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Scaling of micro-slip in tangentially loaded rock contact

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A dry contact between randomly rough surfaces is examined which is loaded in normal and tangential direction. If the tangential load is below the friction force, no macroscopic tangential movement takes place. Nevertheless, some part of the contact area will be in sticking and some will be in sliding state depending on the local stress configuration. This effect will be called micro-slip.

The maximum value of this micro-slip is reached when the last contacting spot goes into sliding state. The maximum micro-slip is a core characteristic of the contact problem. It appears in rock friction laws as a characteristic length parameter, which is often empirically determined. It can be interpreted as the characteristic size of micro-contacts appearing in rate-and-state friction theory (1). The scaling behavior of this characteristic length parameter is not yet clarified (2). It is of special interest for geophysical applications, where laboratory experiments and real systems differ in size by several orders of magnitude.

In former works many suggestions have been made on the scaling context of this length parameter: surface roughness, total slip length, shear strain and system size ((1),(3),(4),(5)) are some of the proposed connected parameters. We recently presented a theoretical estimation of the maximum micro-slip for randomly rough surfaces, which is based on the iterrelation of the normal and tangential contact problem. Using recent finding concerning the normal contact problem of randomly rough surfaces (6) we were able to suggest a scaling law for the maximum micro-slip. It suggests a power-law scaling with the present normal force (7). A numerical contact model using the boundary element method was implemented for comparison, both results coincide perfectly.

In addition we will present experiments with rock-rock contact in the preface of instable sliding. The set-up is a single-block slider model. From high resolution measurements, we were able to capture the micro-slip preceding a global slip event in a stick-slip regime, including the maximum micro-slip.

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