NAG Library Function Document

nag_idwt_2d (c09ebc)

1 Purpose

nag_idwt_2d (c09ebc) computes the inverse two-dimensional discrete wavelet transform (DWT) at a single level. The initialization function nag_wfilt_2d (c09abc) must be called first to set up the DWT options.

2 Specification

```
#include <nag.h>
#include <nagc09.h>
void nag_idwt_2d (Integer m, Integer n, const double ca[], Integer ldca,
     const double ch[], Integer ldch, const double cv[], Integer ldcv,
     const double cd[], Integer ldcd, double b[], Integer ldb,
     const Integer icomm[], NagError *fail)
```

3 Description

nag_idwt_2d (c09ebc) performs the inverse operation of function nag_dwt_2d (c09eac). That is, given sets of approximation, horizontal, vertical and diagonal coefficients computed by function nag_dwt_2d (c09eac) using a DWT as set up by the initialization function nag_wfilt_2d (c09abc), on a real matrix, B, nag_idwt_2d (c09ebc) will reconstruct B.

4 References

None.

5 Arguments

1: **m** – Integer *Input*

On entry: number of rows, m, of data matrix B.

Constraint: this must be the same as the value **m** passed to the initialization function nag_wfilt_2d (c09abc).

2: **n** – Integer *Input*

On entry: number of columns, n, of data matrix B.

Constraint: this must be the same as the value **n** passed to the initialization function nag_wfilt_2d (c09abc).

3: **ca**$[dim]$ – const double *Input*

Note: the dimension, *dim*, of the array **ca** must be at least **ldca** $\times n_{\text{cn}}$ where n_{cn} is the argument **nwcn** returned by function nag_wfilt_2d (c09abc).

The (i,j)th element of the matrix is stored in **ca**$[(j-1) \times$ **ldca** $+ i - 1]$.

On entry: contains the n_{cm} by n_{cn} matrix of approximation coefficients, C_a. This array will normally be the result of some transformation on the coefficients computed by function nag_dwt_2d (c09eac).

4: **ldca** – Integer *Input*

On entry: the stride separating matrix row elements in the array **ca**.

Constraint: **ldca** $\geq n_{\mathrm{cm}}$ where $n_{\mathrm{cm}} = n_{\mathrm{ct}}/(4n_{\mathrm{cn}})$ and n_{cn}, n_{ct} are returned by the initialization function nag_wfilt_2d (c09abc).

5: **ch**$[dim]$ – const double *Input*

Note: the dimension, *dim*, of the array **ch** must be at least **ldch** $\times n_{\mathrm{cn}}$ where n_{cn} is the argument **nwcn** returned by function nag_wfilt_2d (c09abc).

The (i,j)th element of the matrix is stored in **ch**$[(j-1) \times$ **ldch** $+ i - 1]$.

On entry: contains the n_{cm} by n_{cn} matrix of horizontal coefficients, C_h. This array will normally be the result of some transformation on the coefficients computed by function nag_dwt_2d (c09eac).

6: **ldch** – Integer *Input*

On entry: the stride separating matrix row elements in the array **ch**.

Constraint: **ldch** $\geq n_{\mathrm{cm}}$ where $n_{\mathrm{cm}} = n_{\mathrm{ct}}/(4n_{\mathrm{cn}})$ and n_{cn}, n_{ct} are returned by the initialization function nag_wfilt_2d (c09abc).

7: **cv**$[dim]$ – const double *Input*

Note: the dimension, *dim*, of the array **cv** must be at least **ldcv** $\times n_{\mathrm{cn}}$ where n_{cn} is the argument **nwcn** returned by function nag_wfilt_2d (c09abc).

The (i,j)th element of the matrix is stored in **cv**$[(j-1) \times$ **ldcv** $+ i - 1]$.

On entry: contains the n_{cm} by n_{cn} matrix of vertical coefficients, C_v. This array will normally be the result of some transformation on the coefficients computed by function nag_dwt_2d (c09eac).

8: **ldcv** – Integer *Input*

On entry: the stride separating matrix row elements in the array **cv**.

Constraint: **ldcv** $\geq n_{\mathrm{cm}}$ where $n_{\mathrm{cm}} = n_{\mathrm{ct}}/(4n_{\mathrm{cn}})$ and n_{cn}, n_{ct} are returned by the initialization function nag_wfilt_2d (c09abc).

