

Package ‘wmlf’

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Type Package

Title Wavelet Leaders in Multifractal Analysis

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Description Analyzing the texture of an image from a multifractal wavelet leader analysis.

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Depends R (>= 3.1.2), waveslim, methods

NeedsCompilation no

Repository CRAN

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bocage	<i>An orthophoto of bocage country near Nantes in France</i>
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Description

An orthophoto of bocage country near Nantes in France in 2012 with a pixel size of 5m.

Usage

```
data("bocage")
```

Format

A matrix with 512 rows and 512 columns.

Source

BD ORTHO 5 m - Institut national de l'information géographique et forestière

Original data can be retrieved here (page reached on 2014-08-01): <http://professionnels.ign.fr/bdortho-5m>

Examples

```
library(wm1f)
data(bocage)
l_b=leader(bocage, frac=1, full=TRUE)
fit(l_b, 2:5)
```

fit-method	<i>Compute the multifractal indicators hmin, c1 and c2</i>
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Description

This function estimates the multifractal indicators of an image. It takes as input a class object "leader" and a range of scales and returns a vector containing hmin, c1 and c2 .

Concretely the function fit uses "df.mf" slot and performs a linear regression of hmin, c1 and c2 columns on the choosen scales. hmin characterizes the uniform smoothness of the image, c1 corresponds to the value of h where L(h) is maximal, and c2 explains the strength of the multifractality. hmin and c1 are positive and c2 negative. The multifractal spectrum is approximated by :

$$L(h) = 2 + \frac{c_2}{2} \left(\frac{h - c_1}{c_2} \right)^2$$

hmin is the minimum value of h such that L(h) is greater than 0. To make comparable analyzes , we subtract frac to c1.

If the analysis is limited, we get only hmin. If the estimate of hmin is negative, strictly speaking one should repeat the analysis with an index of fractional integration "frac" greater than -hmin. hmin, t1 and t2 are calculated on the original wavelet coefficients (without the fractional integration).

Usage

```
## S4 method for signature 'Leader'
fit(object,scales)
```

Arguments

object A object of "Leader" class
scales The scales of range of the estimate. This range must be contained in 1:J

Value

A vector containing 1 (hmin) or 3 (hmin,c1,c2) values.

Author(s)

Francois Semecurbe

References

Herwig Wendt, Stephane Roux, Stephane Jaffard, Patrice Abry. Wavelet leaders and bootstrap for multifractal analysis of images. Signal Processing, Elsevier, 2009, 6 (89), pp.1100-1114.

Patrice Abry, Herwig Wendt, Stephane Jaffard. When Van Gogh meets Mandelbrot: Multifractal Classification of Painting's Texture. Signal Processing, Elsevier, 2013, 93 (3), pp.554-572.

Examples

```
library(wm1f)
data(bocage)
l_b=leader(bocage,frac=1,full=TRUE)
fit(l_b,2:5)
```

leader

Calculating the wavelet leaders decomposition of a square matrix

Description

This function calculates the wavelet decomposition leaders of a square matrix . Concretely , the output function returns a 'Leader' class object that allows calculations hmin , c1 and c2 . These indicators can then be used to discriminate, classify, study the image.

Usage

```
leader(image, wf="d6",frac = 0, full = T, energy=F)
```

Arguments

image	a square matrix representing the image in gray level to analyze
wf	name of the wavelet filter to use in the decomposition. By default, "d6" is used . "d6" has 3 vanishing moments which implies that it is orthogonal to polynomials of degree 2. Only "d4", "d6" and "d8" are available.
frac	Index of fractional integration
full	boolean indicating whether the analysis is complete , or if it is limited to the wavelet decomposition. The full analysis (TRUE) enables the estimation of hmin , c1 and c2. The limited analysis (FALSE) estimates hmin and determines the index of fractional integration.
energy	boolean indicating whether the indicators t1 and t2 are calculated. t1 is the logarithm of the sum of wavelet coefficients, t2 is the logarithm of the sum of wavelet coefficients. t2 is related to energy.

Value

leader returns an object of class "Leader". An object of class "Leader" is a list containing the following components :

dwtm	The wavelet decomposition . This decomposition preserves only the maximum absolute value for the detailed breakdown HL , LH and HH for each pixel
leader	wavelet leaders decomposition
J	The number of scale of the wavelet decomposition. This number is equal to the number of significant scales.
frac	Index of fractional integration
full	boolean indicating whether the analysis is complete or limited
full	boolean indicating whether the analysis is complete or limited
df.mf	Data frame containing the indicators by scales of analysis allowing calculation of hmin , c1 and c2

The access to the components is done with : objet\$component and object["component"].

Author(s)

Francois Semecurbe

References

Herwig Wendt, Stephane Roux, Stephane Jaffard, Patrice Abry. Wavelet leaders and bootstrap for multifractal analysis of images. Signal Processing, Elsevier, 2009, 6 (89), pp.1100-1114.

See Also

[plotfit](#)

Examples

```
library(wm1f)
data(bocage)
l_b=leader(bocage, full=FALSE)
plotfit(l_b)

l_b=leader(bocage, frac=1, full=TRUE)
plotfit(l_b)
fit(l_b, 2:5)
```

openfield

An orthophoto of openfield country near Nantes in France

Description

An orthophoto of openfield country near Reims in France in 2012 with a pixel size of 5m.

Usage

```
data("cocage")
```

Format

A matrix with 512 rows and 512 columns.

Source

BD ORTHO 5 m - Institut national de l'information géographique et forestière

Original data can be retrieved here (page reached on 2014-08-01): <http://professionnels.ign.fr/bdortho-5m>

Examples

```
library(wm1f)
data(openfield)
l_o=leader(openfield, frac=1, full=TRUE)
fit(l_o, 2:5)
```

`plotfit-method`*Displays the scales indicators to estimate h_{min} , c_1 and c_2*

Description

Displays graphics to choose the range of scales for estimating h_{min} , c_1 and c_2 . If the analysis is limited, this function only displays the graph of the logarithm of the maximum wavelet decomposition by scales. If this curve is descending, it is essential to integrate the image.

Usage

```
## S4 method for signature 'Leader'  
plotfit(object)
```

Arguments

`object` A object of "Leader" class

Author(s)

Francois Semecurbe

References

Herwig Wendt, Stephane Roux, Stephane Jaffard, Patrice Abry. Wavelet leaders and bootstrap for multifractal analysis of images. Signal Processing, Elsevier, 2009, 6 (89), pp.1100-1114.

Examples

```
library(wm1f)  
data(bocage)  
l_b=leader(bocage, frac=1, full=TRUE)  
plotfit(l_b)
```

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