

“ACOUSTIC MAPPING” OF A RAILWAY NETWORK: APPLICATION OF A SYSTEM BASED ON MEASUREMENT OF AXLEBOX VIBRATION

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The Research and Innovation Department of SNCF, the French national railway system, is undertaking the so-called LECAV project, which has the following three objectives:

- To provide track roughness mapping of the entire railway network in order to anticipate the requirements of the future European Directive EN 2002/49
- To determine potential sites for rolling stock homologation
- To monitor acoustic performance of the track for grinding policy.

Acoustic mapping of the railway will be undertaken using a train-based measuring system that can be fitted to a conventional vehicle (Fig. 1.). The first step has been to determine whether this can be done using equipment that is commercially available. To this end a textbook example of a comparative validation exercise was undertaken in November 2009 with two systems that the SNCF had determined were potentially satisfactory. One such system, the HSRCA (High Speed Rail Corrugation Analyser) is based upon axlebox accelerometers. This is produced by RailMeasurement Ltd and is the subject of this paper. The second system is based primarily on measurement of noise radiated from the wheels, and is the subject of a second abstract offered to IWRN10.



Fig. 1. Test train used for LECAV project, comprising conventional carriages and locomotive

RailMeasurement Ltd's HSRCA has previously been used primarily to produce measurements of the severity of corrugation and of welds. These were used to schedule and monitor the progress of rail maintenance such as weld straightening and grinding. In this application the principal output that was desired was the one-third-octave spectrum of railhead roughness. Spectra could be compared directly to the spectrum for a "smooth rail" in ISO3095 (or to the corresponding spectra for the European Technical Specifications for Interoperability, or TSIs).

The validation exercise undertaken by the participating suppliers in collaboration with SNCF included measurement of the entire line from Paris to Orange, in the south of France, and back: a distance in total of some 800km. On this section of line there were three test sites, each of 100m length, which had been measured in detail before the test runs according to the protocol in Annex A of ISO 3095. Transponders were also bolted to the rail foot so that the test sites could be accurately located in records made later from the test train. Participating suppliers were provided with roughness measurements of the wheels, and from two of these three test sites, one of which was selected to have relatively low and the other relatively high roughness. One of these sites had concrete sleepers and the other timber, which tested the sensitivity of the measuring systems to dynamic behaviour of the trackform. These sites were measured using the Corrugation Analysis Trolley (CAT) as well as straight-edge based equipment.

Three passes with the test train were undertaken around a loop of about 150km length on the "conventional" line through Avignon, Miramas and Cavaillon where there were three further test sites of 100m length, which were also measured in detail with straight-edge based equipment. Measurements for acoustic roughness of test sites on the loop were not given to the participating suppliers. At one site the test train passed at speeds of 60km/h, 120km/h and 160km/h to assess reproducibility whereas a second was passed over at a fairly constant 120km/h to assess repeatability.

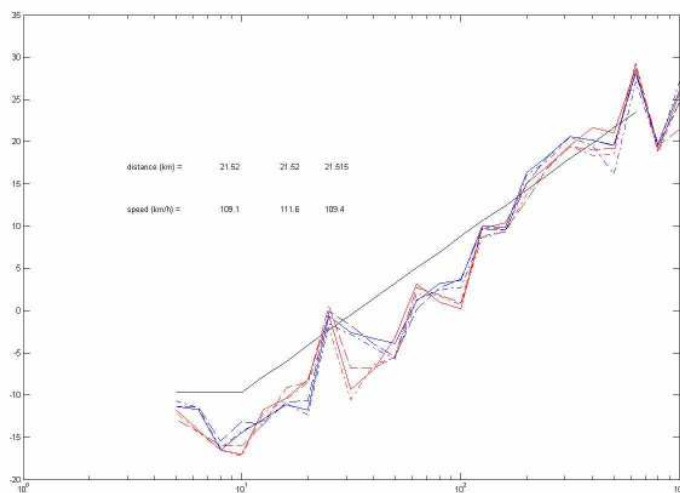


Fig. 2. Repeatability of roughness measurements over a 100m site at 110km/h, showing effect of grinding marks at 25mm

The paper will present results from the test campaign, including those from software that was developed to show the one-third octave spectra at 10m intervals, calculated for a "window" of 100m length, along the complete line from Paris to Orange, and to superpose data from three runs simultaneously around the test loop, which was used to produce Figure 2. A comparison will also be given of the full set of manual and train-based measurements of acoustic roughness for all test sites and conclusions drawn regarding the suitability of this equipment for noise-mapping of a network. iwrn10@rtri.or.jp.