



GPR surveying of transport infrastructures and buildings; underground utility and void sensing - ongoing activities in Working Group 2 of COST Action TU1208

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This work aims at presenting the ongoing research activities carried out in Working Group 2 "GPR surveying of pavements, bridges, tunnels and buildings; underground utility and void sensing" 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 Ground Penetrating Radar (GPR) techniques in civil engineering, whilst simultaneously promoting throughout Europe the effective use of this safe and non-destructive technique in the monitoring of infrastructures and structures. Four Working Groups (WGs) carry out the research activities. WG1 focuses on the development of innovative GPR equipment dedicated for civil engineering applications. WG2 deals with the development of guidelines and protocols for the surveying, through the use of a GPR system, of transport infrastructure and buildings, as well as for the sensing of utilities and voids. WG3 deals with the development of electromagnetic forward and inverse scattering methods, for the characterization of GPR scenarios, as well as with data-processing algorithms for the elaboration of the data collected during GPR surveys. WG4 is concerned with the use of GPR in fields different from the civil engineering, as well as with the integration of GPR with other non-destructive testing techniques. Each WG includes several Projects.

WG2 includes five Projects. Project 2.1 focuses on outlining "Innovative inspection procedures for effective GPR surveying of critical transport infrastructures (pavements, bridges and tunnels)." Project 2.2 is concerned with the development of "Innovative inspection procedures for effective GPR surveying of buildings." Project 2.3 deals with identifying "Innovative inspection procedures for effective GPR sensing and mapping of underground utilities and voids, with a focus to urban areas." Project 2.4 focuses on the development of "Innovative procedures for effective GPR inspection of construction materials and structures." The WG2 also includes Project 2.5 on the "Determination, by using GPR, of the volumetric water content in structures, sub-structures, foundations and soil," this is a topic of great interest in civil engineering, as water infiltration is often a relevant cause of degradation of structures, such as roads of bridges, and of rebar corrosion.

During the first year of the Action, information was collected and shared about state-of-the-art, ongoing studies, problems and future research needs, in the topics covered by the five above-mentioned Projects [1-3].

Based on the experience and knowledge gained from the in-depth review work carried out by WG2, several case studies were then conducted; they were presented during the Second General Meeting and the GPR 2014 conference [5, 6]. Furthermore, the extension of GPR application to railways track ballast assessment was demonstrated [7].

The WG2 identified reference test-sites, suitable to compare inspection procedures or to test GPR equipment. The IFSTTAR geophysical test site is an open-air laboratory including a large and deep area, filled with various materials arranged in horizontal compacted slices, separated by vertical interfaces and water-tightened in surface; several objects as pipes, polystyrene hollows, boulders and masonry are embedded in the field [4]. The IFSTTAR full-scale APT facility is an outdoor circular carousel dedicated to full-scale pavement experiments, consisting of a central tower and four long arms equipped with wheels, running on a circular test track [4].

Furthermore, the WG2 is building a database of available experimental results, which are at the disposal of WG3 Members to test their electromagnetic modeling/inversion/data-processing methods.

Another interesting and promising WG2 initiative that has to be mentioned is the development of a Catalogue of European test sites and laboratories for the testing of GPR equipment, methodology and procedures, that is being coordinated by France and Italy. The catalogue will represent a useful tool for the GPR community and it will contribute to identifying new cooperation possibilities among research groups, to clarifying which

are the missing testing facilities in the various European regions, and to addressing current or future research needs.

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References

[1] Proc. First Action’s General Meeting (Rome, Italy, 22-24 July 2013), 1st edition, COST Action TU1208, L. Pajewski, A. Benedetto, Eds., ISBN 978-88-548-6191-6 (Aracne, 2013).

[2] Civil Engineering Applications of Ground Penetrating Radar, A. Benedetto, L. Pajewski, Eds., ISBN 978-3-319-04812-3 (Springer, 2015).

[3] A. Benedetto, “State of the Art of GPR Applications and New Trends in Transportation Infrastructures,” Future Trends in Civil Engineering, A. Ceric, S. Lakusic, Eds., ISBN 978-953-6272-65-5 (2014).

[4] Proc. 2013 Working Group Progress Meeting (Nantes, France, 24-25 February 2014), COST Action TU1208, L. Pajewski, X. Derobert, Eds., ISBN 978-88-548-7223-3 (Aracne, 2014).

[5] Proc. 15th International Conference on Ground Penetrating Radar - GPR2014, S. Lambot, A. Giannopoulos, L. Pajewski, F. De André, E. Slob, C. Craeye, Eds., IEEE Conf. Number 35163 (IEEE, 2014).

[6] Proc. Second Action’s General Meeting (Vienna, Austria, 30 April-2 May 2014), COST Action TU1208, L. Pajewski, A. Benedetto, Eds., ISBN 978-88-548-7224-0 (Aracne, 2014).

[7] S. Fontul, F. De Chiara, E. Fortunato, A. Lopes, “Evaluation of ballast condition using Ground Penetrating Radar,” The Ninth Intl. Conf. on Engineering Computational Technology (2014).