On the effect of superimposed vibrations on systems with dry friction

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Abstract

Systems subjected to dry friction play an important role in engineering applications and have been studied intensively in the past. Although friction may be essential in many systems, several undesired effects related to dry friction and its non-smooth characteristics have been observed.

The reduction of frictional forces and a modification of the corresponding friction characteristics may be achieved by superposition of longitudinal or transverse vibrations. Providing an appropriate excitation, the average impact of friction has been shown to reduce, such that the non-smooth friction characteristics can be transformed into a viscous-like behavior. Consequently, undesired effects associated with the characteristics of dry friction, such as friction-induced vibrations, can be quenched in presence of superimposed vibrations.

Referring to the literature, simple modeling using classical Coulomb friction captures the relevant mechanisms and provides general insight into the topic of vibrational smoothing. However, the agreement with related experimental results appears not to be sufficient, as the effect of friction reduction is overestimated by the corresponding model.

Within this contribution, the effect of longitudinal and transverse vibrations on simple mechanical models is investigated using a class of dynamic friction models accounting for contact compliance. The results are compared to the classical results for rigid contacts, showing both quantitative and qualitative effects on the effective friction characteristics. Subsequently, the onset of friction-induced vibrations is discussed, showing the ability of superimposed vibrations to quench undesired oscillations and the impact of compliant contacts. Finally, the model based results are compared to related experimental observations.