

GTS-PCA {GTSPCA}

Generalized Principal Component Analysis for Non-Stationary Vector Time Series

**Description**

This function is used to segment a stationary/nonstationary multivariate series into  $n$  uncorrelated subseries. Notice that the following libraries are needed to be installed before using the GTSPCA function: `library(roll)`; `library(expm)`.

**Usage**

```
GTSPCA(x,w,1)
```

**Arguments**

`x`  
a  $T$ -by- $m$  data matrix, where the rows are " $T$ " time points, and the columns are " $m$ " variables

`w`  
window width (i.e. window length)

`1`  
number of lagged series to be included in the calculation of GTS-PCA

**Value**

`X`  
returns the transform  $n$  uncorrelated series

`mw`  
returns the estimated quadratic order moving cross-covariance matrix of the data matrix `x`

`gamma`  
returns the eigenvectors of the matrix `mw`

`Vinv`  
returns the matrix  $M^{-1/2}$ , where  $M$  is the moving cross-covariance matrix of the data matrix `x`. The standardized data matrix of `x` is obtained by left multiplying the data matrix `x` by `Vinv`. This is a preliminary step in the calculation of GTS-PCA; See Alshammri and Pan (2020)

**Note**

See the example below.

**Author(s)**

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**References**

Alshammri, F. and Pan, J. (2020). Generalized Principal Component Analysis for Non-Stationary Vector Time Series. Manuscript submitted for publication.

**Examples**

```
##This is Example 2 of Alshammri and Pan (2020).
##The data matrix X is a non-stationary time series with m=5 and T=1000.
m=5;T=1000
##Generate x_t
X=mat.or.vec(m,T)
u=arima.sim(list(order=c(1,1,3),ar=0.75,ma=c(1.5,0.5,0.2)),n=T+1,sd=1)
for(i in 1:2) X[i,]=u[1+i:T]
v=arima.sim(list(order=c(2,1,3),ar=c(-0.5,-0.4),ma=c(-1.2,-2.75,0.5)),n=T+1,sd=1)
for(i in 3:4) X[i,]=v[(i-1):(T+1-2)]
w=arima.sim(list(order=c(2,0,4),ar=c(-0.9,-0.45),ma=c(-1.1,-0.8,-0.6,-1.3)),n=T,sd=1)
X[5,]=w[1:T]
A=matrix(runif(m*m, -5, 5), ncol=m)
YY=A%*%X
YY=t(YY)
YY=ts(YY)
##here we have YY is the used data matrix (i.e. x=YY), the window size is 100, and we use 5 lags in the calculation of mw
myresults=GTSPCA(YY,100,5)
##the final result (i.e. the transformed uncorrelated subseries)
myresults$X
```

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