Documentation for BNEW analysis MATLAB package

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This package provides code for implementing the BNEW (Brownian Noise Extracted with Wavelets) analysis method described in the associated manuscript. The code is designed to be applied to a data set of particle trajectories that have been extracted from experimental tracking studies or simulation results.

The required input for this code is a cell array of two-dimensional trajectories (each an Nx2 array, where N can vary from trajectory to trajectory). The trajectories are assumed to be sampled at uniform time intervals. Three wavelet forms are provided: Haar wavelets, Savitzky-Golay wavelets of arbitrary degree, and a sliding-mean wavelet.

Example particle trajectories with diffusive motion, localization error, and persistent random drift can be simulated with the `simTracks.m` function. A example set of simulated trajectories is provided in `exampleTracks.mat` for testing purposes. The analysis results for these trajectories are shown in Fig. 1a.

An alternate set of trajectories corresponding to fractional Brownian motion ($\alpha = 0.5$), localization error, and persistent random drift is provided in `exampletracksFBM.mat`. The analysis results for these trajectories are show in Fig. 1b. The tabulated functions $f(\alpha), g(\alpha)$ for extracting estimates for D_{fit} and ϵ_{fit} are provided in `fgfunc.mat`. They can be regenerated using `generateFGfunc.m`.

An example script for running the BNEW analysis on these, or other trajectory sets is given in `BNEWexample.m`, which was used to generate Fig. 1.

To quantify errors in the fit parameters, Fortran code is provided in the BNEWerrors directory, with its own documentation.

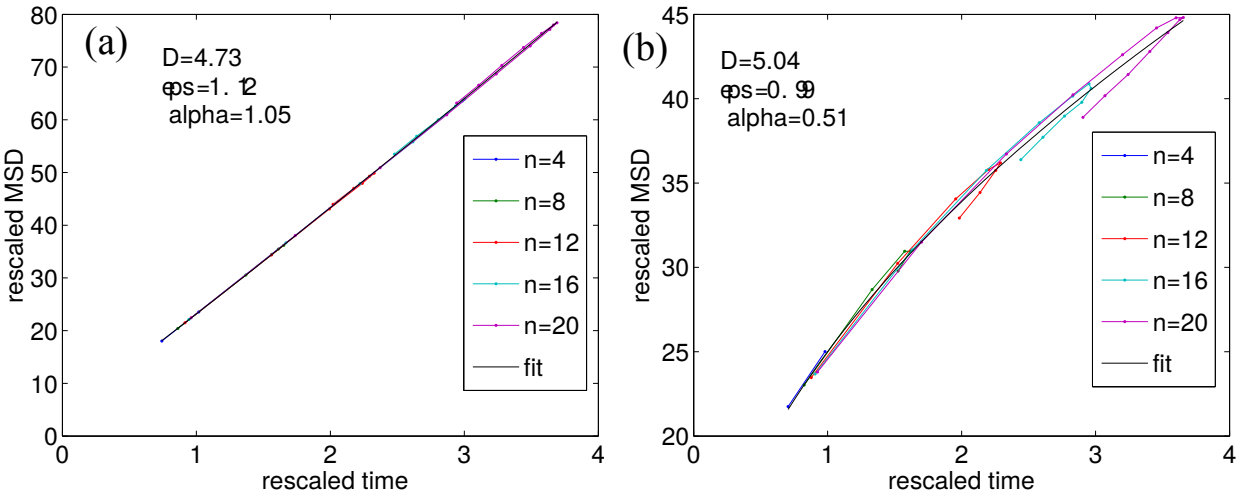

Figure 1: Results of BNEW analysis with example simulated trajectories with (a) Brownian motion ($\alpha = 1, D = 5$; trajectories stored in exampletracks.mat) and (b) fractional Brownian motion ($\alpha = 0.5, D = 5$; trajectories stored in exampletracksFBM.mat). In both cases, trajectories also include localization error ($\epsilon = 1$) and persistent random drift of magnitude $\gamma = 1$ and correlation time $\tau = 100$. Parameters extracted with power-law fits are shown for each.