Abenchmarkof filtering methods for tribological surfaces

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1. Introduction

To determinethe relationship betweena surfaceandits tribological behaviour, the tribologist uses many roughness parameters. However,a multi-scale analysisis proposed to reveal the relevant scales,with respect to theanalysed tribological behaviour (Fourier transform, Wavelet and Modal Decomposition).

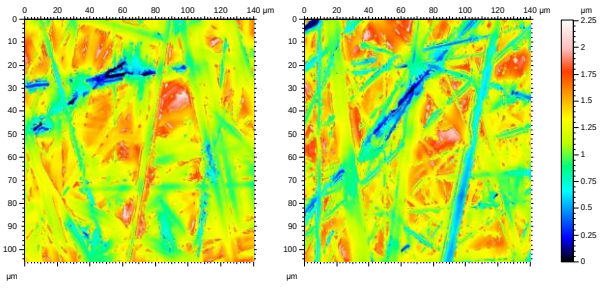
Threw the study of 15 tribological processes (Table 1), this paper aims at quantifying the capability of each method to highlight surfaces tribological properties.

Table 1 Tribological processes

Tribological Process	Study
Adhesion	Adhesion on a molding process
Tribo corrosion	Wear on knee prosthesis
Abrasion	Polishing surfaces
Grinding	Super finishing by grinding process
Plastic deformation	Cold rolling surfaces
Fatigue contact	Ball bearing with different lubricants
Moderate impact	Sand blasting
Low impact	Super finishing by ultrasonic sand blasting
High Impact	Shot penning
Surface polishing	Brushing
Super finishing	Belt finishing process
Tribometer	Study with different lubricant
Tooled surface	Analyses of high precision turning
Cold rolling	Influence of number of passes on a Zenzimir

2. Example: application of the methodology on a tribological process (abrasion)

Two titanium surfaces were polished with grit paper 120 (Fig 1a) and 220 (Fig 1b). Figure 1 shows representations of the measured topographies: nearly similar surfaces have been chosen to enable the comparison of the efficiency of the filtering methods.



(1a) **(1b)**

Fig.1 Representations of 2 abraded surfaces

Multiscale analyses are processed for each method (High pass and low pass filtering, detail reconstruction for the wavelet transform), and roughness parameters are computed at each scale of decomposition. Parameters relevance is computed by using *Mesrug* expert system. Figure 2 and 3illustrate that the best roughness parameters are given by Gaussian and Modal filtering (Sa), whereas Wavelet transform appears to be less robust. Therelevance comparison of the three methods (Fig. 2) indicates that only the 100 first parameters can be as highly significant with a same degree of relevance (according to a 0 % confidence interval). Thus, histograms of the mean of the 100 best roughness parameters are shown (included histograms fig. 2a-c). It indicates that many roughness parameters are relevant to discriminate these two abraded surfaces. In this case, it also emerges that the Wavelet transform does not provide parameters as relevant as obtained by using the other methods.

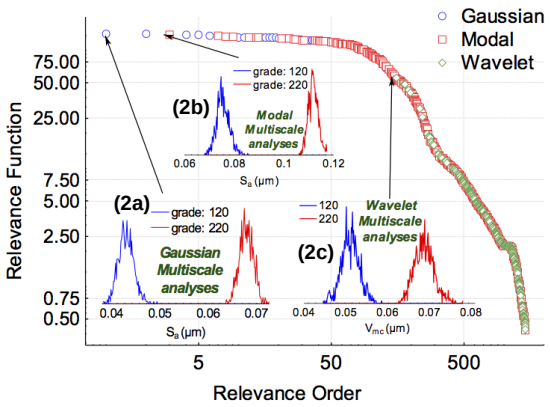


Fig.2 Relevance comparison of the 3 methods **(2a-c)** Histograms of the mean of the 100 best roughness parameters for each decomposition

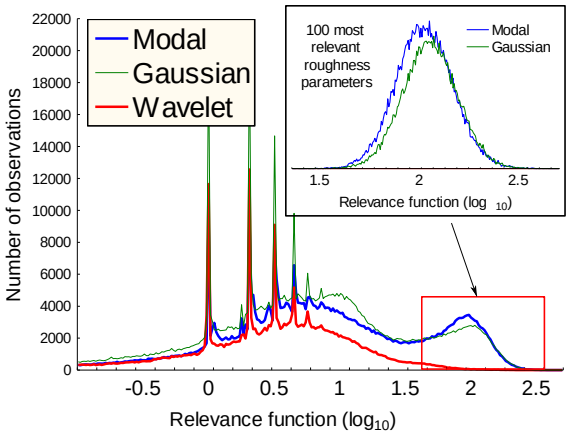


Fig. 3 Analysis of the relevance of the three methods.