Multifractal Analysis in Binary Images

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We discuss quantitatively the restrictions linked with the multifractal (MF) characterisation of binary images. We have review the MF analysis (MFA) normally used when the image is transform in a matrix (or cube), containing only 1 and 0 elements, and boundaries related to the percentage of black pixels (ϕ) were derived for the partition function. In the context of images, when a lower scale process is applied the number of black pixels (bp) should reflect a certain probability value at each iteration (n). Following this process we arise to threshold values for the maximum and minimum probabilities to be represented in function of ϕ, n and image size.

A cascade model, with different initial probabilities, was applied to generate several MF distributions that were transformed to matrices of integer numbers conserving the same generalized dimensions (D_q). These matrices, although resulting from a purely multi-cascade process, illustrates all the restrictions described earlier.

References

Bird, N., Díaz, M.C., Saa, A. and Tarquis, A.M..2006. A Review of Fractal and Multifractal Analysis of Soil Pore-Scale Images. J. of Hydrology, 322, 211- 219.

Perrier, E., Tarquis, A.M. and Dathe, A.. 2006. A Program for Fractal and Multifractal Analysis of Two-Dimensional Binary Images. Computer Algorithms versus Mathematical Theory. Geoderma, 134, 284-294.

Tarquis, A.M., McInnes, K., Keys, J., Saa, A., García, M.R. and Díaz, M.C.. 2006. Multiscaling Analysis In A Structured Clay Soil.. J. of Hydrology, 322, 236-246.

Acknoledgements