Package ‘dvfBm’

February 19, 2015

Type Package
Title Discrete variations of a fractional Brownian motion
Version 1.0
Date 2009-10-14
Author Jean-Francois Coeurjolly
Maintainer J.-F. Coeurjolly
  <jean-francois.coeurjolly@upmf-grenoble.fr>
Description Hurst exponent estimation of a fractional Brownian motion
by using discrete variations methods in presence of outliers
and/or an additive noise
License GPL (>= 2.0)
LazyLoad yes
Depends wmtsa
Repository CRAN
Date/Publication 2009-11-22 16:11:39
NeedsCompilation no

R topics documented:

dvfBm-package ........................................................................... 2
circFBM ................................................................................... 3
dilatation ................................................................................... 4
dvFBM ...................................................................................... 5
filt ............................................................................................ 6
perturbFBM .............................................................................. 7

Index 10
Simulation and Inference of contaminated Fractional Brownian Motions

Description

Generates contaminated (with additive outliers or additive noise) sample paths of a fractional Brownian motion and proposes robust Hurst exponent estimates that are computationally fast and that do not require the estimation of other parameters.

Details

<table>
<thead>
<tr>
<th>Package: dvfBm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type: Package</td>
</tr>
<tr>
<td>Version: 1.0</td>
</tr>
<tr>
<td>Date: 2009-10-14</td>
</tr>
<tr>
<td>License: GPL (&gt;=2.0)</td>
</tr>
<tr>
<td>LazyLoad: yes</td>
</tr>
</tbody>
</table>

Author(s)

J.-F. Coeurjolly

References


S. Achard and J.-F. Coeurjolly (2009). Discrete variations of the fractional Brownian in the presence of outliers and an additive noise. Submitted

Examples

```r
n <- 10000; H <- 0.8
z <- perturbFBM(n, H, type="AO", SNR=-20, plot=TRUE)
dvfBM(z, method="ST")
dvfBM(z, nma="d4", method="TM", par=list(beta1=.1, beta2=.1))
```
Simulation of a fractional Brownian motion by using the circulant matrix method

Description

Generates a discretized sample path of a fBm, \( B_H = (B_H(0), ..., B_H(n-1/n)) \), at times 0, ..., \((n-1)/n\) with Hurst parameter \( H \) in (0,1) by using the circulant matrix method. A fBm with scaling coefficient \( C > 0 \) and discretized at times 0,...,n-1 is obtained by the operation: \( n^H * C * B_H \).

Usage

circFBM(n, H, plotfBm = FALSE)

Arguments

- \( n \) sample size
- \( H \) Hurst parameter
- plotfBm possible plot of the generated sample path

Details

The circulant matrix method consists in embedding the covariance matrix of the increments of the fractional Brownian motion (which is a Toeplitz matrix since the increments are stationary) in a matrix, say \( M \), whose size is a power of 2 greater than \( n \). One then uses general results on circulant matrices to compute easily and very quickly the eigenvalues of \( M \). Note that the simulation fails if the procedure does not find a matrix \( M \) such that all its eigenvalues are positive.

Value

Returns a vector of length \( n \).

Author(s)

J.-F. Coeurjolly

References


Examples

tmp1<-circFBM(500, 0.2)
tmp2<-circFBM(5000, 0.5)
tmp3<-circFBM(50000, 0.8)
dilatation

Provides the dilated version of a vector

Description

Computes the vector $a^m : a^m_i = a_{i/m}$ if $i/m$ is an integer and 0 otherwise. As an example, if $a = a^1 = (1, -2, 1)$, then $a^2 = (1, 0, -2, 0, 1)$, ...

Usage

dilatation(a = c(1, -2, 1), m = 2)

Arguments

- **a**: a numeric vector
- **m**: an integer associated to the dilatation factor

Value

Return a vector of length $m*(\text{length}(a)-1)+1$

Author(s)

J.-F. Coeurjolly

See Also

filt

Examples

dilatation(c(1,-1,1),1)
dilatation(c(1,-1),2)
##
dilatation(filt("i2"),5)
**dvFBM**

Discrete Variations estimate for a contaminated fBm

**Description**

Robust estimator of the Hurst parameter of a fractional Brownian possibly contaminated by additive outliers and/or an additive noise.

**Usage**

\[
par = list(), llplot = FALSE)
\]

**Arguments**

- **fbm**  
  data
- **nma**  
  name of the filter used for filtering the data. See `filt` for possible choices. Default is "i2"
- **M1**  
  Minimum value of the dilatation factor. Default is 1.
- **M2**  
  Maximum value of the dilatation factor. Default is 5.
- **method**  
  Type of the discrete variations method.
- **par**  
  Parameters depending on method. If method is "Q", "B0-Q", "B1-Q", a list with two vectors `vecp` and `vecc` is needed. If method is "TM", "B0-TM", "B1-TM", a list with two real numbers `betaQ` and `betaR` is needed.
- **llplot**  
  If true a plot of \( \log(U_n^m) \) against \( \log(m) \) for \( m = M_1, ..., M_2 \) is produced.

**Details**

An estimate of the Hurst exponent parameter is provided without estimating the scaling coefficient \( C \) and \( \sigma \) (parameter related to an additive noise). The standard method ST is based on filtering the data with dilated versions of the initial filter (whose name is `nma`). Other methods are improvements. Methods TM and Q are based on trimmed-means and sample quantiles respectively. Methods B0 and B1 exploit the fact that the contamination is a Brownian motion or a Gaussian white noise. Other methods are combinations of the two last classes. See Achard and Coeurjolly (2009) for more details.

