Package 'dvfBm'

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Type Package

Title Discrete variations of a fractional Brownian motion

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Description Hurst exponent estimation of a fractional Brownian motion by using discrete variations methods in presence of outliers and/or an additive noise

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LazyLoad yes

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dvfBm-package *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 computationnally fast and that do not require the estimation of other parameters.

Details

Package:	dvfBm
Type:	Package
Version:	1.0
Date:	2009-10-14
License:	GPL (>=2.0)
LazyLoad:	yes

Author(s)

J.-F. Coeurjolly

References

J.-F. Coeurjolly (2001) Simulation and identification of the fractional Brownian motion: a bibliographic and comparative study. Journal of Statistical Software, Vol. 5.

A.T.A. Wood and G. Chan (1994) Simulation of stationary Gaussian processes in $[0,1]^d$. Journal of computational and graphical statistics, Vol. 3 (4), p.409–432.

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

Examples

```
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))
```

`circFBM` *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

J.-F. Coeurjolly (2001) Simulation and identification of the fractional Brownian motion: a bibliographic and comparative study. Journal of Statistical Software, Vol. 5.

A.T.A. Wood and G. Chan (1994) Simulation of stationary Gaussian processes in $[0, 1]^d$. Journal of computational and graphical statistics, Vol. 3 (4), p.409–432.

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 : $a_i^m = a_{i/m}$ 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*(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

```
dvFBM(fbm, nma = "i2", M1 = 1, M2 = 5, method = c("ST", "Q", "TM",
"B1-ST", "B1-Q", "B1-TM", "B0-ST", "B0-Q", "B0-TM"),
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 beta1 and beta2 is needed.
llplot	If true a plot of $\log(U_n^{a^m})$ 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 σ (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")
## AO
z<-perturbFBM(n,H,type="AO",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")
```

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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"

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 filter are obtained by using the function wavDaubechies

Value

a numeric vector corresponding to the filter

Author(s)

J.-F. Coeurjolly

References

D. B. Percival and A. T. Walden (2000). Wavelet Methods for Time Series Analysis, Cambridge University Press.

I. Daubechies (2006). Orthonormal Bases of Compactly Supported Wavelets, Communications on Pure and, Applied Mathematics, 41, 909-996.

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. σ is chosen such that the SNR of the increments equals SNR

"B1" $FBM + \sigma * B1$ where B1 are i.i.d. Gaussian standard variables. σ 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 dsicretized sample path of a fractional Brownian motion with parameters (H,C) at times $i = 1, ..., n$ 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)
```

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