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Heterogeneities characterization from a core image using the wavelet transform

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Core analysis provides valuable information about rocks properties in the sub-surface. In this paper, we suggest a new approach which goes beyond the conventional core analysis. It consists of investigating heterogeneities from core image using two-dimensional Brownian motion (2D-mBm) model. The latter allows to study processes whose regularity varies in space.
Synthetic 2D-mBm paths are firstly generated using the kriging method. Then, these simulated paths are used to validate algorithms, developed for estimating Hölderian regularity functions, which are: FFT-based algorithms using the Morlet wavelet and the Mexican hat, and the multiple filter technique generalized to 2 dimensions (2D MFT). The results showed that the latter algorithm yields the best regularity estimates.

Next, the suggested analysis is extended to digitalized image data of a core extracted from an Algerian borehole. It is demonstrated that the data exhibit a fractal behavior. In addition, the derived regularity maps can characterize the core heterogeneities. The lithological changes (faults, breaks, stratifications, etc.) are perfectly reflected by local variations of the Hölder exponent value.

Keywords: core image, two-dimensional multifractional Brownian motion, fractal, regularity