The Representative Topography of Worn Hot Rolling Mill Cylinders

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1. Introduction

To minimize topographical error measurements, several roughness measurements are often proceeded on surfaces. This multi measuring is more and more practiced due to automatism of 3D roughness apparatus. However, this amount of data becomes more and more difficult to be visually explored. A possible alternative consists in analyzing the roughness parameters that can a priori do not require the observation of the surface. However, to the author's opinion, the visualization of the surface is of major importance before computing parameters to avoid bad measurements and after parameters computation to analyze the meaning of the physical parameters obtained by the statistical analyses. In this paper, a method is proposed to retain the surface from n surfaces that are the most representative.

2. Method

The aim of this work is to select the topography that is the main representative of the whole. This philosophy allows us to select only topography to visualize that will be very more comfortable to analyze process in other study. For each sample, N measures are carry on. Then different filtering cut-off are performed to reconstruct roughness and waviness of the surface leading to computation of $p_{i,n}$ roughness parameters related to the nth surface ($i \in \{1...I\}$). Then the mean of each roughness parameter computed from the N surfaces is evaluated leading to $\overline{p}_i$ and standard deviation σ_i. The indicator q_n is then proposed for the nth surface:

$$q_n = \sqrt{\frac{1}{I}\sum_i \left(\frac{p_{i,n} - \overline{p}_i}{\sigma_i} \right)^2}$$

Then the most representative n_{opt} surface is given by:

$$n_{opt} = n / \min_{n \in N} q_n$$

This relation claimed that the most representative surface is closed to the mean of all surfaces characterized by all roughness parameters computed at all scales.

3. The wear of hot rolling mill cylinder.

The method is then applied to a complex system: the wear of cylinders of a 7 cages tandem hot rolling mill. At different zones of the cylinder, replicas are done during process on all cylinders at different lateral positions. Our algorithm is then applied. For example, the figure 1 represents 4 topographical measurements on the center of the superior cylinder (cage 1) after 570 km of rolling process.

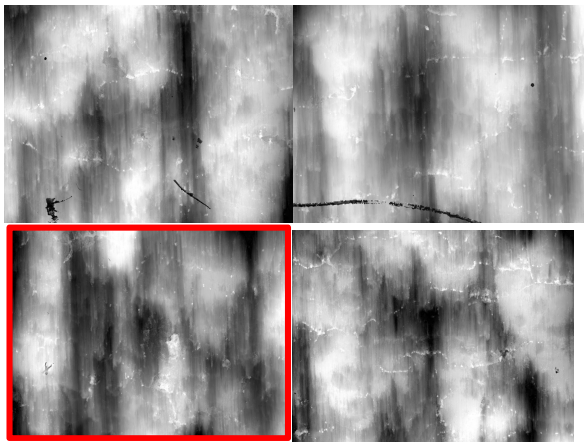

Figure 1. Similar topographical images on the center of a worn cylinder (the most representative is in red).

Then the most representative images are used to analyzed wear and is compared with the roughness parameters statistics. The figure 2 represents the representative topographical images used to analyze the effect of wear along the horizontal axis of the cylinder.

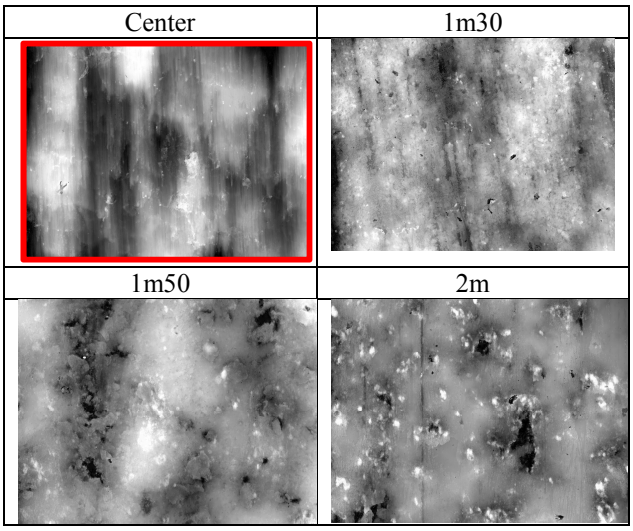

Figure 2. Evolution of the representative topography along the axis cylinder in meter.

4. Summary

The method of representative topography allows us to analyze visually the variation of complex topographies of processes.