GDR 134

GROUPEMENT DE RECHERCHE
TRAITEMENT DU SIGNAL ET IMAGES

[redacted]

CONTENTS

Wavelet Toolbox Demonstrations

dwtdemo : Example script for wavelet decomposition
dwptdemo : Example script for wavelet packet decomposition
bdwtdemo : Example script for boundary wavelet decomposition

Digital Signal Processing Tools

Contents

addnc

Purpose

Addition of two non causal signals

Synopsis

[z,tz] = addnc(x,tx,y,ty)

Description

[z,tz] = addnc(x,tx,y,ty) adds two non causal signals x and y starting at time tx and ty, respectively.

Authors

J-C. Pesquet and H. Krim

costh

Purpose

Entropic cost function

Synopsis

c = costh(x)

Description

c = costh(x) computes the entropic cost of signal x.

Authors

J-C. Pesquet and H. Krim

dec2nc

Purpose

Decimation by a factor of 2 of a non causal signal

Synopsis

[y,ty] = dec2nc(x,tx)

Description

[y,ty] = dec2nc(x,tx) decimates the incoming series x starting at time tx. ty is the time delay of y.

See also

INT2NC in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

filtnc

Purpose

Non causal filtering of a non causal signal

Synopsis

[y,ty] = filtnc(b,tb,x,tx)

Description

[y,ty] = filtnc(b,tb,x,tx) performs a non causal filtering of the non causal signal x, starting at time tx, using the filter b with time delay tb. y is the filtered signal which starts at time ty.

See also

FILTNC_P in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

filtnc_p

Purpose

Non causal filtering of a non causal periodized signal

Synopsis

y = filtnc_p(b,tb,x,tx)

Description

y = filtnc_p(b,tb,x,tx) performs non causal filtering of the non causal periodized signal x, starting at time tx, using the filter b whose time delay is tb.

See also

FILTNC in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

int2nc

Purpose

Interpolation with zeros of a non causal signal

Synopsis

[y,ty] = int2nc(x,tx)

Description

[y,ty] = int2nc(x,tx) interpolates with zeros the non causal signal x. y is twice length of (x -1) long. tx is the delay of the original signal and ty the delay of the interpolated signal.

See also

DEC2NC in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

lowpow2

Purpose

Compute the biggest power of 2 value less than or equal to the length of a signal

Synopsis

y = lowpow2(x)

Description

y=lowpow2(x) returns the biggest power of 2 value less than or equal to x.

Authors

J-C. Pesquet and H. Krim

nfft

Purpose

Compute the normalized Discrete Fourier Transform

Synopsis

y = nfft(x,n)

Description

y = nfft(x,n) computes the normalized DFT where x is the input data, and n is the number of samples. By default n is equal to length(x).

See also

NIFFT in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

nifft

Purpose

Compute the inverse normalized Discrete Fourier Transform

Synopsis

y = nifft(x,n)

Description

y = nifft(x,n) computes the inverse normalized DFT where x is the input data, and n is the number of samples. By default n is equal to length(x).

See also

NFFT in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

polypow

Purpose

Compute the power of a polynomial

Synopsis

c = polypow(b,n)

Description

c = polypow(b,n) computes the power n of polynomial b.

Authors

J-C. Pesquet and H. Krim

Wavelet Decompositions

Contents

bdwtd

Purpose

Discrete wavelet decomposition using boundary wavelets

Synopsis

y = bdwtd(h,g,hl,gl,Al,hr,gr,Ar,x,rm)

Description

y = bdwtd(h,g,hl,gl,Al,hr,gr,Ar,x,rm) computes the discrete wavelet decomposition of the signal x using boundary wavelets. h and g are the lowpass and highpass QMFs whose impulse responses are taken between -n+1 and n where n = length(h)/2. hl is the matrix of the lowpass coefficients for the left boundary, gl is the matrix of the highpass coefficients for the left boundary, Al is the preconditioning matrix for the left boundary, hr is the matrix of the lowpass coefficients for the right boundary, gr is the matrix of the highpass coefficients for the right boundary and Ar is the preconditioning matrix for the right boundary. x is the data vector and rm is the maximum resolution level. y is the vector of approximation coefficients at the lowest level and wavelet coefficients stored according to increasing resolution order.

