README

In the MFD.zip file you can find the following files: frdimsigfmc1.m, MFD\_compute.m, signalFramed.m, BbClarinet.wav, example\_bio.mat. More details follows:

1. **FRDIMSIGFMC1.m is the main function that computes the Multiscale Fractal Dimension**

%FRDIMSIGFMC1 Fractal dimension of 1D signal via flat morph. covers.

% D=FRDIMSIGFMC1(X,'maxscale',M) computes the fractal dimension of the 1D

% real signal array X by computing multiscale flat dilations and erosions

% of X over scales r=1,...M, measuring the area of the difference

% among these dilations and erosions, and fitting a straight line over

% these multiscale area data over a log-log plot.

% D is the slope of this least-squares line fit.

% Str. Element for dilation/erosion= symmetric 3-sample flat line segment.

% Required length of signal for reliable results: length(X) >> 2\*M+1.

%

% [D,A]=FRDIMSIGFMC1(X,'maxscale',M) also provides as output the array A[r],

% r=1,...,M, of multiscale area mesurements.

%

% D=FRDIMSIGFMC1(X,'maxscale',M,'window',W) computes a "multiscale fractal

% dimension" of X by locally computing the slope of the log-log plot over

% sequentially advancing scale windows of length W <= M.

% D[r] is the array of multiscale fractal dimensions for r=1,...,(M-W+1).

% In general, 2 <= W <= M. If M and W are not given, M=W=5 is assumed.

% If M or W is given but with wrong value(s), a correct default pair (W,M) is chosen.

%

% READING to understand the theory behind this algorithm:

% P. Maragos, "Fractal Signal Analysis Using Mathematical Morphology'', in

% Advances in Electronics and Electron Physics, vol.88, edited by P. Hawkes & B. Kazan,

% Academic Press, 1994, pp.199--246.

% Author: P. Maragos

% v. 1.1: 12 Mar 1998

% 1.2: 25 May 2001, Add checks for values of M,W. Separate it from its 2D version.

1. **MFD\_compute.m, a startup function where 3 examples are demonstrated on how to use FRDIMSIGFMC1.m, compute MFD and plot its profile.**

The three examples are: 1. A music signal that can be found in the directory with the MFD code (BbClarinet.wav), 2. A synthesized note implemented as sinusoids that are added one by one and 3. An EEG signal (alpha band) that can be found in the directory with the MFD code (example\_bio.mat).

%% Start file for Multiscale Fractal Dimension Computation

%

% Read the signal

% Preprocessing: Frame and/or window the signal

% MFD: Chose parameters for maxscale M and window W that are needed for the

% MFD computation

% Run frdimsigfmc1.m and compute MFD

%

% Plotting of errorbars: as examples are user

% 1. A music signal that can be found in the directory with the MFD code

% 2. A synthesized note implemented as sinusoids that are added

% 3. An EEG signal

%

% Author: N. Zlatintsi

% Adapted for the CEPS package April. 2022

%

% The MFD code parameters are adapted for each individual signal.

% Regarding the music signals and the synthesized sinusoid "note"

% more details can be found:

% A. Zlatintsi and P. Maragos, "Multiscale Fractal Analysis of Musical

% Instrument Signals with Application to Recognition", IEEE Trans. on Audio,

% Speech and Language Processing, vol. 21, no. 4, pp.737-748, Apr. 2013.

% Link: http://cvsp.cs.ntua.gr/publications/jpubl+bchap/ZlatintsiMaragos\_MultiscaleFractalAnalMusicInstrumSignalsApplicRecogn\_ieeetASLP2013.pdf

1. **signalFramed.m, which is needed in order to window two of the example signals**

% [sigFramed,sigWindowed] = signalFramed(x,fs,windowLength, windowShift, windowed)

% buffers and windows the signal

%

% Author: N. Zlatintsi, 2012

% Adapted for the CEPS package April. 2022