Geophysical Research Abstracts
Vol. 17, EGU2015-15792, 2015
EGU General Assembly 2015

Exchanging knowledge and working together in COST Action TU1208: Short-Term Scientific Missions on Ground Penetrating Radar

Sonia Santos Assuncao (1), Philippe De Smedt (2), Iraklis Giannakis (3), Loredana Matera (4), Nicolas Pinel (5), Klisthenis Dimitriadis (6), Antonios Giannopoulos (3), Jacopo Sala (7), Sébastien Lambot (8), Immo Trinks (9), Marian Marciniak (10), and Lara Pajewski (11)

(1) Universitat Politecnica de Catalunya, Department of Strength of Materials and Structural Engineering, Barcelona, Spain (sonia.assuncao@upc.edu), (2) Ghent University, Ghent, Belgium (philippe.desmedt@ugent.be), (3) The University of Edinburgh, School of Engineering, Edinburgh, United Kingdom (i.giannakis@ed.ac.uk), (4) University of Bari, Bari, Italy (loredana.matera@uniba.it), (5) Alyotech Technologies, Nantes, France (nicolas.pinel@alyotech.fr), (6) Geoservice, Athens, Greece (workst@geoservice.gr), (7) 3d-radar, Trondheim, Norway (jacopo@3d-radar.com), (8) Université Catholique de Louvain, Earth and Life Institute, Louvain-la-Neuve, Belgium (sebastien.lambot@uclouvain.be), (9) Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology, Vienna, Austria (immo.trinks@archpro.lbg.ac.at), (10) National Institute of Telecommunications, Warsaw & Kielce University of Technology, Kielce, Poland (m.marciniak@itl.waw.pl), (11) Roma Tre University, Department of Engineering, Rome, Italy (lara.pajewski@uniroma3.it)

This work aims at presenting the scientific results stemming from six Short-Term Scientific Missions (STSMs) funded by the COST (European COoperation in Science and Technology) Action TU1208 “Civil Engineering Applications of Ground Penetrating Radar” (Action Chair: Lara Pajewski, STSM Manager: Marian Marciniak). STSMs are important means to develop linkages and scientific collaborations between participating institutions involved in a COST Action. Scientists have the possibility to go to an institution abroad, in order to undertake joint research and share techniques/equipment/infrastructures that may not be available in their own institution. STSMs are particularly intended for Early Stage Researchers (ESRs), i.e., young scientists who obtained their PhD since no more than 8 years when they started to be involved in the Action. Duration of a standard STSM can be from 5 to 90 days and the research activities carried out during this short stay shall specifically contribute to the achievement of the scientific objectives of the supporting COST Action.

The first STSM was carried out by Lara Pajewski, visiting Antonis Giannopoulos at The University of Edinburgh (United Kingdom). The research activities focused on the electromagnetic modelling of Ground Penetrating Radar (GPR) responses to complex targets. A set of test scenarios was defined, to be used by research groups participating to Working Group 3 of COST Action TU1208, to test and compare different electromagnetic forward- and inverse-scattering methods; these scenarios were modelled by using the well-known finite-difference time-domain simulator GprMax. New Matlab procedures for the processing and visualization of GprMax output data were developed.

During the second STSM, Iraklis Giannakis visited Lara Pajewski at Roma Tre University (Italy). The study was concerned with the numerical modelling of horn antennas for GPR. An air-coupled horn antenna was implemented in GprMax and tested in a realistically modelled pavement scenario; moreover, the horn was compared with a previously-implemented ground-coupled bowtie antenna. The numerical results indicate that air-coupled antennas receive clear reflections from distinct layers within the pavement but they are incapable in the considered setting to detect cracks filled with air. On the other hand, by using ground-coupled antennas it is easier to interpret hyperbolic responses from the buried cracks. The developed modelling framework is a powerful tool in evaluating the performance of high-frequency GPR transducers in realistic situations and this approach can lead to better design of GPR antennas.

The third STSM was carried out by Sonia Santos Assunçao visiting Klisthenis Dimitriadis at Geoservice (Greece). They worked at the non-destructive inspection of the Tholos Tomb of Acharnon. The unknown thickness of the Tomb walls was determined by using a GPR. Data were plotted in impressive circular radargrams. Discontinuities in the measured data were identified and associated to fissures or voids, indicating internal and superficial damages of the Tomb. A combination of GPR with electrical resistivity tomography allowed a more accurate data interpretation. Vibrations in the Tomb were quantified by using seismic measurements and endoscopy was used to confirm the thickness of the walls.

During the fourth STSM, Philippe De Smedt visited Immo Trinks at the Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology. The research activities regarded the reconstruction of prehistoric environments at Stonehenge, by means of multiple electromagnetic survey methods. Different datasets

were processed, analysed and compared: data from a multi-receiver electromagnetic induction survey (collected by the ORBit research group from Ghent University, Belgium), and data from a 3D GPR survey (collected by the Ludwig Boltzmann Institute for Virtual Archaeology and Archaeological Prospection, Austria). The aim was that of creating a robust methodological foundation for the combined analysis of electromagnetic-induction and GPR data.
The fifth STSM was carried out by Loredana Matera, who visited Jacopo Sala at 3d-radar (Norway). They tested an innovative reconfigurable stepped-frequency GPR, designed and realised in Italy. The prototype was compared with commercial equipment produced in Norway. Through laboratory experiments as well as outdoor campaigns in urban scenarios with archaeological remarks, a deeper knowledge of the Italian prototype was achieved and plans were made to improve it.
Finally, Nicolas Pinel visited Sébastien Lambot at the Université catholique de Louvain (UCL); the last STSM presented in this abstract, was devoted to investigating how to model the effect of soil roughness in the inversion of ultra wide-band off-ground monostatic GPR signals. The aim of this research is the noninvasive quantification of soil properties through the use of GPR. The work focused on incorporating the improved asymptotic forward electromagnetic model developed by Pinel et al. in the multilayer Green function code developed at UCL.

Acknowledgement
The Authors thank COST, for funding the Action TU1208 “Civil Engineering Applications of Ground Penetrating Radar,” supporting these STSMs.