See also

IBDWTD, BWAVELD, BWAVERD in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

References

[1] A. Cohen and I. Daubechies, "Wavelets on the interval and Fast Wavelet Transform", Applied and Computational Harmonic Analysis 1, 54-81, 1993.

bwaveld

Purpose

Generation of left boundary wavelet coefficients

Synopsis

[H,G,A] = bwaveld(h)

Description

[H,G,A] = bwaveld(h) generates the coefficients for the left boundary wavelets of the lowpass filter h whose impulse response is taken between -N2+1 and N2 where N2 = length(h)/2. H is the matrix of the lowpass coefficients for the left boundary, G is the matrix of the highpass coefficients for left boundary and A is the preconditioning matrix for left boundary data.

See also

BDWTD, BWAVERD in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

References

[1] A. Cohen and I. Daubechies, "Wavelets on the interval and Fast Wavelet Transform", Applied and Computational Harmonic Analysis 1, 54-81, 1993.

bwaverd

Purpose

Generation of right boundary wavelet coefficients

Synopsis

[H,G,A] = bwaverd(h)

Description

[H,G,A] = bwaverd(h) generates the coefficients for the right boundary boundary wavelets of the lowpass filter h whose impulse response is taken between -N2+1 and N2 where N2 = length(h)/2. H is the matrix of the lowpass coefficients for the right boundary data, G is the matrix of the highpass coefficients for the right boundary data and A is the preconditioning matrix for the right boundary data.

See also

BDWTD, BWAVELD in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet - H. Krim

References

[1] A. Cohen and I. Daubechies, "Wavelets on the interval and Fast Wavelet Transform", Applied and Computational Harmonic Analysis 1, 54-81, 1993.

cdwt

Purpose

Redundant discrete wavelet decomposition

Synopsis

[y,ty] = cdwt(H,tH,G,tG,x)

[y,ty] = cdwt(H,tH,G,tG,x,rm)

Description

[y,ty] = cdwt(H,tH,G,tG,x) computes the redundant discrete wavelet decompositon vector y of the signal x. y is a vector where the details of x are stored from coarse to fine resolution. H and G are the impulse responses of the analysis lowpass and highpass filters starting at time tH and tG, respectively, and ty is a matrix containing the following information :
- 1st row: delays of y signals
- 2nd row: length of y signals

[y,ty] = cdwt(H,tH,G,tG,x,rm) computes the redundant discrete wavelet decompositon up to the resolution rm.

Algorithm

The discrete wavelet decomposition function is computed using the pyramid algorithm which is described by Mallat in [1]. This algorithm consists in decomposing the signal spectrum into two equal (orthogonal case) or unequal (biorthogonal case) frequency bands using a lowpass (H) and a highpass (G) quadrature mirror filters (QMFs). They are called the approximations vector and the details vector, respectively. Then, the same procedure is applied again to the approximations vector as many times -resolution levels- as it is possible. But, the results of H and G are not decimated by 2, and therefore the number of generated wavelet coefficients increases exponentially with the number of resolution levels.

See also

PCDWT in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

References

[1] S. G. Mallat, "A Theory for Multiresolution Signal Decomposition: The Wavelet Representation," IEEE Trans. PAMI , vol. 11, pp. 674-692, no. 7, July 1989.

dwt

Purpose

Discrete wavelet transform

Synopsis

[y,ty] = dwt(H,tH,G,tG,x)

[y,ty] = dwt(H,tH,G,tG,x,rm)

Description

[y,ty] = dwt(H,tH,G,tG,x,rm) returns the discrete wavelet decomposition coefficients y of the signal x up to the resolution level rm (optional). the details of the signal x are stored in y from coarse to fine resolution. H and G are the impulse responses of the analysis lowpass and highpass filters which start at time tH and tG, respectively, and ty is a matrix which contains information on y in the following way:
- 1st row: delays of the y signals
- 2nd row: length of the y signals

rm is the highest resolution level which is by default equal to LOWPOW2(x).

