Instructions for the `RD_Form` Command

The command,

`[phi_n, phi_f, C2D, RANKS, alfa_n, alfa_f]=RDForm(`t_{on}`, `t_{off}`, dt)`

takes two conjugated column vectors of N random times (or any other kind of non-negative observations) t_{on} and t_{off}, and a time increment, `dt`, and returns as an output all the extractable information contained in the data, and the reduced dimensions (RD) form that best describes the data. The mechanism-free information that is extracted from the data includes:

(1) The exponential expansion parameters, $\{c_x\};\{\lambda_x\}$, of the waiting time probability density functions (WT-PDFs) of the single events (*on* and *off*),

$$\phi_x(t)=\sum_{i=1}^{L_x} c_{x,i} e^{-\lambda_{x,i} t} \quad , \qquad x=on,\ off$$

are contained as two column vectors in the output of each of the objects '`phi_n`' and '`phi_f`'.

(2) The matrices of coefficients, $\{\sigma_{x,y}\}_{x,y=on,off}$, in the exponential expansions of all two-dimensional WT-PDFs,

$$\phi_{x,y}(t_1,t_2)=\sum_{i=1}^{L_x}\sum_{j=1}^{L_y} \sigma_{x,y,ij} e^{-\lambda_{x,i} t_1-\lambda_{y,j} t_2} \ ;\ x,y=on,\ off.$$

are contained in the matrix `C2D`: $\mathtt{C2D}=\begin{pmatrix}\sigma_{on,on} & \sigma_{on,off}\\ \sigma_{off,on} & \sigma_{off,off}\end{pmatrix}$.

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(3) The ranks of the $\phi_{x,y}(t_1,t_2)$ s are given by the row vector RANKS:

RANKS= $[R_{on,on}\ R_{on,off}\ R_{off,on}\ R_{off,off}]$.

The mechanism-dependent information that is extracted from the data is contained in the objects 'alfa_n' and 'alfa_f', which are the (three indices) coefficients in the exponentials expansion for the WT-PDFs for the connections in the RD form,

$\varphi_{x,ij}(t) = \sum_{H=1}^{L_x} \alpha_{x,iHj}\ e^{-\lambda_{x,H}t}$; x=*on,off*.

$\varphi_{x,ij}(t)$ connects substates $j_x \rightarrow i_y$ in the RD form ($x \neq y$) . The RD form is specified once the $\alpha_{x,iHj}$ s are specified.

The methods in the toolbox are based on known statistical methods in data analysis, combined with statistical methods and numerical algorithms designed specifically for the current problem. Some of the mathematical discussion is presented in [1].

The implementation of our toolbox is fast (analyzing a 10^6 cycle trajectory from a thirty-parameter mechanism takes a couple of hours on a PC with a 2.66 GHz processor).

At a first step, the toolbox is designed to work in Matlab environment, and uses the optimization toolbox in Matlab. In the final form, the toolbox will be the basis for a web-interface that analyzes the signal for web-users. Subscription will be needed for using the web-interface.

Reference

[1] O. Flomenbom, and R. J. Silbey, *Toolbox for analyzing finite two-state trajectories*, Phys. Rev. E **78**, 066105 (2008).

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