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MULTISCALE CONTACT MECHANICS FOR ROUGH SURFACES WITH APPLICATIONS TO RUBBER FRICTION, ADHESION AND THE LEAKAGE OF SEALS

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ABSTRACT

Surface roughness has a big influence on the dry or lubricated contact between solids in stationary or sliding contact. Surface roughness often occurs over many decades in length scale, e.g., from nm to the linear size of the objects. Thus the nature of the contact between two solids cannot be treated by exact numerical methods, e.g., molecular dynamics, without simplifications.

I have developed an analytical contact mechanics theory which can take into account all relevant length scales. The theory is very flexible and can be applied not only to homogeneous elastic solids but can include layering, plasticity and viscoelasticity (which is important for rubber-like materials).

Both dry and lubricated contact mechanics can be studied using this approach. The theory predicts the area of real contact, the distribution of contact stresses and the distribution of interfacial separations which is important for the leak-rate of seals or for microbial ingress during the shelf life of syringes. It also predicts the viscoelastic contribution to rubber friction and can be used to obtain the Stribeck curves for lubricated contacts.

In this presentation I will describe the theory in some detail and give some applications to rubber friction, adhesion and the leakage of rubber seals.