Algorithm

The discrete wavelet decomposition function is computed using the pyramid algorithm which is described by Mallat in [1]. This algorithm consists in decomposing the signal spectrum into two equal (orthogonal case) or unequal (biorthogonal case) frequency bands using a lowpass (H) and a highpass (G) quadrature mirror filters (QMFs). The results of H and G are decimated by 2 and are called the approximations vector and the details vector, respectively. Then, the same procedure is applied again to the approximations vector only as many times -resolution levels- as it is possible. The wavelet coefficients localized outside the signal support are computed by zero padding the signal. As a result, the number of wavelet coefficients is greater than the signal length.

See also

IDWT in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

References

[1] S. G. Mallat, "A Theory for Multiresolution Signal Decomposition: The Wavelet Representation," IEEE Trans. PAMI , vol. 11, pp. 674-692, no. 7, July 1989.

ibdwtd

Purpose

Inverse discrete wavelet decomposition on the interval

Synopsis

x = ibdwtd(h,g,Ml,iAl,Mr,iAr,y)

x = ibdwtd(h,g,Ml,iAl,Mr,iAr,y,rm)

Description

x = ibdwtd(h,g,Ml,iAl,Mr,iAr,y,rm) computes the inverse discrete wavelet decomposition on the interval. h and g are the lowpass and highpass impulse responses of the synthesis filters, Ml and Mr are the matrices used at left and right boundaries to reconstruct the signal, iAl, iAr are the inverses of the preconditionning matrices for left and right data boundaries, y is the vector of the wavelet coefficients, rm is the maximum resolution level of decomposition and x is the reconstructed signal.

See also

BDWTD, IBWAVELD, IBWAVERD in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

References

[1] A. Cohen and I. Daubechies, "Wavelets on the interval and Fast Wavelet Transform", Applied and Computational Harmonic Analysis 1, 54-81, 1993.

ibwaveld

Purpose

Generate the left boundary matrices used in the inverse wavelet decomposition on the interval

Synopsis

[Ml,iAl] = ibwaveld(h,g,hl,gl,Al)

Description

[Ml,iAl] = ibwaveld(h,g,hl,gl,Al) computes the matrices allowing to reconstruct the signal at the left boundary in the inverse wavelet decomposition on the interval function. h and g are the impulse responses of the synthesis lowpass and highpass filters and hl, gl and Al are the matrices obtained from BWAVELD.

See also

IBDWTD, IBWAVERD in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

References

[1] A. Cohen and I. Daubechies, "Wavelets on the interval and Fast Wavelet Transform", Applied and Computational Harmonic Analysis 1, 54-81, 1993.

ibwaverd

Purpose

Generate the right boundary matrices used in the inverse wavelet decomposition on the interval.

Synopsis

[Mr,iAr] = ibwaverd(h,g,hr,gr,Ar)

Description

[Mr,iAr] = ibwaverd(h,g,hr,gr,Ar) computes the matrices allowing to reconstruct the signal at the right boundary in the inverse wavelet decomposition on the interval. h and g are the impulse responses of the synthesis lowpass and highpass filters. hr, gr and Ar are the matrices obtained from BWAVERD.

