects [1, 2]. In carrying out this work, the WG1 strongly benefited from the participation of IDS Ingegneria dei Sistemi, one of the biggest GPR manufacturers, as well as from the contribution of external experts as David J. Daniels and Erica Utsi, sharing with the Action Members their wide experience on GPR technology and methodology (First General Meeting, July 2013). The synergy with WG2 and WG4 of the Action was useful for a deep understanding of the problems, merits and limits of available GPR equipment, as well as to discuss how to quantify the reliability of GPR results.

An innovative reconfigurable ground-coupled stepped-frequency GPR is being studied and optimised by a group of WG1 Members; it was designed in Italy and is equipped with two bow-tie antennas, with a series of switches along their arms, so that their size can be varied. The system was tested in several sites, both indoor and outdoor, in comparison with a commercial ground-coupled pulsed system [1, 3, 4]. Subsequently, within a COST Short-Term Scientific Mission (STSM), the prototype device was sent to Norway and compared with a commercial ground-coupled stepped-frequency radar [5]. These experimental activities were fundamental to gain a deeper knowledge of the reconfigurable GPR prototype and to plan its improvement.

Another innovative system being designed within the Action and proposed by Italian Members, will allow investigating the mechanical properties of pavement, in addition to its geometrical and electromagnetic properties.

Cooperation with the COST Action IC1102 “Versatile, Integrated, and Signal-aware Technologies for Antennas (VISTA)” has been established, concerning the design of GPR antennas.

At least two more WG1 activities need to be mentioned, as they are very interesting and promising. The first one, coordinated by Italy and involving Members and external experts from Germany, United Kingdom, Japan and United States, is the development of a protocol providing recommendations for the safety of people and instruments in near surface geophysical prospecting, with a particular focus to the use of GPR.

The second initiative is called GPR4Everyone, it was proposed by Italy and consists in creating a virtual store of GPR equipment at the disposal of Members from inclusiveness Countries: some Institutes have GPR systems and complementary NDT equipment no longer used, while there are Institutes who cannot afford to buy a GPR; thus, the idea is to cense the unused equipment and make it available to be given for free to researchers from less research-intensive countries, as a small step to counterbalance research communities' unequal access to funding and resources distribution.

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