TOOLBOX DESCRIPTION

LINEAR MODEL-BASED ESTIMATION

- `bim_mos_idVAR`: model order selection for identification of a strictly causal vector autoregressive (VAR) model
- `bim_idVAR`: general linear regression modelling through least squares model identification
- `bim_VARspectra`: VAR spectral matrices (transfer function and power spectral density - PSD)
- `bim_fGC_lin`: frequency domain bivariate Granger Causality (GC), Total Dependence (TD) and Instantaneous Causality (IC) from the PSD of a VAR model

Resolution of the Yule-Walker (YW) equations

- `bim_Yule`: solution of the YW equations for a VAR process (using discrete time Lyapunov equation)
- `bim_LinReg`: linear regression of random processes through resolution of the YW equations; performs linear regression of the present state of given target processes from the past states of given driver processes
- `bim_MIRdec_lin_YW`: performs computation of the mutual information rate (MIR) and the causal terms of its decomposition (transfer entropies – TE – and instantaneous transfer – IT) in the time and spectral domains; estimation through resolution of the YW equations

State-space (SS) models

- `bim_SSmodel`: computation of SS model parameters [A,C,K] from VAR model parameters [Am]
- `bim_submodel`: derivation of a submodel (i.e., a reduced model) of a state space (SS) model
- `bim_MIRdec_lin_SS`: performs computation of the mutual information rate (MIR) and the causal terms of its decomposition (TE, IT) in the time and spectral domains; estimation through SS models

MODEL-FREE ESTIMATION

- `bim_MIRdec_knn`: decomposition of the MIR into TEs and IT through the k-nearest neighbors (KNN) estimator
- `bim_MIRdec_bin`: decomposition of the MIR into TEs and IT through the binning estimator
- `bim_MIRdec_perm`: decomposition of the MIR into TEs and IT through the permutation estimator
- `bim_H`: entropy of a discrete multidimensional variable (logarithm of the probability distribution)

- `bim_quantization`: quantization of the input series with a given number of quantization levels – used for binning estimator
- `bim_ObsMat`: computation of the observation matrix (for entropy computation)
- `bim_SetLag`: sets the vector of indexes for series and lags to be used for conditioning
- `bim_thsim_modelfree`: simulated example which replicates physiological interactions and shows the behaviour of the three estimators (KNN, permutation, binning) at varying hyperparameters such as memory length, quantization levels, or the number of nearest neighbors

OTHER FUNCTIONS

- `bim_AR_filter`: autoregressive low-pass, high-pass filter for pre-processing
- `bim_surrtimeshift`: time shifted surrogates (makes use of a circular shift with a minimum number of shifted samples)
- `bim_WCspectra`: non-parametric power spectral density via weighted covariance estimator
- `bim_VARfilter`: filter a white noise with a strictly causal VAR model
- `bim_theoreticalVAR`: theoretical coefficients for simulated VAR process