See also

IBDWTD, IBWAVELD in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

References

[1] A. Cohen and I. Daubechies, "Wavelets on the interval and Fast Wavelet Transform", Applied and Computational Harmonic Analysis 1, 54-81, 1993.

idwt

Purpose

Inverse discrete wavelet decomposition

Synopsis

x = idwt(H,tH,G,tG,y,ty,Lx)

Description

x = idwt(H,tH,G,tG,y,ty,Lx) computes the inverse discrete wavelet decomposition of a vector y where the details of the original signal x, whose length is Lx, are stored from coarse to fine resolution. H and G are the impulse responses of the synthesis lowpass and highpass filters starting at time tH and tG, respectively. ty is the matrix which contains information on y such that :
- 1st row: delays of the y signals
- 2nd row: length of the y signals

Algorithm

The reconstruction of the signal from its wavelet decomposition coefficients is achieved by up-sampling and convolving the approximations and details vectors of the highest resolution level with the synthesis lowpass and highpass filters, respectively. These two results are then summed up to give a new approximations vector at a lower resolution level. This procedure is repeated as many times as the number of resolution levels which has been used to decompose the signal.

See also

DWT in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

References

[1] S. G. Mallat, "A Theory for Multiresolution Signal Decomposition:The Wavelet Representation," IEEE Trans. PAMI , vol. 11, pp. 674-692, no. 7, July 1989.

ipdwt

Purpose

Inverse periodic discrete wavelet decomposition

Synopsis

x = ipdwt(H,G,y)

x = ipdwt(H,G,y,rm)

Description

x = ipdwt(H,G,y) computes the inverse periodic discrete wavelet decomposition of the vector y where the wavelet coefficients are stored in the increasing resolution order. H and G are the frequency responses of the lowpass and highpass synthesis filters, respectively. H and G may be chosen different at each resolution level.

x = ipdwt(H,G,y,rm) computes the inverse periodic discrete wavelet decomposition of the vector y up to the resolution rm. rm is the highest rsolution which is by default equal to LOWPOW2(X).

Algorithm

See PDWT algorithm.

See also

PDWT in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

References

[1] S. G. Mallat, "A Theory for Multiresolution Signal Decomposition:The Wavelet Representation," IEEE Trans. PAMI , vol. 11, pp. 674-692, no. 7, July 1989.

ipdwt_it

Purpose

Inverse periodic discrete wavelet decomposition computed over one iteration

Synopsis

x = ipdwt_it(H,G,Hx,Gx,r,Lx)

Description

x = ipdwt_it(H,G,Hx,Gx,r,Lx) computes one iteration of the inverse periodic discrete wavelet decomposition of the vector y. H and G are the frequency responses of the synthesis lowpass and highpass filters used at each resolution level, Hx and Gx are the approximations and details, respectively, r is the resolution level and Lx is the length of the original signal. x is the reconstructed signal at the resoultion r-1 (approximation or detail).

Algorithm

See IPDWT algorithm.

See also

IPDWT in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

References

[1] S. G. Mallat, "A Theory for Multiresolution Signal Decomposition:The Wavelet Representation," IEEE Trans. PAMI, vol. 11, pp. 674-692, no. 7, July 1989.

pcdwt

Purpose

Redundant periodic discrete wavelet decomposition

Synopsis

pcdwt(H,tH,G,tG,x)

pcdwt(H,tH,G,tG,x,rm)

Description

y = pcdwt(H,tH,G,tG,x) computes the redundant periodic discrete wavelet decompositon of the signal x up to the resolution level rm (default value: LOWPOW(x)). y is a vector where all the details of signal x are stored from coarse to fine resolution. H and G are the impulse responses of the lowpass and highpass analysis filters starting at time tH and tG, respectively.

y = pcdwt(H,tH,G,tG,x,rm) computes the redundant periodic discrete wavelet decompositon of signal x up to the resolution level rm.

Algorithm

The discrete wavelet decomposition function is computed using the pyramid algorithm which is described by Mallat in [1]. This algorithm consists in decomposing the signal spectrum into two equal frequency bands using a lowpass (H) and a highpass (G) quadrature mirror filters (QMFs). They are called the approximations vector and the details vector, respectively. Then, the same procedure is applied again to the approximations vector as many times -resolution levels- as it is possible. But, the results of H and G are not decimated by 2, and therefore the number of generated wavelet coefficients increases exponentially with the number of resolution levels.

