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A compact internal drum test rig for measurements of rolling contact forces between a single tread block and a substrate

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Abstract

A novel test rig design is presented which enables detailed studies of the three force components generated in the impact and release phase of rolling contact between a tyre tread block and a substrate. The design of the compact internal drum test rig provides realistic impact and release angles for the tread block-substrate contact and enables force measurements at high rolling speeds with a high signal-to-noise ratio. Measurements of the rolling contact forces are presented for different values of rolling velocity, static pre-load and acceleration. It is demonstrated that this test rig provides results which contribute to the understanding of tyre–road interaction and can be used as input to modelling-based development of both tyres and roads aiming for improved handling, safety, energy efficiency and comfort.

Keywords: Tread block; Road; Contact forces; Rubber friction; Rolling contact; Test rig

1. Introduction

Traction, braking and steering performance of road vehicles are determined by the forces which are transmitted within the interface between the tyre and the substrate, often referred to as the contact patch. The contact patch for a car tyre has the approximate size of the palm of the hand and the character of the forces generated within these interfaces are of vast importance for the safety and handling of road vehicles. Moreover, the rolling contact forces are also responsible for the excitation of tyre vibrations which are partly radiated as sound, partly transformed into heat (rolling resistance) and partly being further transmitted to the vehicle chassis which in turn lead to comfort issues such as interior low frequency noise and vibrations. In addition, the tyre–road contact forces generate tyre wear which due to the rubber particle emissions is not only an economic, but also an environmental/health concern. Conclusively, since a strengthened knowledge concerning the generation of tyre–road contact forces can be used to improve many features such as handling, safety, energy efficiency and comfort, there is a strong motivation for vehicle industry and research institutes to enhance the modelling methodologies related to the tyre-substrate contact force generation.

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