Practical Work: Roughness Analysis and Contact Problem

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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

The script generates a self-affine surface and saves it to `csv` file.

3. Roughness analysis

- Generate random roughness data using the script above.
- Create a new Python script that will read the data from the file and plot the surface.
- 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.
- 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.