Multifractal Fields Simulation Software

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Matlab functions eps1D and eps2D

1 Basic Summary

A fractal feld with a continuous distribution of exponents, the singularity spectrum, rather than a single exponent, its fractal dimension, is called a multifractal field. Many field in geophysics are multifractal fields such as river flow, wind turbulence and geomagnetic field variations. The multifractal field here is generated according to the multifractality index α and the codimension C1.

2 Input

There are 5 inputs required for eps2D, the first two, lambdat and lambday, are the resolution of the field. The third input is α, the multifractality index and the fourth one is C1, the codimension which measures the mean inhomogeneity. The last input is a switch which allows to make the process acausal (switch=0) or causal (switch $\tilde{=}$ 0). eps1D works in the same way but with only one input for the resolution, lambda.

3 Output

The output of eps2D is a two dimensional multifractal field in the form of a matrix of dimension lambdat by lambday. The output for eps1D is is a one dimensional multifractal field.

4 Example 2D

Eps2D
lambdat=256
lambday=256
alpha=1.8
C1=0.1
switch=1

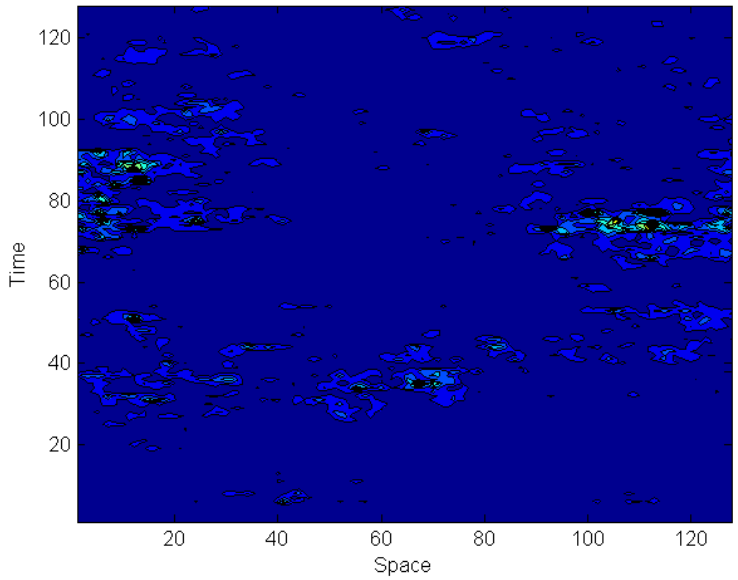

Figure 1: Inputting the resulting matrix into the function *contourf* yields this figure.

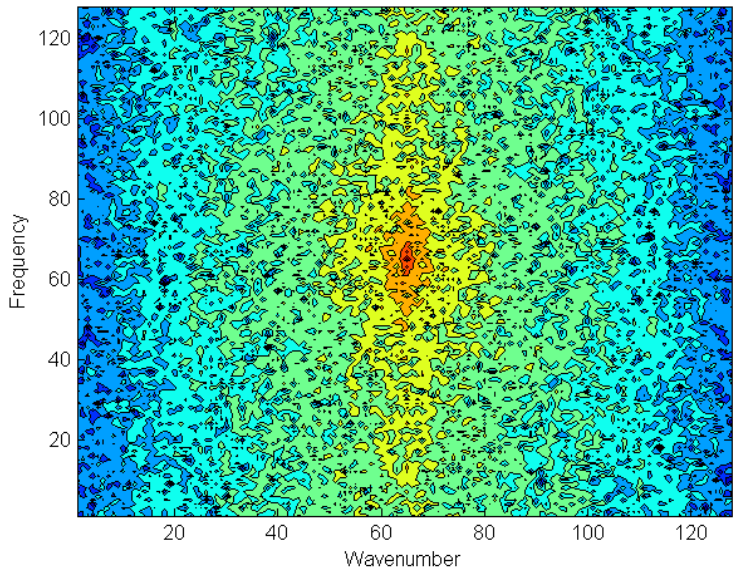

Figure 2: Logarithm of the power spectrum of a 2D causal simulation.

5 Example 1D

Eps1D
lambda=8192
alpha=1.8
C1=0.1
switch=1

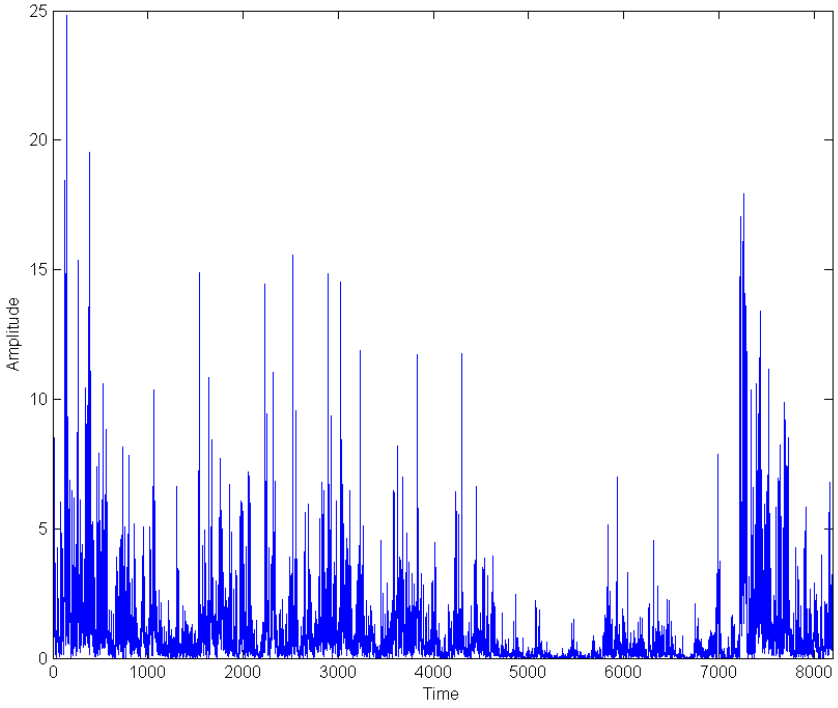

Figure 3: If we *plot* the resulting series, with obtain such a graphic.

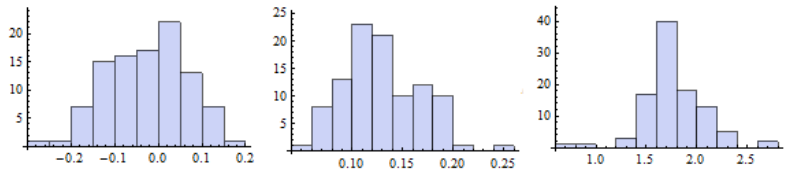

Figure 4: Histogram of the empircal probability distribution of the multifractal parameters, calculated over 100 realizations of length 2048 with input parameters $C1 = 0.1$ and $\alpha = 1.8$, whereas H always equal 0 for this simulation software. The average parameters are very close to those inputted: $H = -0.03$, $C1 = 0.13$ and $\alpha = 1.78$