Practical Work: Roughness Analysis and Contact Problem

Vladislav A. Yastrebov

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1. Introduction

Roughness of contact surface determines to a large extent everything that happens in contact interfaces. In this practical work, we will learn to analyze and characterize the roughness. We will also learn how to use the roughness data in contact problems.

2. Synthetic roughness data

For the purpose of this practical work, we will use synthetic roughness data generated by the following Python script:

RandomField.py

The full code is available through the following link: SelfAffineSurfaceGenerator

3. Roughness analysis

- Generate random roughness data using the script above (check `test.py` for an example).
- Construct Probability Density Function (PDF) of the surface heights.
- Construct the autocorrelation function of the surface heights.
- Construct the power spectral density function of the surface heights.
- Calculate the Hurst exponent of the surface heights.
- Check how the standard deviation changes with the size of the measurement area, start for a window with the size below the correlation length and gradually increase the size up to the full surface size.
- Detect and characterize asperities on the surface.

4. Contact problem

- Take the generated random surface.
- Generate a rigid spherical indenter of radius R centered at the $x = L/2, y = L/2$.

- Push the indenter into the surface with a monotonic displacement prescribed in time $\delta(t)$.
- Calculate penetration at every asperity.
- Calculate the total generated force and the total contact area using Hertz theory.