Tyre/Road Noise

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Introduction

Traffic noise is considered to be an important environmental problem, leads to annoyance and even health damage. The interaction between the tyre and road surface causes tyre vibrations and air displacements, by which sound is generated (figure 2). Today tyre/road noise is the dominant noise source for driving speeds exceeding 40 km/h (figure 1).

Figure 1 : Will tyre/road noise be dominant now?

The introduction of porous road surfaces has reduced tyre/road noise significantly. After some years, however, the sound reduction is decreased because of pollution of the porous layer. Noise reduction can also be accomplished by optimization of the tyre. Simplified tyre models have been developed, which suffer from limited accuracy. Finite element models are more accurate, but computationally very expensive at high frequencies.

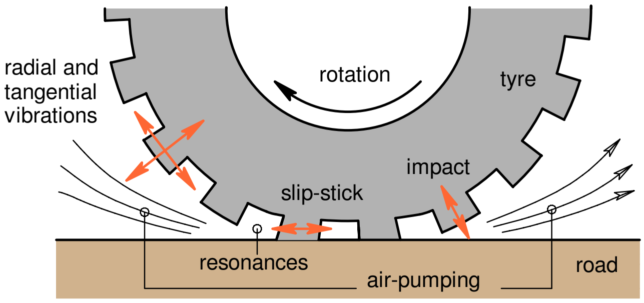

Figure 2 : Mechanisms of tyre/road noise generation.

Objective

The aim of this research is to develop a numerical model, which is sufficiently fast to quantitatively predict tyre/road noise by means of a direct contact approach.

Methods

The tyre will be modelled by means of finite elements, suitable for large deformations and anisotropic material behaviour [1].
The contact will be modelled in the time domain, because of the inherent non-linearity. A direct contact approach [2] is used to model the contact between tyre and road. The convergence is good and friction between tyre and road is accounted for.
The boundary element method [3] will be used to calculate the radiated sound from the tyre vibrations. The road's influence is taken into account. A preliminary result is given in figure 3.

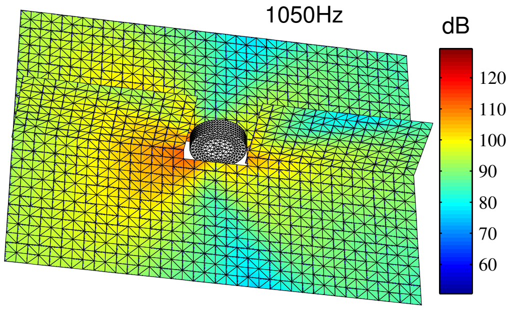

Figure 3 : Sound pressure level at 1050 Hz of a slick tyre on a flat, acoustic hard road (the tyre rolls to the right) [2].

References

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3. Visser, R. (2004) PhD thesis, University of Twente, Enschede, The Netherlands.

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