9: **cd**$[dim]$ – const double *Input*

Note: the dimension, *dim*, of the array **cd** must be at least **ldcd** $\times n_{\mathrm{cn}}$ where n_{cn} is the argument **nwcn** returned by function nag_wfilt_2d (c09abc).

The (i,j)th element of the matrix is stored in **cd**$[(j-1) \times$ **ldcd** $+ i - 1]$.

On entry: contains the n_{cm} by n_{cn} matrix of diagonal coefficients, C_d. This array will normally be the result of some transformation on the coefficients computed by function nag_dwt_2d (c09eac).

10: **ldcd** – Integer *Input*

On entry: the stride separating matrix row elements in the array **cd**.

Constraint: **ldcd** $\geq n_{\mathrm{cm}}$ where $n_{\mathrm{cm}} = n_{\mathrm{ct}}/(4n_{\mathrm{cn}})$ and n_{cn}, n_{ct} are returned by the initialization function nag_wfilt_2d (c09abc).

11: **b**[**ldb** $\times$ **n**] – double *Output*

Note: the (i,j)th element of the matrix B is stored in **b**$[(j-1) \times$ **ldb** $+ i - 1]$.

On exit: the m by n reconstructed matrix, B, based on the input approximation, horizontal, vertical and diagonal coefficients and the transform options supplied to the initialization function nag_wfilt_2d (c09abc).

12: **ldb** – Integer *Input*

On entry: the stride separating matrix row elements in the array **b**.

Constraint: **ldb** $\geq$ **m**.

13: **icomm**[**180**] – const Integer *Communication Array*

On entry: contains details of the discrete wavelet transform and the problem dimension as setup in the call to the initialization function nag_wfilt_2d (c09abc).

14: **fail** – NagError * *Input/Output*

The NAG error argument (see Section 3.6 in the Essential Introduction).

6 Error Indicators and Warnings

NE_ALLOC_FAIL

Dynamic memory allocation failed.

NE_BAD_PARAM

On entry, argument ⟨*value*⟩ had an illegal value.

NE_INITIALIZATION

Either the initialization function has not been called first or **icomm** has been corrupted.

Either the initialization function was called with **wtrans** = Nag_MultiLevel or **icomm** has been corrupted.

NE_INT

On entry, **ldca** = ⟨*value*⟩.
Constraint: **ldca** $\geq$ ⟨*value*⟩, the number of wavelet coefficients in the first dimension.

On entry, **ldcd** = ⟨*value*⟩.
Constraint: **ldcd** $\geq$ ⟨*value*⟩, the number of wavelet coefficients in the first dimension.

On entry, **ldch** = ⟨*value*⟩.
Constraint: **ldch** $\geq$ ⟨*value*⟩, the number of wavelet coefficients in the first dimension.

On entry, **ldcv** = ⟨*value*⟩.
Constraint: **ldcv** $\geq$ ⟨*value*⟩, the number of wavelet coefficients in the first dimension.

On entry, **m** = ⟨*value*⟩.
Constraint: **m** = ⟨*value*⟩, the value of **m** on initialization (see nag_wfilt_2d (c09abc)).

On entry, **n** = ⟨*value*⟩.
Constraint: **n** = ⟨*value*⟩, the value of **n** on initialization (see nag_wfilt_2d (c09abc)).

NE_INT_2

On entry, **ldb** = ⟨*value*⟩ and **m** = ⟨*value*⟩.
Constraint: **ldb** $\geq$ **m**.

NE_INTERNAL_ERROR

An internal error has occurred in this function. Check the function call and any array sizes. If the call is correct then please contact NAG for assistance.

7 Accuracy

The accuracy of the wavelet transform depends only on the floating-point operations used in the convolution and downsampling and should thus be close to ***machine precision***.

8 Parallelism and Performance

nag_idwt_2d (c09ebc) is threaded by NAG for parallel execution in multithreaded implementations of the NAG Library.

Please consult the Users' Note for your implementation for any additional implementation-specific information.

9 Further Comments

None.

10 Example

See Section 10 in nag_dwt_2d (c09eac).