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Method for the reduction of measurement errors associated to the wheel rotation in railway dynamometric wheelsets

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ABSTRACT

The precise experimental measurement of wheel–rail forces is vital both for railway vehicle acceptance processes and for research in vehicle–track interaction. With this aim, dynamometric wheelsets are used. These systems can be based on the installation of sensors either on the axle or on the web of the wheel. Existing measurement methods face a number of difficulties associated with wheel to rail contact, making them low accuracy solutions. One of the main difficulties encountered in methods based on wheel instrumentation is signal variation with wheel rotation. This work proposes a variety of solutions that provide an improvement over existing solutions, laying the starting basis for the development of modern dynamometric wheelsets that meet current requirements for accuracy.

1. Introduction

Research into most of the problems associated with railway vehicles requires the experimental determination of forces transmitted through the wheel–rail contact. This information is of great importance in a number of different cases:

- Experimental validation of theoretical models [1,2].
- Research into phenomena related to wheel–rail contact [3–7].
- Vehicle acceptance process.

Issues related to the acceptance process stand out among these problems. The objective of the acceptance process is to obtain authorisation for revenue service of a new vehicle. This process is of high importance due to its economic consequences (the high cost of the process in itself and associated to the modifications to be undertaken in the case of unsuccessful approval processes), political commitments and consequences in terms of safety—as is particularly critical under extreme conditions, such as in the case of high speed vehicles or heavy load locomotives.

Currently, the acceptance process in Europe is ruled by prEN-14363 [8]. This standard is based on the definition of testing scenarios, analysis conditions and experimental measurements, identifying limiting values for a number of different parameters mainly associated with vehicle safety and ride quality [9–11].

The standard defines a number of different vehicle approval methods. Applicability to a specific vehicle depends on the design of the vehicle itself and conditions of operation. Variables to be measured are specified for each method.

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