

RESEARCH REPORT, ERI 2014

VÁN P.¹²³

Period of Stay: 2014/07/16 - 2014/08/30

Research project: Thermodynamics of rate- and state-dependent friction laws

Host Researcher: Takahiro HATANO

During my stay in ERI my primary aim was a focused overview and analysis of rate- and state-dependent friction laws from a thermodynamic point of view. At the end I have successfully derived new constitutive and evolution equations in a non-equilibrium thermodynamic framework, that seem to unify the good properties of the classical Dieterich and Ruina laws. For velocity jumps the relaxation is exponential and symmetric in the displacement for the upward and downward cases (see figure 1). The simulations are promising for the healing experiments, too. We are testing the performance of the theoretical model and compare with experiments and also investigate a possible continuum extension together with my colleagues Noa Mitsui (Wigner) and Takahiro Hatano (ERI).

The research environment of ERI was stimulating and resourceful. We have clarified fine experimental details and theoretical problems in several vivid discussions with Masao Nakatani, whose deep insight helped us a lot. I have also become familiar with related research lines of Nobuki Kame. I have given a seminar on 21/08/2014 about the preliminary results. We plan to communicate our research results by submitting a paper in the near future.

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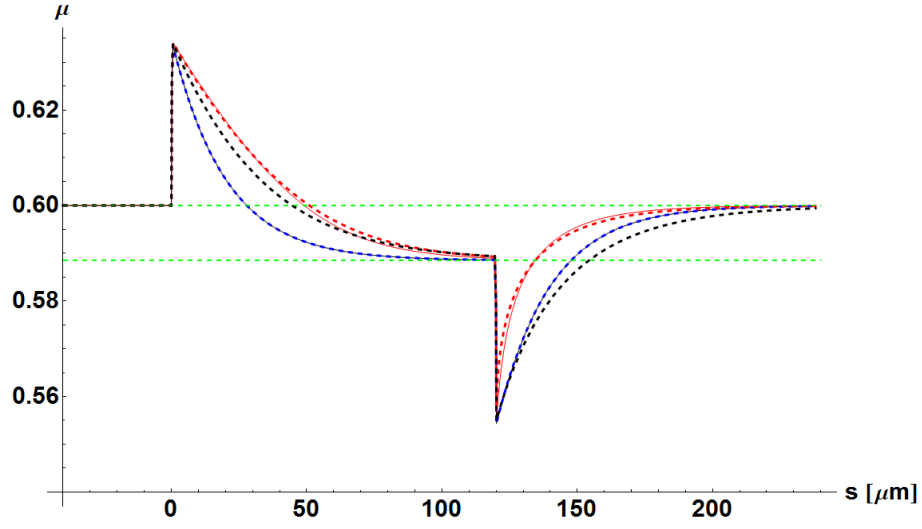


FIGURE 1. Simulation of a velocity jump experiment with the Dieterich law (thin red), Ruina law (thin blue), and the new thermodynamic friction law (thick dashed lines) with different parameter values. One can obtain relaxation curves identical to the ones calculated with Ruina law (blue dashed), close to the asymmetric Dieterich law (red dashed) and close to the Dieterich law, but more symmetric (black dashed).