Multifractal analysis based on wavelet bases: Part 2. Estimation, Bayesian models and multivariate data.

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The successful use of multifractal analysis in applications crucially relies on accurate procedures for assessing and comparing the parameters of multifractal models. We will show how parameters associated with the multifractal spectrum can be estimated in practice in a robust manner, based on wavelet expansions of finite resolution time series or images. We will begin with revisiting the computation of estimates through log-log plot regressions and discuss the advantages, limitations and pitfalls of this approach. Then we will show how certain multifractal parameters can be assessed within a Bayesian model for the logarithm of wavelet leaders, with the practical benefit of stabilizing estimates. Finally, motivated by the fact that in an increasing number of applications, the acquired data are naturally multivariate (i.e., they consist of a collection of spatially/temporally/spectrally organized time series or images), we will show how the associated collections of multifractal parameters can be estimated jointly within appropriate hierarchical Bayesian models, enabling their regularization through the use of suitable priors. Several illustrations will be provided involving real-world multivariate time series and images from biomedical and remote sensing applications.

Joint work with Patrice Abry (Ecole Normale Supérieure de Toulouse, France), Yoann Altmann (Heriot-Watt University, UK), Sébastien Combrexelle (University of Toulouse, France), Stephen McLaughlin (Heriot-Watt University, UK) and Jean-Yves Tourneret (University of Toulouse, France).