See also

CDWT, PDWT in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

References

[1] S. G. Mallat, "A Theory for Multiresolution Signal Decomposition:The Wavelet Representation," IEEE Trans. PAMI , vol. 11, pp. 674-692, no. 7, July 1989.

pdwt

Purpose

Periodic discrete wavelet decomposition

Synopsis

y = pdwt(H,G,x)

y = pdwt(H,G,x,rm)

Description

y = pdwt (H,G,x) computes the discrete wavelet decomposition of the signal x. The wavelet coefficients are stored in y in the increasing resolution order. H and G are the frequency responses of the analysis lowpass and highpass filters. The highest resolution level is set by default to LOWPOW2(x).

y = pdwt (H,G,x,rm) computes the discrete wavelet decomposition, y, of the signal x up to the resolution rm.

Algorithm

The discrete wavelet decomposition function is computed using the pyramid algorithm which is described by Mallat in [1]. This algorithm consists in decomposing the signal spectrum into two equal (orthogonal case) or unequal (biorthogonal case) frequency bands using a lowpass (H) and a highpass (G) quadrature mirror filters (QMFs). The results of H and G are decimated by 2 and are called the approximations vector and the details vector, respectively. Then, the same procedure is applied again to the approximations vector only, as many times -resolution levels- as it is possible. In this decomposition, the linear convolutions are replaced by circular convolutions, which is equivalent to periodizing the analyzed signal. This procedure allows to reduce the boundary effects.

See also

IPDWT in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

References

[1] S. G. Mallat, "A Theory for Multiresolution Signal Decomposition:The Wavelet Representation," IEEE Trans. PAMI, vol. 11, pp. 674-692, no. 7, July 1989.

pdwt_it

Purpose

Periodic discrete wavelet decomposition computed over one iteration

Synopsis

[HX, GX] = pdwt_it(H,G,X,r,Lx)

Description

[HX, GX] = pdwt_it(H,G,X,r,Lx) computes one iteration of the periodic discrete wavelet decomposition of signal x, expressed in the spectral domain by X (Fourier Transform of x). H and G are the frequency responses of the lowpass and highpass analysis filters, used at each level of the analysis and stored in decreasing resolution order. r is the desired resolution level, Lx the length of the original signal. HX and GX contain the approximation and details coefficients of X in the spectral domain. In this decomposition, the convolutions are replaced by circular convolutions which is equivalent to periodizing the analyzed signal. This procedure allows to reduce the boundary effects.

Algorithm

See PDWT algorithm.

See also

PDWT in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

References

[1] S. G. Mallat, "A Theory for Multiresolution Signal Decomposition:The Wavelet Representation," IEEE Trans. PAMI, vol. 11, pp. 674-692, no. 7, July 1989.

Wavelet Packet Decompositions

Contents

dwpt

Purpose

Discrete wavelet packet decomposition

Synopsis

[Vx,INFO,tVx] = dwpt(h,th,g,tg,x,criterion)

[Vx,INFO,tVx] = dwpt(h,th,g,tg,x,criterion,rm)

[Vx,INFO,tVx] = dwpt(h,th,g,tg,x,criterion,rm,enerthresh)

[Vx,INFO,tVx] = dwpt(h,th,g,tg,x,criterion,rm,enerthresh,entthresh)

Description

[Vx,INFO,tVx] = dwpt(h,th,g,tg,x,criterion) computes the discrete wavelet packet decomposition vector Vx of signal x according to the cost function "criterion". h and g are the impulse responses of the analysis lowpass and highpass filters starting at time th and tg, respectively. INFO is a matrix which serves to manage the discrete wavelet packet decomposition. Each column contains information on each signal of Vx. There are $2^{(rm+1)}-1$ columns. Each row contains information of different types :

- 1st row: index of the beginning of the signal in Vx
- 2nd row: signal length

tVx is a vector containing the delays of Vx signals

[Vx,INFO,tVx] = dwpt(h,th,g,tg,x,criterion,rm) computes the discrete wavelet packet decomposition of signal x up to the resolution rm.

