Reduction of real contact area under shear and the value of static friction

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The frictional properties of rough contact interfaces are controlled by the area of real contact. Dynamical variations of this area are at the roots of our modern understanding of the ubiquitous state-and-rate friction law. In particular, the area of real contact is proportional to the normal load, slowly increases at rest through aging and abruptly drops at slip inception. Here, through direct measurements on various elastomer contacts, we show that it is also a decreasing function of the tangential load, with reductions as large as 30%, starting well before macroscopic sliding. All data are well captured by an empirical quadratic reduction law which enables excellent predictions of the observed static friction force. The overall reduction in rough contacts is the result of a shrinking of each micro-junction, with the same behaviour as that of model mono-contacts. These findings are shown to also apply to contacts involving human fingers.