**Value**

Returns the Hurst parameter estimate

**Author(s)**

J.-F. Coeurjolly
References
S. Achard and J.-F. Coeurjolly (2009). Discrete variations of the fractional Brownian in the presence of outliers and an additive noise. Submitted

See Also
circFBM, perturbFBM

Examples
n<-10000; H<-.8
## no
z<-perturbFBM(n, H, type="no", plot=FALSE)
dvFBM(z, method="ST")
dvFBM(z, method="TM", par=list(beta1=.1, beta2=.1))
dvFBM(z, method="B0-Q", par=list(vecp=.5, vecc=1))
dvFBM(z, method="B1-ST")
## A0
z<-perturbFBM(n, H, type="A0", SNR=20, plot=FALSE)
dvFBM(z, nma="d4", method="ST")
dvFBM(z, nma="d4", method="TM", par=list(beta1=.1, beta2=.1))
## B0
z<-perturbFBM(n, H, type="B0", SNR=0, plot=FALSE)
dvFBM(z, M2=10, method="ST")
dvFBM(z, M2=10, method="B0-ST")
## B1
z<-perturbFBM(n, H, type="B1", SNR=0, plot=FALSE)
dvFBM(z, method="ST")
dvFBM(z, method="B1-ST")

filt

Components of a named filter

Description
This function gives the components of an increment-type filter or a (classical) wavelet Daubechies filter

Usage
filt(nm = "i2")

Arguments

nm
a character string denoting the filter type. Supported types include:

INCREMENT-TYPE: "in" where n is an integer

EXTREMAL PHASE (daublet): "haar", "d2", "d4", "d6", "d8", "d10", "d12", "d14", "d16", "d18", "d20"
perturbFBM

LEAST ASYMMETRIC (symmlet): "s2", "s4", "s6", "s8", "s10", "s12", "s14", "s16", "s18", "s20"
BEST LOCALIZED: "l2", "l4", "l6", "l14", "l18", "l20"
COIFLET: "c6", "c12", "c18", "c24", "c30"
Default: "i2".
Note that wavelet Daubechies filters are obtained by using the function wavDaubechies

Value
a numeric vector corresponding to the filter

Author(s)
J.-F. Coeurjolly

References

See Also
dilatation, wavDaubechies

Examples
filt()
filt("d4")
dilatation(filt("d4"),2)

perturbFBM

Simulation of a perturbed fBm

Description
Simulation of a sample path of a fractional Brownian motion contaminated by outliers or an additive Gaussian noise

Usage
perturbFBM(n, H, C = 1, type = "no", SNR=NULL, plot = FALSE)
Arguments

n  sample size
H  Hurst parameter
C  scaling coefficient. Default is 1
type  type of perturbation. Possible choices are "no", "B0", "B1", "AO"
SNR  Signal Noise Ratio parameter for the contamination
plot  if plot is TRUE a (2,2) plot of the sample path of the fractional Brownian motion, the fractional Gaussian noise and their contaminated version is produced. Default is FALSE

Details

Possible contaminated models are

"no"  no contamination
"AO"  additive outliers models. 0.5% of the data are perturbed by Gaussian variables with variance such that the SNR equals SNR.
"B0"  \( FBM + \sigma * B0 \) where \( B0 \) is a standard Brownian motion. \( \sigma \) is chosen such that the SNR of the increments equals SNR
"B1"  \( FBM + \sigma * B1 \) where \( B1 \) are i.i.d. Gaussian standard variables. \( \sigma \) is chosen such that the SNR of the increments equals SNR

See Achard and Coeurjolly (2009) for a more detailed description.

Value

returns a vector of length \( n \) of a discretized sample path of a fractional Brownian motion with parameters \((H, C)\) at times \( i = 1, \ldots, n \) possibly contaminated by an additive outliers models, a Brownian motion or a Gaussian white noise.

Author(s)

J.-F. Coeurjolly

References

S. Achard and J.-F. Coeurjolly (2009). Discrete variations of the fractional Brownian in the presence of outliers and an additive noise. Submitted

See Also

circFBM, dvFBM
Examples

n<-1000;H1<-.3;H2<-.8
## "no"
tmp1<-perturbFBM(n,H1,type="no",plot=TRUE)
tmp2<-perturbFBM(n,H2,type="no",plot=TRUE)
## "AO"
tmp3<-perturbFBM(n,H1,type="AO",SNR=0,plot=TRUE)
tmp4<-perturbFBM(n,H2,type="AO",SNR=-20,plot=TRUE)
## "B0"
tmp5<-perturbFBM(n,H1,type="B0",SNR=10,plot=TRUE)
tmp6<-perturbFBM(n,H2,type="B0",SNR=0,plot=TRUE)
## "B1"
tmp7<-perturbFBM(n,H1,type="B1",SNR=10,plot=TRUE)
tmp8<-perturbFBM(n,H2,type="B1",SNR=0,plot=TRUE)
Index

*Topic** package
  dvFBm-package, 2

circFBM, 3, 6, 8

dilatation, 4, 7
dvFBM, 5, 8
dvfBm-package, 2

filt, 4, 5, 6

perturbFBM, 6, 7

wavDaubechies, 7