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A Discrete Model for Dynamical Simulation of Normal and Tangential Contact on Rough Surfaces

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ABSTRACT

The dynamical properties of two contacting bodies can be described by the friction coefficient and the contact stiffness, which are mainly influenced by the material properties and the roughness of the contacting surfaces. Occurring effects like contact separation during sliding can have large influence on the friction properties. To model these effects, the contact was split in a rough, rigid surface with equivalent roughness which represents the roughness of both partners and an elastic, smooth surface, representing the elasticity of the contact zone. A similar, simple model was used for the modelling rubber hysteresis by Sextro [1]. In our model, the elastic layer consists of a number of point-masses m. They have two DOF, in case they are not in contact, and are connected with springs and dampers. These elements are also coupled by springs and dampers to a reference frame moving with velocity v (see fig. 1).

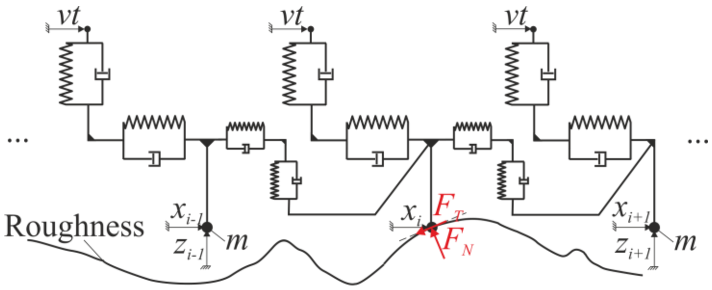

Fig. 1: Mechanical model of the elastic layer with rougness profile

This elastic layer is described by a system of ordinary differential equations (ODEs) which are solved in time-domain using solvers for stiff problems supplied by MATLAB. During the simulation the contact condition of each point-mass is monitored. When a point mass gets into, or loses contact, the ODEs are automatically updated before the simulation continues. Elements in contact are not able to penetrate the roughness profile, have one degree of freedom tangential to the surface profile and encounter an external tangential force F_T (see fig. 1). The vertical and tangential stiffnesses can be identified by experiments or FE-Analysis. The normal and tangential contact can be simulated dynamically by this model, while taking effects like friction and contact separation at rough surfaces into account. First simulations show good agreements with established contact theories.

REFERENCES

[1] Sextro W., Moldenhauer P., Wangenheim M., Lindner M., Kröger. M.: **Contact Behaviour of a Sliding Rubber Element.** In: Lecture Notes in Applied and Computational Mechanics, Hrsg.: Wriggers P. and Nackenhorst U., Springer-Verlag, Berlin, Heidelberg, April, 2006