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On the usefulness of the height-difference-autocorrelation function for contact mechanics

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Abstract

We show that various quantities of relevance to the contact mechanics of randomly rough surfaces can be directly estimated from the easy-to-acquire height-difference-autocorrelation function $G_{\delta h}(\Delta r)$. These include the areal elastic energy density and the stress autocorrelation function, for which we derive expressions that are exact for full contact (within linear elasticity) and approximate for partial contact (within Persson theory). Our approach makes it possible to estimate scale–dependent contact areas, stresses, stress gradients, or to make well-informed corrections to the Dahlquist criterion for adhesion with elementary mathematical operations that do not necessitate the Fourier transform to be taken.

Keywords: contact mechanics, self-affine surfaces, surface spectra, Persson theory

1. Introduction

Traditionally, roughness of nominally flat surfaces is characterized by the height-distribution function, also known as Abbott-Firer stone or bearing area curve [1], or by its first few moments: root-mean-square height, skewness, and kurtosis. However, their knowledge hardly provides useful information for contact mechanics. In order to make predictions on quantities like real contact area,