[Vx,INFO,tVx] = dwpt(h,th,g,tg,x,critere,rm,enerthresh) stops the discrete wavelet packet decomposition if the energy of the wavelet packet coefficients is below the energy threshold "enerthresh".

[Vx,INFO,tVx] = dwpt(h,th,g,tg,x,criterion,rm,enerthresh,entthresh) stops the discrete wavelet packet decomposition if the energy of the wavelet packet coefficients is below the entropic threshold "entthresh".

Algorithm

The wavelet packet bases form a collection -library- of orthonormal bases composed of functions of the form $W_n(2^l x-k)$ where l, k $\in$ Z and n $\in$ N. Each element of the library is determined by the following subset of indices :

1) a scaling parameter l
2) a localization parameter k
3) an oscillating parameter n

This algorithm, which is well explained in [1] an [2], consists in decomposing the signal on the best wavelet packet basis according to a certain criterion or cost function.

See also

IDWPT in the GDR Wavelet Toolbox.

Authors

H. Carfantan, H. Krim and J-C. Pesquet.

References

[1] R. R. Coifman and M. V. Wickerhauser, Best-adapted wavelet packet bases, preprint, Yale University.

[2] Yves Meyer and M. V. Wickhauser, Acoustic signal compression with wavelet packets, preprint, Yale University, August, 1989.

idwpt

Purpose

Inverse discrete wavelet packet decomposition

Synopsis

z = idwpt (H,G,tH,tG,Vx,INFO,tVx,Lx)

Description

z = idwpt (H,G,tH,tG,Vx,INFO,tVx,Lx) reconstructs the signal z of length Lx from its wavelet packet decomposition coefficients Vx. H and G are the impulse responses of the synthesis lowpass and highpass filters starting at time tH and tG, respectively. tVx is a vector containing the delays of Vx signals and INFO is a matrix containing information on Vx in the following way:

- 1st row: index of the beginning of Vx
- 2nd row: length of Vx signals

Algorithm

The reconstruction of the signal from its wavelet packet decomposition coefficients is achieved by up-sampling and convolving the approximations and details vectors with the synthesis lowpass and highpass filters, respectively. These two results are summed up to give an approximations vector of lower resolution. Then the same procedure is repeated as many times as the number of resolutions levels and following -from right to left - the same tree which has been used in the decomposition.

See also

DWPT in the GDR Wavelet Toolbox.

Authors

H. Carfantan, H. Krim and J-C. Pesquet.

References

[1] R. R. Coifman and M. V. Wickerhauser, Best-adapted wavelet packet bases, preprint, Yale University.

[2] Yves Meyer and M. V. Wickhauser, Acoustic signal compression with wavelet packets, preprint, Yale University, August, 1989.

ipdwpt

Purpose

Inverse periodic discrete wavelet packet decomposition

Synopsis

x = ipdwpt(H,G,Vx,INFO,rm)

Description

x = ipdwpt(H,G,Vx,INFO) computes the periodic dicrete wavelet packet decomposition of a vector Vx where the wavelet packet coefficients are stored. H and G are frequency responses of the lowpass and highpass synthesis filters. INFO is a matrix containing information on the decomposition:

- 1st row: index of the beginning of the signals in Vx
- 2nd row: signals length

x = ipdwpt(H,G,Vx,INFO,rm) computes the periodic dicrete wavelet packet decomposition up to the resolution level rm.

Algorithm

See DWPT algorithm

See also

PDWPT in the GDR Wavelet Toolbox.

Authors

H. Carfantan, H. Krim and J-C. Pesquet.

References

[1] R. R. Coifman and M. V. Wickerhauser, Best-adapted wavelet packet bases, preprint, Yale University.

