RESEARCH ARTICLE

Measuring Wheel-Set Design

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ABSTRACT
Rail- Wheel contact forces significantly affect dynamic behaviour and derailment of a train. The aim is to develop a unique method that provides continuous measurement of wheel-rail contact forces and contact point position using a measuring wheel-set. Numerical simulation of vehicle behaviour is performed in SIMAPCK and use these results as an input parameter for performing FEM calculations. The study addresses critical issues in development measuring wheel-Set, such as to locate strain sensitive location in the wheel, determining optimal location, number, and way of connecting strain gauges. The relation between strain in the wheel and the input parameter is formulated and verified using the FEM study. The developed method calculated contact forces and contact point locations with an estimated error of less than 10%.

KEYWORDS
Instrumented Wheel-Set, Finite Element Analysis, Multibody Simulation

1. Numerical Simulation of Vehicle Behaviour

It is essential to know about contact point variation and contact patch dimension for a running vehicle as they affect contact force acting on a wheel. Numerical simulation is performed in SIMPACK on an equivalent wheel-set model that replaces the actual system under practical constraints. Wheel profile IRS R-19/93 and rail profile UIC 60 is used to generate wheel-set in SIMPACK, as shown in Figure 1. Special Hertzian contact is used at rail wheel interaction. FASTSIM algorithm formulated by Kalkar is used to measure rail-wheel contact forces. Simulation is performed for v =10 m/s, and the result is plotted for the right wheel. The lateral displacement of the wheel-set from a mean position is shown in the Figure 2. The dimension of a contact patch variation with lateral displacement is shown in the Figure 3. Figure 3a shows that contact patch length is almost constant, having a dimension of 6.4 mm, and it is minimum when the flange touches the rail. Figure 3b shows that contact patch width is almost constant, having a dimension of 1 mm, and it increases when flange touches the rail. The equivalent dimension of faces is generated on the CAD model of the wheel face. The Wheel-set displaces from the mean position is from -2.5 mm to +2.5 mm.

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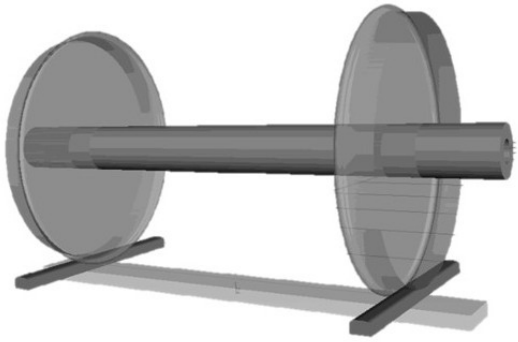


Figure 1.: Equivalent wheel-set model generated in SIMPACK

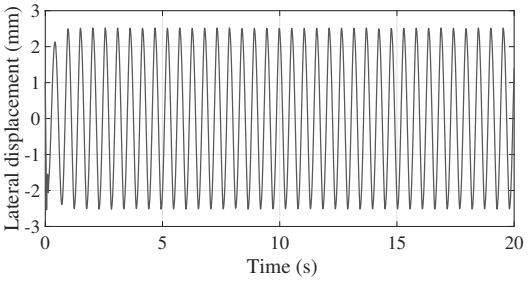
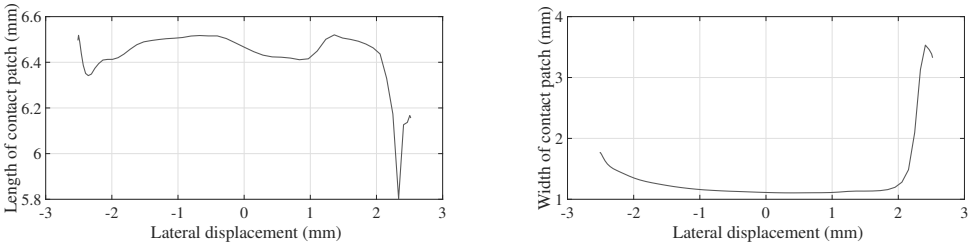


Figure 2.: Lateral displacement of wheel-set



(a) Length of contact patch (b) Width of contact patch

Figure 3.: Contact patch variation with lateral displacement of wheel-set