Package 'waved'

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Title Wavelet Deconvolution

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Description Makes available code necessary to reproduce figures and tables in recent papers on the WaveD method for wavelet deconvolution of noisy signals as presented in The WaveD Transform in R, Journal of Statistical Software Volume 21, No. 3, 2007.

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URL http://www.maths.usyd.edu.au/u/michaels/waved http://www.jstatsoft.org/

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R topics documented:

FWaveD *FWaveD*

Description

Computes the Forward WaveD Transform.

Usage

```
FWaveD(y, g = 1, L = 3, deg = 3, F = (log2(length(y)) - 1), thr = rep(0, log2(length(y))), SOFT = FALSE)
```

Arguments

y	Sample of $f * g$ + (Gaussian noise), a vector of dyadic length (i.e. 2^{J-1} where J is the largest resolution level). Here f is the target function, g is the convolution kernel.
g	Sample of g or g + (Gaussian noise), same length as yobs. The default is the Dirac mass at 0.
L	Lowest resolution level; the default is 3.
deg	The degree of the Meyer wavelet, either 1, 2, or 3 (the default).
F	Finest resolution level; the default is the data-driven choice j1 (see Value below).
thr	A vector of length $F - L + 1$, giving thresholds at each resolution levels $L, L + 1, \ldots, F$; default is maxiset threshold.
SOFT	if SOFT=TRUE, uses the soft thresholding policy as opposed to the hard (SOFT=FALSE, the default).

Value

Returns a vector of wavelet coefficients of length n (the same length as y), the last $n/2$ entries are wavelet coefficients at resolution level $J - 1$, where $J = \log_2(n)$; the $n/4$ entries before that are the wavelet coefficients at resolution level $J - 2$, and so on until level L. In addition the 2^L entries are scaling coefficients at coarse level $C = L$.

References

Johnstone, I., Kerkyacharian, G., Picard, D. and Raimondo, M. (2004), 'Wavelet deconvolution in a periodic setting', *Journal of the Royal Statistical Society, Series B* **66**(3),547–573. with discussion pp.627–652.

Raimondo, M. and Stewart, M. (2006), 'The WaveD Transform in R', preprint, School and Mathematics and Statistics, University of Sydney.

See Also

WaveD

Examples

```
library(waved)
data=waved.example(TRUE,FALSE)
lidar.w=FWaveD(data$lidar.blur,data$g)
```

`WaveD` *WaveD*

Description

Performs statistical wavelet deconvolution using Meyer wavelet.

Usage

```
WaveD(yobs, g = c(1, rep(0, (length(yobs) - 1))), MC = FALSE, SOFT = FALSE, F = find.j1(g, scale(yobs))[2
```

Arguments

`yobs`	Sample of $f * g$ + (Gaussian noise), a vector of dyadic length (i.e. 2^{J-1} where J is the largest resolution level). Here f is the target function, g is the convolution kernel.
`g`	Sample of g or g + (Gaussian noise), same length as yobs. The default is the Dirac mass at 0.
`MC`	Option to only return the (fast) translation-invariant WaveD estimate (MC=TRUE) as opposed to the full WaveD output (MC=FALSE, the default), as described below. MC=TRUE recommended for Monte Carlo simulation.
`SOFT`	if SOFT=TRUE, uses the soft thresholding policy as opposed to the hard (SOFT=FALSE, the default).
`F`	Finest resolution level; the default is the data-driven choice j1 (see Value below).
`L`	Lowest resolution level; the default is 3.
`deg`	The degree of the Meyer wavelet, either 1, 2, or 3 (the default).
`eta`	Tuning parameter of the maxiset threshold; default is $\sqrt{6}$.
`thr`	A vector of length $F - L + 1$, giving thresholds at each resolution levels $L, L + 1, \ldots, F$; default is maxiset threshold.
`label`	Auxiliary plotting parameter; do not change this.

Value

In the case that MC=TRUE, WaveD returns a vector consisting of the translation-invariant WaveD estimate. In the case that MC=FALSE (the default), WaveD returns a list with components

`waved`	translation invariant WaveD transform; in the case MC=TRUE this is all that is returned.
`ordinary`	ordinary WaveD transform

FWaveD	Forward WaveD Transform; see FWaveD.
w	alternate name for FWaveD
w.thr	thresholded version of w
IWaveD	Inverse WaveD Transform
iw	alternate name for IWaveD
s	estimate of the noise standard deviation
j1	estimate of optimal resolution level (for maxiset threshold).
F	Fine resolution level used (may be different to j1).
M	estimate of optimal Fourier frequency (for maxiset threshold).
thr	vector of thresholds used (default is maxiset threshold).
percent	percentage of thresholding per resolution level
noise	noise proxy, wavelet coefficients of the raw data at the largest resolution level, used for estimating noise features.
ps	P-value of the Shapiro-Wilk test for normality applied to the noise proxy.
residuals	wavelet coefficients that have been removed before fine level F.

Author(s)

Marc Raimondo and Michael Stewart

References

Cavalier, L. and Raimondo, M. (2007), 'Wavelet deconvolution with noisy eigen-values', *IEEE Trans. Signal Process*, Vol. 55(6), In the press.

Donoho, D. and Raimondo, M. (2004), 'Translation invariant deconvolution in a periodic setting', *The International Journal of Wavelets, Multiresolution and Information Processing* **14**(1),415–423.

Johnstone, I., Kerkyacharian, G., Picard, D. and Raimondo, M. (2004), 'Wavelet deconvolution in a periodic setting', *Journal of the Royal Statistical Society, Series B* **66**(3),547–573. with discussion pp.627–652.

Raimondo, M. and Stewart, M. (2007), 'The WaveD Transform in R', Journal of Statistical Software.

See Also

FWaveD

Examples

```
library(waved)
data=waved.example(TRUE,FALSE)
doppler.wvd=WaveD(data$doppler.noisy,data$g)
summary(doppler.wvd)
```

waved.example *WaveD examples*

Description

Generate data sets and figures to illustrate the WaveD function.

Usage

```
waved.example(pr = TRUE, gr=TRUE)
```

Arguments

pr	If pr=TRUE (default) uses the same parameters as in the reference paper below. If pr=FALSE user level parameter specifications.
gr	If gr=TRUE (default) text and graphical displays are provided.

Value

lidar.noisy	Noisy blurred LIDAR signal (Gaussian noise)
lidar.noisyT	Noisy blurred LIDAR signal (Student t_2 noise)
doppler.noisy	Noisy blurred Doppler signal (Gaussian noise)
doppler.noisyT	Noisy blurred Doppler signal (Student t_2 noise)
lidar.blur	Blurred LIDAR signal
doppler.blur	Blurred Doppler signal
t	Rime vector scaled to [0,1]
n	Sample size
g	Convolution kernel
lidar	LIDAR signal
doppler	Doppler signal.
seed	Used in set.seed
sigma	Noise standard deviation.
g.noisy	Convolution kernel plus Gaussian noise.
g.noisyT	Convolution kernel plus Student t_2 noise.
dip	Degree of Ill-posedness.
k.scale	Scale of the convolution kernel

Author(s)

Marc Raimondo

References

Raimondo, M. and Stewart, M. (2007), "The WaveD Transform in R", Journal of Statistical Software.

See Also

WaveD

Examples

```
data=waved.example(TRUE,FALSE)
```

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