ACOUSTICS2008/778
Transmissibility of a deformed rotating tyre

Ruud Van Doorn, Ines Lopez, René Van Der Steen, N.b. Roozen and Henk Nijmeijer
Eindhoven University of Technology, Dept. of Mechanical Engineering, Dynamics & Control, P.O. Box 513, 5600MB Eindhoven, Netherlands

The major source of environmental noise exposure is road traffic noise. Of all noise sources, tyre rolling noise is dominant for speeds above 30 km/h for passenger cars. Tyre rolling noise can be subdivided into interior and exterior noise. For the interior noise to which the passengers are exposed to, the tyre transmissibility is essential since it relates the contact forces with the axle forces. These axle forces are responsible for the structure borne interior noise. Here, a Finite Element tyre model, including a fully coupled air column, is used to examine the transmissibility in the frequency domain 0-300 Hz. It is shown that three aspects are essential in modeling the axle forces resulting from tyre-road interaction: 1) the tyre deformation since it leads to a set of non-axisymmetric eigenmodes, 2) the relatively low-damped non-axisymmetric acoustic resonance, and 3) rotation. A methodology using substructuring techniques is presented to include rotational effects both in the case of an undeformed and deformed tyre. These effects of rotation on the transmissibility differ in the deformed and undeformed case: frequency loci veering occurs in the deformed case, while in the undeformed case rotation results in a pure split of the eigenfrequencies.