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LOCAL AND GLOBAL FRICTION PHENOMENA IN ROLLING AND SLIPPING TIRES

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ABSTRACT

The global dynamics of automotive tires under operating conditions can be described in the frame of a simple pulsed-driven rotator exposed to friction. Interestingly, the dynamical character of such systems can possibly switch (depending from the numerical value of an internal parameter) from a regular periodic to quasi-periodic or even chaotic behavior.

The presence of rolling losses as well as longitudinal and lateral forces of rolling and/or slipping tires are largely influenced by local frictional phenomena and due to dissipation within the inner bulk and/or near-interface bulk rubber materials. The hierarchy of different frictional phenomena will be discussed.

Introducing a physically motivated multiscale approach of polymer dynamics, I demonstrate how local friction in polymer networks under the presence of filler particles determines the visco-elastic behavior of the rubber from very low to very high deformation frequencies. Furthermore, it is shown how local (Rouse-like) network chain dynamics becomes non-linear for largely stretched network chain conformations which occur near tips of propagating cracks in rubber materials. These effects are discussed together with some specific features of the rubber fracture-mechanics and the failure behavior of rubber components.