On stickiness criteria for nominally flat rough contacts

M. Ciavarella(1), A. Papangelo(1,2)

(1) Politecnico di BARI. Center of Excellence in Computational Mechanics. Viale Gentile 182, 70126 Bari. Mciava@poliba.it

(2) Department of Mechanical Engineering, Hamburg University of Technology, Am Schwarzenberg-Campus 1, 21073 Hamburg, Germany

Abstract

Recent numerical investigation on self-affine Gaussian surfaces by Pastewka & Robbins have led to a criterion for "stickiness" based on when the slope of the (repulsive) area-load relationship seems to become vertical in numerical simulations. However, a simple check of the results in terms of pull-off, shows that Pastewka & Robbins have many more data which fail their criterion than the ones who satisfy it, and this is evident even in their own Figures, so it could not be due to our misinterpretation of their data or criterion. It is noted that the criterion gives the same order of error of classical asperity model based one. For practical uses, a proposal to modify the criterion to better fit their data is put forward. However, the general conclusion that stickiness should depend only on slopes and curvature, and not on rms amplitude, may still be unwarranted. The PR criterion would imply that for fractal dimension $D \simeq 2.4$, stickiness should be relatively stable with resolution, but in general the problem of truncation of the spectrum seems ill-defined.

Key words:
Roughness, Adhesion, DMT adhesion, Pastewka and Robbins's theory, Fuller and Tabor's theory

1. Conclusions

We have shown that the pull-off data shown by Pastewka and Robbins are inconsistent with their stickiness criterion, and we have proposed a simple modification may be more realistic — which requires a corrective factor of

the order 5, similar to what is needed to correct the Fuller-Tabor predicted threshold for stickiness with their data.

As the real limit behaviour at large reduction from theoretical strength is unclear from the Pastewka-Robbins data, the criterion is simply indicating an arbitrary level of reduction of pull-off.

However, PR data are too limited to draw any general conclusion about stickiness, and in particular that stickiness should depend only on slopes and curvature (let alone giving the exact multiplicative factors), seems not a certain conclusion. Incidentally, this would also define an ill-posed problem, because stickiness would be defined by the very fine scale, if not the atomic limit, unless the fractal dimension is $D = 2.4$.

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