Automatic Processing of Train-mounted GPR Data for Ballast Inspection

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Until very recently, inspection of railtrack using high-speed GPR was not possible due to hardware technology limitations. With the development of newer and faster GPR systems, the prospect of high-speed GPR inspection of rail ballast has become very real, and there is increased interest in developing interpretation algorithms capable of dealing with the large volumes (typically gigabytes) of GPR data that result from such surveys. Such computational tools are required to process and interpret the multi-channel GPR data in a robust, consistent and reliable manner, and present the results in a manner consistent with industry expectations and regulations.

This paper presents recent developments towards new GPR data interpretation software enabling fast, reliable and automated processing of multiple data sets of unlimited size. Specifically, algorithms have been designed for processing the GPR data to reduce the effect of background and clutter using novel signal and image processing techniques. Techniques have been formulated for minimising/ eliminating the effect of sleepers (steel and concrete) on high speed rail GPR data. Interactive semi-automated layer picking routines have been designed for pinpointing the ballast-subgrade interface, and for identifying surface anomalies such as AWS magnets and footbridges. Automated and semi-automated methods are presented for ballast dielectric modelling based on the data interpretation and any available corroborative information such as core samples. This allows automatic depth calibration and profiling. Finally, pattern recognition techniques have been been developed to characterise spent or fouled ballast from clean ballast, and have been employed in conjunction with neural networks to automatically characterise the quality of the ballast sub-track by determining the level and nature of degradation in ballast. Results are presented from a number of high-speed trials in the UK.