[2] Yves Meyer and M. V. Wickhauser, Acoustic signal compression with wavelet packets, preprint, Yale University, August, 1989.

pdwpt

Purpose

Periodic discrete wavelet packet decomposition

Synopsis

[Vx,INFO] = pdwpt(H,G,x,ncost)

[Vx,INFO] = pdwpt(H,G,x,ncost,rm)

[Vx,INFO] = pdwpt(H,G,x,ncost,rm,enerthresh)

[Vx,INFO] = pdwpt(H,G,x,ncost,rm,enerthresh,entthresh)

Description

[Vx,INFO] = pdwpt(H,G,x,ncout) computes the periodic discrete wavelet packet decomposition of signal x relative to the cost function "ncost". H and G are the frequency responses of the analysis lowpass and highpass filters. INFO is a matrix which manages the wavelet packet decomposition: each column contains information on each signal of Vx. There are $2^{(rm+1)}$-1 columns. Each row contains information of a different type:

- 1st row : index of the beginning of the signal in Vx.
- 2nd row : signal length.

[Vx,INFO] = pdwpt(H,G,x,ncost,rm) computes the periodic discrete wavelet packet decomposition up to the resolution rm. rm is the highest resolution (default value: LOWPOW2(x)).

[Vx,INFO] = pdwpt(H,G,x,ncost,rm,enerthresh) computes the periodic discrete wavelet packet decomposition up to the resolution rm. If the energy of the signal is below the energy threshold "enerthresh" then the signal is no more decomposed.

[Vx,INFO] = pdwpt(H,G,x,ncost,rm,enerthresh,entthresh) computes the periodic discrete wavelet packet decomposition up to the resolution rm. if the energy of the signal is below the energy threshold then the signal is no more decomposed. The same thing happens if the entropic cost of the signal is below the entropic threshold "entthresh".

Algorithm

See DWPT algorithm

See also

IPDWPT in the GDR Wavelet Toolbox.

Authors

H. Carfantan, H. Krim and J-C. Pesquet.

References

[1] R. R. Coifman and M. V. Wickerhauser, Best-adapted wavelet packet bases, preprint, Yale University.

[2] Yves Meyer and M. V. Wickhauser, Acoustic signal compression with wavelet packets, preprint, Yale University, August, 1989.

Design Tools

Contents

exmeyer

Purpose

Example function to construct Meyer's wavelet

Synopsis

y = exmeyer(f)

Description

y = exmeyer(f) constructs Meyer's wavelet . f is the vector of inputs between 0 and 1.

Algorithm

Meyer's wavelet is reconstructed using the following formula :

$y = 1 - \exp(al/(f-1)^2)$, al< 0, 0 <= f <= 1.

If f = 0 then y = 1/sqrt(2) and if f = 1 then y = 1.

See also

FRMEYER in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

freqcqf

Purpose

Complex conjugate frequency response of a filter

Synopsis

G = freqcqf(H,P,t)

Description

G = freqcqf(H,P,t) computes the frequency response G which is the complex conjugate of filter H , P is the delay (default value: 0) and t is the phase shift (default value: 0).

Algorithm

The frequency response G is computed using the following formula :

G(F) = exp(-j(2P+1)F+t) conj(H(F+1/2))

where : H: lowpass filter samples
F: frequency
P: delay
t: phase shift.

See also

QMF in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

frmeyer

Purpose

Frequency response of Meyer's QMF filter

Synopsis

H = frmeyer(N,ga,ep)

Description

H = frmeyer(N,ga,ep) returns the frequency response of the lowpass QMF filter corresponding to Meyer's wavelet. N is the number of samples, ga is function allowing to construct the wavelet, it must return values between 1/sqrt(2) and 1 for arguments between 0 and 1 and ep is a parameter between 0 and 1/6 : a small value ensures a good frequency localization (default value : 1/6).

