A high-resolution velocity analysis to improve GPR data migration for rebars investigation

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Investigation of rebars in reinforced concrete is a matter of high interest in civil engineering. Reinforced concrete has been widely used for over a century as a high-performance construction material, although it is subject to damage and deterioration for a variety of different and complex reasons. Hence, a large number of tests and routine assessments are usually required for this material. To these purposes, destructive and non-destructive testing methods have been used specifically to identify particular features of rebars.

Non-destructive testing methods are gaining momentum in this area of research. Ultrasonic sensors are used to assess dimensions of the rebars as well as for damage location purposes (e.g., voids and cracks); location of reinforcement and assessment of corrosion have been carried out using electromagnetic methods, such as radiography, eddy current sensors and impedance tomography. Chemical-based techniques, thermography and impedance tomography are widely used methods for detection of moisture. Within this scenario, it is worth to mention that the ground-penetrating radar (GPR) non-destructive testing method has proved to be suitable to the largest spectrum of the above application areas. In more detail, GPR systems with high-frequency antennas are extensively used on concrete structures, and several GPR-based algorithms for effective assessment of corrosion and moisture infiltration have been developed in the literature. Research is nowadays being oriented towards the assessment of the size of rebars. One of the most common applications of GPR in reinforced concrete relates with the rebars location and the estimation of the concrete cover depth. Accuracy of the above estimations is improved using dedicated data processing algorithms, e.g. migration. Within this context, although a good degree of accuracy can be reached by the available commercial software, a higher precision can be required for quality control and health monitoring purposes.

In this study, a demonstration of the potential of GPR for improving location of rebars and estimation of the concrete cover depth is given. To this purpose, a high-frequency GPR system with a dual-polarised antenna has been used to collect data in a reinforced concrete pavement. Hence, a high-resolution velocity analysis has been proposed to improve data migration and locate rebars with a higher accuracy. Results demonstrated the viability of the high-frequency GPR system coupled with the proposed velocity analysis for rebars investigation purposes.