Geophysical Research Abstracts
Vol. 18, EGU2016-18416, 2016
EGU General Assembly 2016

Non-destructive tests for railway evaluation: Detection of fouling and joint interpretation of GPR and track geometric parameters - COST Action TU1208

Mercedes Solla (1), Simona Fontul (2), Vânia Marecos (2), and Andreas Loizos (3)

(1) Defense University Center, Spanish Naval Academy, Marin, Spain, (2) National Laboratory for Civil Engineering, LNEC, Lisbon, Portugal, (3) National Technical University of Athens, Athens, Greece

During the last years high-performance railway lines have increased both their number and capabilities. As all types of infrastructures, railways have to maintain a proper behaviour during the entire life cycle. This work is focused on the analysis of the GPR method and its capabilities to detect defects in both infra and superstructure in railways. Different GPR systems and frequency antennas (air-coupled with antennas of 1.0 and 1.8 GHz, and ground-coupled with antennas of 1.0 and 2.3 GHz) were compared to establish the best procedures.

For the assessment of the ground conditions, both GPR systems were used in combination with Falling Weight Deflectometer (FWD) load tests, in order to evaluate the bearing capacity of the subgrade. Moreover, Light Falling Weight Deflectometer (LFWD) measures were performed for the validation of the interpretation of the damaged areas identified from GPR and FWD tests. Finally, to corroborate the joint interpretation of GPR and FWD-LFWD, drill cores were extracted in the damaged areas identified based on the field data. Comparing all the data, a good agreement was obtained between the methods, when identifying both anomalous deflections and reflections. It was also demonstrated that ground-coupled systems have clear advantages compared to air-coupled systems since these antennas provide both better signal penetration and vertical resolution to detect fine details like cracking.

Regarding the assessment of the thickness, three different high-speed track infrastructure solutions were constructed in a physical model, using asphalt as subballast layer. Four different antennas were used, two ground- and two air-coupled systems. Two different methodologies were assumed to calibrate the velocity of wave propagation: coring and metal plate. Comparing the results obtained, it was observed that the ground-coupled system provided higher values of wave velocity than the air-coupled system. The velocity values were also obtained by the amplitude or metal plate method with the air-coupled system. These velocities values were similar to those values obtained with the ground-coupled system, when using the coring method.

Some laboratory tests were also developed in this work aiming to evaluate the dielectric constants for different levels of ballast fouling (0, 7.5 and 15%). The effect of the water presence on the dielectric constant was also evaluated by simulating different water contents: 5.5, 10 and 14%. Different GPR systems and configuration were used. The results have demonstrated that dielectric values increase with the increasing of fouling conditions. The dielectric constants also increase with the increasing of water content. However, the analysis of all the results obtained has revealed that values are more sensitive to the fouling level rather than to the water content variation. The dielectric constants obtained with a frequency of 1.0 GHz were slightly lower than those obtained with higher frequencies of 1.8 and 2.3 GHz. Additionally, the dielectric constants obtained for all the measurements, increasing fouling conditions and water contents, with a frequency of 1.0 GHz, were also different. Thus, the dielectric constant values obtained with the ground-coupled antenna were slightly lower than those obtained with the air-coupled antenna.