See also

EXMEYER in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

frsplis

Purpose

Frequency responses of lowpass B-spline symmetric wavelet filters

Synopsis

H = frsplis(N,r)

Description

H = frsplis(N,r) computes the frequency response of lowpass QMFfilters corresponding to B-spline symmetric wavelets with order r. N is the number of samples of H.

See also

IRSPLIS in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

gene_pw

Purpose

Generation of filters H and G for periodic discrete wavelet decomposition

Synopsis

[H,G] = gene_pw (N,TYP)

[H,G] = gene_pw (N,TYP,RM)

Description

[H,G] = gene_pw (N,TYP) returns the frequency responses of the lowpass and highpass filters which allow to reconstruct each multiresolution level. N is the data length and TYP is the wavelet type. The resolution level is by default set to NEXTPOW2(N).

[H,G] = gene_pw (N,TYP,RM) allows to specify the resolution level RM.

See also

QMF in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

irdaub

Purpose

Impulse response of Daubechies wavelet filters

Synopsis

h = irdaub(n)

Description

h = irdaub(n) computes the impulse responses of the lowpass QMF filters with minimum phase and length n, allowing to generate Daubechies wavelets. n should be an integer number greater than 0. n = 1 corresponds to the Haar basis. h is 2*n long.

See also

IRSPLIS in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

References

[1] I. Daubechies, "Orthonormal Bases of Compactly Supported Wavelets," Comm. in Pure and Applied Math., vol. 41, pp. 909-996, 1988.

irsplis

Purpose

Impulse response of lowpass B-spline symmetric wavelet filters

Synopsis

[h,th] = irsplis(N,r)

Description

[h,th] = irsplis(N,r) computes the impulse responses of lowpass QMF filters allowing to generate B-spline symmetric wavelets. N is the number of samples (should be chosen large enough to avoid truncation troubles), r is the spline order and th is the starting time of h.

See also

IRDAUB, FRSPLIS in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

pdwav

Purpose

Generation of discrete periodic wavelets and scaling functions

Synopsis

x = pdwav(H,G,N,R,T,TYP)

Description

x = pdwav(H,G,N,R,T) generates the discrete periodic wavelets and scaling functions corresponding to the lowpass and highpass filters whose frequency responses are given by H and G. N is the length of X, R is the highest resolution and T is the time position for the frequency bandwidth from 0 to $N/2^{(R-1)}$. By choosing R large enough the continuous functions are approximated.

x = pdwav(H,G,N,R,T,TYP) allows to specify the wavelet type. TYP is the wavelet type. if TYP= 'a', then the scaling function is computed, otherwise the wavelet function is computed.

See also

GENE_PW in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim

References

[2] I. Daubechies, "Orthonormal Bases of Compactly Supported Wavelets," Comm. in Pure and Applied Math., vol. 41, pp. 909-996, 1988.

pdwavp

Purpose

Generation of discrete periodic wavelet packets

Synopsis

x = pdwavp(H,G,N,R,p,t)

Description

x = pdwavp(H,G,N,R,p,t) generates the discrete wavelet packets corresponding to the lowpass and highpass filters whose frequency responses are given by H and G. N is the signal length, R is the maximum resolution level, p is the position of the frequency band from 0 to 2^R -1 and t is the time position of the frequency band from 0 to $N/2^R$ -1.

See also

PDWAV in the GDR Wavelet Toolbox.

Authors

H. Carfantan, H. Krim and J-C. Pesquet.

References

[1] R. R. Coifman and M. V. Wickerhauser, Best-adapted wavelet packet bases, preprint, Yale University, February.

[2] Yves Meyer and M. V. Wickhauser, Acoustic signal compression with wavelet packets, preprint, Yale University, August, 1989.

qmf

Purpose

Conjugate quadrature mirror filter

Synopsis

g = qmf(h)

Description

g=qmf(h) computes the conjugate quadrature mirror filter of a filter whose impulse response is given by h.

See also

FREQCQF in the GDR Wavelet Toolbox.

Authors

J-C. Pesquet and H. Krim