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A robust method for estimating the multifractal wavelet spectrum in geophysical images

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The description of natural phenomena by an analysis of the statistical scaling laws is always a popular topic. Many studies aim to identify the fractal feature by estimating the self-similar parameter H, considered constant at different scales of observation. However, most real world data exhibit a multifractal structure, that is, the self-similarity parameter varies erratically with time.

The multifractal spectrum provide an efficient tool for characterizing the scaling and singularity structures in signals and images, proving useful in numerous applications such as fluid dynamics, internet network traffic, finance, image analysis, texture synthesis, meteorology, and geophysics.

In recent years, the multifractal formalism has been implemented with wavelets. The advantages of using the wavelet-based multifractal spectrum are: the availability of fast algorithms for wavelet transform, the locality of wavelet representations in both time and scale, and intrinsic dyadic self-similarity of basis functions.

In this work we propose a robust Wavelet-based Multifractal Spectrum Estimator for the analysis of geophysical signals and satellite images. Finally, a simulation study and examples are considered to test the performances of the estimator.