NAG Library Function Document

nag_idwt_3d (c09fbc)

1 Purpose

nag_idwt_3d (c09fbc) computes the three-dimensional inverse discrete wavelet transform (IDWT) at a single level. The initialization function nag_wfilt_3d (c09acc) must be called first to set up the DWT options.

2 Specification

```c
#include <nag.h>
#include <nagc09.h>

void nag_idwt_3d (Integer m, Integer n, Integer fr, Integer lenc,
    const double c[], double b[], Integer ldb, Integer sdb,
    const Integer icomm[], NagError *fail)
```

3 Description

nag_idwt_3d (c09fbc) performs the inverse operation of function nag_dwt_3d (c09fac). That is, given sets of wavelet coefficients computed by function nag_dwt_3d (c09fac) using a DWT as set up by the initialization function nag_wfilt_3d (c09acc), on a real data array, B, nag_idwt_3d (c09fbc) will reconstruct B.

4 References

None.

5 Arguments

1: \( m \) – Integer \( \text{Input} \)
   
   On entry: the number of rows of each two-dimensional frame.
   
   Constraint: this must be the same as the value \( m \) passed to the initialization function nag_wfilt_3d (c09acc).

2: \( n \) – Integer \( \text{Input} \)
   
   On entry: the number of columns of each two-dimensional frame.
   
   Constraint: this must be the same as the value \( n \) passed to the initialization function nag_wfilt_3d (c09acc).

3: \( fr \) – Integer \( \text{Input} \)
   
   On entry: the number two-dimensional frames.
   
   Constraint: this must be the same as the value \( fr \) passed to the initialization function nag_wfilt_3d (c09acc).

4: \( lenc \) – Integer \( \text{Input} \)
   
   On entry: the dimension of the array \( c \).
   
   Constraint: \( lenc \geq nct \), where \( nct \) is the total number of wavelet coefficients, as returned by nag_wfilt_3d (c09acc).
5: \( \text{c[lenc]} \) – const double

\textit{Input}

\textit{On entry:} the coefficients of the discrete wavelet transform. This will normally be the result of some transformation on the coefficients computed by function \texttt{nag_dwt_3d} (c09fac).

Note that the coefficients in \( c \) may be extracted according to type into three-dimensional arrays using \texttt{nag_wav_3d_coeff_ext} (c09fyc), and inserted using \texttt{nag_wav_3d_coeff_ins} (c09fzc).

6: \( b[dim] \) – double

\textit{Output}

\textit{Note:} the dimension, \( \text{dim} \), of the array \( b \) must be at least \( \text{ldb} \times \text{sdb} \times \text{fr} \).

\textit{On exit:} the \( m \) by \( n \) by \( \text{fr} \) reconstructed array, \( B \), with \( B_{ijk} \) stored in \( b[(k-1) \times \text{ldb} \times \text{sdb} + (j-1) \times \text{ldb} + i - 1] \). The reconstruction is based on the input wavelet coefficients and the transform options supplied to the initialization function \texttt{nag_wfilt_3d} (c09acc).

7: \( \text{ldb} \) – Integer

\textit{Input}

\textit{On entry:} the stride separating row elements of each of the sets of frame coefficients in the three-dimensional data stored in \( b \).

\textit{Constraint:} \( \text{ldb} \geq m \).

8: \( \text{sdb} \) – Integer

\textit{Input}

\textit{On entry:} the stride separating corresponding coefficients of consecutive frames in the three-dimensional data stored in \( b \).

\textit{Constraint:} \( \text{sdb} \geq n \).

9: \( \text{icomm[260]} \) – const Integer

\textit{Communication Array}

\textit{On entry:} contains details of the discrete wavelet transform and the problem dimension as setup in the call to the initialization function \texttt{nag_wfilt_3d} (c09acc).

10: \( \text{fail} \) – \texttt{NagError*}

\textit{Input/Output}

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

6 \ Error Indicators and Warnings

\textbf{NE_ALLOC_FAIL}

Dynamic memory allocation failed.
See Section 3.2.1.2 in the Essential Introduction for further information.

\textbf{NE_BAD_PARAM}

On entry, argument \( \langle \text{value} \rangle \) had an illegal value.

\textbf{NE_INITIALIZATION}

Either the communication array \texttt{icomm} has been corrupted or there has not been a prior call to the initialization function \texttt{nag_wfilt_3d} (c09acc).

The initialization function was called with \texttt{wtrans} = Nag_MultiLevel.

\textbf{NE_INT}

On entry, \( \text{fr} = \langle \text{value} \rangle \).
Constraint: \( \text{fr} = \langle \text{value} \rangle \), the value of \( \text{fr} \) on initialization (see \texttt{nag_wfilt_3d} (c09acc)).

On entry, \( m = \langle \text{value} \rangle \).
Constraint: \( m = \langle \text{value} \rangle \), the value of \( m \) on initialization (see \texttt{nag_wfilt_3d} (c09acc)).
On entry, \( n = \langle\text{value}\rangle \).
Constraint: \( n = \langle\text{value}\rangle \), the value of \( n \) on initialization (see nag_wfilt_3d (c09acc)).

**NE_INT_2**
On entry, \( ldb = \langle\text{value}\rangle \) and \( m = \langle\text{value}\rangle \).
Constraint: \( ldb \geq m \).
On entry, \( lenc = \langle\text{value}\rangle \) and \( nc1 = \langle\text{value}\rangle \).
Constraint: \( lenc \geq nc1 \), where \( nc1 \) is the number of DWT coefficients returned by nag_wfilt_3d (c09acc) in argument \( nwct \).
On entry, \( sdb = \langle\text{value}\rangle \) and \( n = \langle\text{value}\rangle \).
Constraint: \( sdb \geq n \).

**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.
An unexpected error has been triggered by this function. Please contact NAG.
See Section 3.6.6 in the Essential Introduction for further information.

**NE_NO_LICENCE**
Your licence key may have expired or may not have been installed correctly.
See Section 3.6.5 in the Essential Introduction for further information.

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_3d (c09fbc) is threaded by NAG for parallel execution in multithreaded implementations of the NAG Library.
Please consult the X06 Chapter Introduction for information on how to control and interrogate the OpenMP environment used within this function. Please also 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_3d (c09fac).