Abstract

This Thesis presents a track surveying approach based on the monitoring of vertical axlebox accelerations, experimented by trains when running along the tracks. For this purpose, several tests have been carried out in the Valencia's underground network, where axlebox accelerations have been registered in different ways, varying the sampling frequency, the anti-aliasing filtering frequency and the location of the accelerometers. In this way, it has been possible to determine the optimum track surveying approach, which combines both sufficient resolution, necessary for detecting the different track singularities, and admissible data storage requirements.

For the analysis of the data coming from the monitoring of vertical axlebox accelerations, time-frequency diagrams based on the short time Fourier transform have been employed. This tool allows detecting and classifying the excitations produced by different track defects and singularities, such as rail welds, rail joints or turnouts. The different vibration modes relative to the elements the track consists of, i.e. the rails, the sleepers, the fastenings and the ballast, have been identified as well. Depending on the track configuration (ballast vs. slab), some of these vibration modes vary their frequencies, which allows detecting the transition zones between both track configurations.

In order to identify all the afore-mentioned aspects, the calibration of the defining parameters for the spectrogram has been carried out. The main parameters are the window length and the window overlapping. This calibration has been carried out along with the identification of track singularities and vibration modes, in a calibration-identification iterative process. The identification criteria for this thesis are related to the visual identification of the different aspects. Other criteria may be implemented in case the aspects identification is achieved by means of digital image processing techniques. In this latter case, time-frequency diagrams are analysed as 2D images from which different patterns respectively linked to track defects and vibration modes may be obtained.

The data registration process as well as the obtained data themselves have been compared with previous measurements carried out by other research groups and railway companies in order to validate them and observe the achieved improvements.

In this way, once the different track aspects have been detected and classified, it is possible to monitor the evolution of the maintenance conditions track geometry and its components, although this task is left for future research.