Li *et al.* Reply: According to the widely accepted concept of Grosh [1], friction of elastomers is due to energy dissipation in the volume of the elastomer as a result of dynamic loading by surface roughness. For small normal or tangential movements, the total energy dissipation can be calculated either by integrating the dissipation rate density over the whole volume or equivalently determined over total force and displacement. Either method, providing the correct relation between macroscopic forces and displacements is therefore suited for simulation of elastomer friction. In [2,3], it was shown that the force-displacement relation (for both normal and tangential contact) of elastic and linearly viscoelastic bodies can be described by a contact with a properly defined one-dimensional foundation, provided the indenter is a body of revolution. For self-affine randomly rough fractal surfaces, the validity of this method of dimensionality reduction (MDR) was confirmed for normal elastic [3] and viscous [4] contact analytically and via comparison with three dimensional boundary element simulations. The authors of the Comment [5] question the validity of the MDR and support their statement by calculating the real area of contact. However, the contact area (in contact of rough surfaces) lies out of the scope of the validity of the MDR. This is clearly stated in the review paper on MDR [6] and in [3]. Thus, the Comment criticizes the MDR outside the region of its validity.

While the contact area cannot be simulated with the MDR, the correctness of the force-displacement relations was confirmed in all cases we have studied. This is illustrated in Fig. 1, where the normalized normal stiffness $\bar{k}$ (as defined in [7]) is shown as a function of the normalized normal force $\bar{F}$. The roughness was assumed to be self-affine with the power density $C_{2D} \propto q^{-2H-2}$. We studied the range of H from -1 to 3 covering all possible types of roughness from "white noise" to smooth single asperities.

FIG. 2 (color online).   The exponent α in the equation $k \propto F^\alpha$ as a function of H.

The 1D and 3D results coincide for very low forces and for complete contact. In the crossover region, the results for the H in the vicinity of $2/3$ (which is the most relevant value for many technical surfaces) coincide too, while there is a moderate deviation for very small ($H \approx 0$) end very large ($H \approx 2$) values. For small forces, the normal stiffness is in all cases a power function of the normal force $k \propto F^\alpha$. The power α is shown in Fig. 2 for $-1 < H < 3$. The proved quality of the MDR was the reason why it was used as a basis of simulations in [8].

Another point of criticism of the Comment is that there are some points which were not addressed in the Letter. But we did not claim the completeness of the model [8]. On the contrary, it is clearly stated that "To achieve the basic understanding of this nonlinear frictional behavior, we consider the following simple model..." However, many of the factors mentioned in the Comment can be taken into account in the frame of the MDR, and we are indeed working on it.

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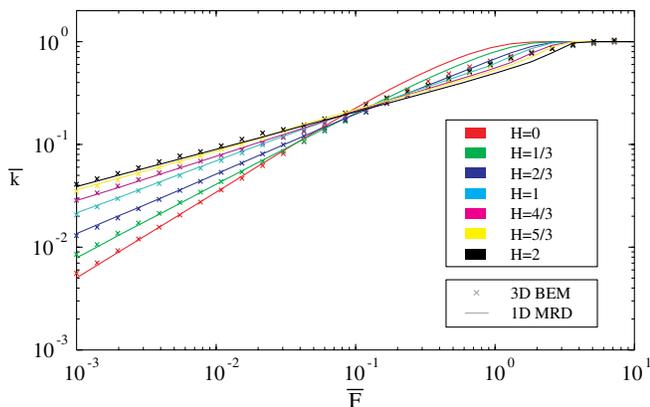

FIG. 1 (color online).   Dependence of the contact stiffness on the normal force for self-affine rough surfaces with different Hurst exponents. Details of the calculation procedure can be found in [3].
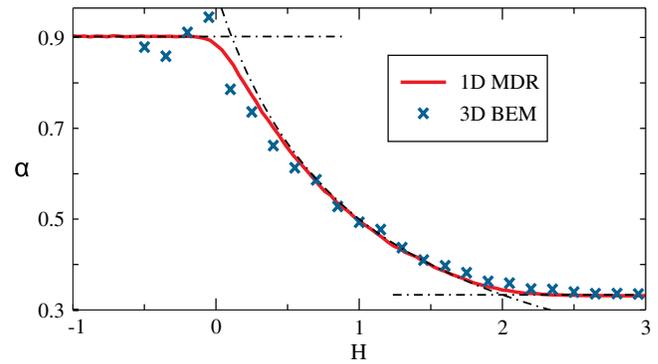
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