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Ground Penetrating Radar technique for railway track characterization in Portugal

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Maintenance actions are significant for transport infrastructures but, today, costs have to be necessary limited. A proper quality control since the construction phase is a key factor for a long life cycle and for a good economy policy. For this reason, suitable techniques have to be chosen and non-destructive tests represent an efficient solution, as they allow to evaluate infrastructure characteristics in a continuous or quasi-continuous way, saving time and costs, enabling to make changes if tests results do not comply with the project requirements. Ground Penetrating Radar (GPR) is a quick and effective technique to evaluate infrastructure condition in a continuous manner, replacing or reducing the use of traditional drilling method. GPR application to railways infrastructures, during construction and monitoring phase, is relatively recent. It is based on the measuring of layers thicknesses and detection of structural changes. It also enables the assessment of materials properties that constitute the infrastructure and the evaluation of the different types of defects such as ballast pockets, fouled ballast, poor drainage, subgrade settlement and transitions problems. These deteriorations are generally the causes of vertical deviations in track geometry and they cannot be detected by the common monitoring procedures, namely the measurements of track geometry. Moreover, the development of new GPR systems with higher antenna frequencies, better data acquisition systems, more user friendly software and new algorithms for calculation of materials properties can lead to a regular use of GPR. Therefore, it represents a reliable technique to assess track geometry problems and consequently to improve maintenance planning. In Portugal, rail inspection is performed with Plasser & Theurer EM120 equipment and recently 400 MHz IDS antennas were installed on it. GPR tests were performed on the Portuguese rail network and, as case study in this paper, a renewed track was considered. The aim was to detect, along the track, changes of the layers in terms of both thicknesses and materials characteristics by using specific software, Railwaydoctor. Different test campaigns were studied in order to determine and compare the materials dielectric constants that can be influenced by water content values, due to measurements performed in different seasons.