Multi-physical model for tire/road contact – the effect of surface texture

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Abstract: When a tire is rolling on a surface, rubber compounds used to make them are deformed principally by the load exerted on it, flattening out in contact patch. This deformation is due to rubber viscoelastic properties and results in energy dissipation in the form of heat. This energy loss known as rolling resistance which is heavily depend on the tire parameters such as inflation pressure, temperature, but also the dynamics of the vehicle and the infrastructure (slope, texture,…). The aim of this study is to develop a multi physical (mechanic, thermal) tire/road contact model that can take into account the effect of infrastructure and temperature (ambient, pavement) in contact patch while calculating the contact forces. This paper is divided into two parts; in first part the development of tire model with multiple contact points/bristles (to represent contact surface) based on brush model is explained where it calculate the change in percentage contact area for different MPD (mean profile depth), evolution of contact area with speed for different MPD and change in the deformation of the individual tread bristles. The development of thermal model and its integration with tire model is done in second part. The tire tread surface and carcass temperature is calculated for different scenarios. The simulations are done on quarter car model. Simulation results suggest that the decrease in percentage contact area with increase in road roughness and the influence of temperature on the viscoelastic properties of the tire is discussed. Experimentally measured road surfaces on IFSTTAR tests tracks are used for validation.

Keywords: Multi physical tire model; Multiple contact points; road roughness; rolling resistance; tire/road interaction; contact area, tire thermal model