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Frequency loci veering in deformed rotating tyres

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In previous work [1] a methodology to model tyre vibrations has been developed, which exploits a modal base determined in a standard FE package and includes rotational effects by a coordinate transformation. In the present paper, the effect of rotation on the eigenfrequencies of a deformed tyre is examined. It is well-known that rotation splits the eigenfrequencies of an undeformed tyre symmetrically around the eigenfrequencies of the non-rotating tyre, where the slope of the eigenfrequency-lines is determined by the circumferential wave number and tyre radius only. However, the eigenfrequency-lines of a deformed tyre demonstrate a fascinating mutual repulsion behaviour if the velocity is increased. This phenomenon is known as frequency loci veering and is induced by the a-periodicity resulting from the tyre deformation. Besides the effect of veering on the eigenfrequencies, the corresponding eigenmodes interact in the transition zones and finally interchange. The effects of veering are extremely intensified by the high modal density of the tyre structure, which results in a decreasing eigenfrequency distribution when the rotational velocity increases.
[1] I. Lopez et al, JSV 307, 481-494, (2007)