FRICTIONAL REGIMES ON SOME PARTICULAR, NATURE-INSPIRED APERIODIC ATOMIC CHAINS

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KEYWORDS
Friction; Surface topography; Modelling in tribology; Prandtl-Tomlinson models

ABSTRACT
Inspired by the role of irrational numbers and that of the most prominent one: the golden ratio, in particular, frequently observed in the arrangement of leaves and seeds in various plants, e.g., red cabbages and sunflowers, this contribution will aim to clarify the frictional peculiarities of such aperiodic atomic configurations based on so-called analytical models of friction.

Nowadays, the Prandtl-Tomlinson models (PT-models) in one- and two-dimensions are very popular for their explanation of nanotribological experiments performed by using a friction or atomic force microscope (AFM). [1] In its original formulation, [2] Prandtl was introducing this model for developing a kinetic theory of solids by assuming a periodic interaction between the bodies. Curiously, in the paper ascribed to the PT-models, [3] Tomlinson was not dealing at all with these, since he was outlining a molecular theory of friction based on the findings by Lennard-Jones. Despite of this historical inaccuracy, currently in a 1D PT-model, one can clearly distinguish between frictional regimes by considering as parameter the ratio between the average interaction and elastic energies, [4] for an illustration see Fig. 1.

In this contribution, the aperiodic corrugation of interest is derived and directly introduced into the corresponding 1D PT-model such that the so resulting Newtonian equation of motion is then solved numerically by applying an adequate fourth-order Runge-Kutta method. [5] The frictional behavior of such a system will be also discussed, especially in comparison to "engineered" periodic corrugations.

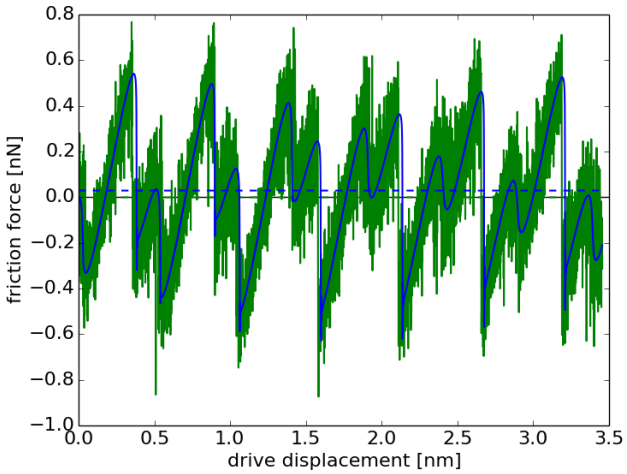

Fig.1 Friction force at 0 K (blue) and room temperature (green) obtained from a 1D PT-model with a periodic corrugation.

ACKNOWLEDGMENTS
This work was funded by the Austrian COMET-Program (Project K2, XTribology, No. 824187/849109) and carried out at the 'Excellence Centre of Tribology' (AC2T research GmbH).

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