

# NAG Library Function Document

## nag\_imldwt (c09cdc)

### 1 Purpose

nag\_imldwt (c09cdc) computes the inverse one-dimensional multi-level discrete wavelet transform (DWT). This function reconstructs data from (possibly filtered or otherwise manipulated) wavelet transform coefficients calculated by nag\_mldwt (c09ccc) from an original set of data. The initialization function nag\_wfilt (c09aac) must be called first to set up the DWT options.

### 2 Specification

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

void nag_imldwt (Integer nwlinv, Integer lenc, const double c[], Integer n,
                double y[], const Integer icomm[], NagError *fail)
```

### 3 Description

nag\_imldwt (c09cdc) performs the inverse operation of nag\_mldwt (c09ccc). That is, given a set of wavelet coefficients, computed up to level  $n_{\text{fwd}}$  by nag\_mldwt (c09ccc) using a DWT as set up by the initialization function nag\_wfilt (c09aac), on a real data array of length  $n$ , nag\_imldwt (c09cdc) will reconstruct the data array  $y_i$ , for  $i = 1, 2, \dots, n$ , from which the coefficients were derived. If the original input dataset is level 0, then it is possible to terminate reconstruction at a higher level by specifying fewer than the number of levels used in the call to nag\_mldwt (c09ccc). This results in a partial reconstruction.

### 4 References

None.

### 5 Arguments

- 1: **nwlinv** – Integer *Input*  
*On entry:* the number of levels to be used in the inverse multi-level transform. The number of levels must be less than or equal to  $n_{\text{fwd}}$ , which has the value of argument **nwl** as used in the computation of the wavelet coefficients using nag\_mldwt (c09ccc). The data will be reconstructed to level  $(\text{nwl} - \text{nwlinv})$ , where level 0 is the original input dataset provided to nag\_mldwt (c09ccc).  
*Constraint:*  $1 \leq \text{nwlinv} \leq n_{\text{fwd}}$ , where  $n_{\text{fwd}}$  is the value used in a preceding call to nag\_mldwt (c09ccc).
- 2: **lenc** – Integer *Input*  
*On entry:* the dimension of the array **c**.  
*Constraint:* **lenc**  $\geq n_c$ , where  $n_c$  is the total number of coefficients that correspond to a transform with **nwlinv** levels and is unchanged from the preceding call to nag\_mldwt (c09ccc).
- 3: **c[lenc]** – const double *Input*  
*On entry:* the coefficients of a multi-level wavelet transform of the dataset.

Let  $q(i)$  be the number of coefficients (of each type) at level  $i$ , for  $i = n_{\text{fwd}}, n_{\text{fwd}} - 1, \dots, 1$ . Then, setting  $k_1 = q(n_{\text{fwd}})$  and  $k_{j+1} = k_j + q(n_{\text{fwd}} - j + 1)$ , for  $j = 1, 2, \dots, n_{\text{fwd}}$ , the coefficients are stored in **c** as follows:

**c**[ $i - 1$ ], for  $i = 1, 2, \dots, k_1$   
 Contains the level  $n_{\text{fwd}}$  approximation coefficients,  $a_{n_{\text{fwd}}}$ .

**c**[ $i - 1$ ], for  $i = k_1 + 1, \dots, k_2$   
 Contains the level  $n_{\text{fwd}}$  detail coefficients  $d_{n_{\text{fwd}}}$ .

**c**[ $i - 1$ ], for  $i = k_j + 1, \dots, k_{j+1}$   
 Contains the level  $n_{\text{fwd}} - j + 1$  detail coefficients, for  $j = 2, 3, \dots, n_{\text{fwd}}$ .

The values  $q(i)$ , for  $i = n_{\text{fwd}}, n_{\text{fwd}} - 1, \dots, 1$ , are contained in **dwtle** which is produced as output by a preceding call to **nag\_mldwt** (c09ccc). See **nag\_mldwt** (c09ccc) for details.

4: **n** – Integer *Input*

*On entry:*  $n$ , the length of the data array,  $y$ , to be reconstructed. For a full reconstruction of **nwl** levels, where **nwl** is as supplied to **nag\_mldwt** (c09ccc), this must be the same as argument **n** used in the call to **nag\_mldwt** (c09ccc). For a partial reconstruction of **nwl** $_{\text{linv}} < \text{nwl}$ , this must be equal to **dwtle**[**nwl** $_{\text{linv}} + 1$ ], as returned from **nag\_mldwt** (c09ccc).

5: **y**[**n**] – double *Output*

*On exit:* the dataset reconstructed from the multi-level wavelet transform coefficients and the transformation options supplied to the initialization function **nag\_wfilt** (c09aac).

6: **icomm**[100] – const Integer *Communication Array*

*On entry:* contains details of the discrete wavelet transform and the problem dimension for the forward transform previously computed by **nag\_mldwt** (c09ccc).

7: **fail** – NagError \* *Input/Output*

The NAG error argument (see Section 2.7 in How to Use the NAG Library and its Documentation).

## 6 Error Indicators and Warnings

### NE\_ALLOC\_FAIL

Dynamic memory allocation failed.

See Section 3.2.1.2 in How to Use the NAG Library and its Documentation for further information.

### NE\_ARRAY\_DIM\_LEN

On entry, **lenc** is set too small: **lenc** =  $\langle \text{value} \rangle$ .

Constraint: **lenc**  $\geq \langle \text{value} \rangle$ .

### NE\_BAD\_PARAM

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

### NE\_INITIALIZATION

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

Either the initialization function was called with **wtrans** = Nag\_SingleLevel or array **icomm** has been corrupted.

On entry, **n** is inconsistent with the value passed to the initialization function: **n** =  $\langle \text{value} \rangle$ , **n** should be  $\langle \text{value} \rangle$ .

**NE\_INT\_2**

On entry, **nwlinv** =  $\langle value \rangle$ .

Constraint: **nwlinv**  $\geq$  1.

On entry, **nwlinv** is larger than the number of levels computed by the preceding call to nag\_mldwt (c09ccc): **nwlinv** =  $\langle value \rangle$ , expected =  $\langle value \rangle$ .

**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 How to Use the NAG Library and its Documentation 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 How to Use the NAG Library and its Documentation 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\_imldwt (c09cdc) is not threaded in any implementation.

**9 Further Comments**

None.

**10 Example**

See Section 10 in nag\_mldwt (c09ccc).

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