NAG Library Routine Document

C09CDF

Note: before using this routine, please read the Users' Note for your implementation to check the interpretation of ***bold italicised*** terms and other implementation-dependent details.

1 Purpose

C09CDF computes the inverse one-dimensional multi-level discrete wavelet transform (DWT). This routine reconstructs data from (possibly filtered or otherwise manipulated) wavelet transform coefficients calculated by C09CCF from an original set of data. The initialization routine C09AAF must be called first to set up the DWT options.

2 Specification

```
SUBROUTINE C09CDF(NWL, LENC, C, N, Y, ICOMM, IFAIL)
INTEGER           NWL, LENC, N, ICOMM(100), IFAIL
double precision  C(LENC), Y(N)
```

3 Description

C09CDF performs the inverse operation of C09CCF. That is, given a set of wavelet coefficients, computed by C09CCF using a DWT as set up by the initialization routine C09AAF, on a real data array of length n, C09CDF will reconstruct the data array y_i, for $i = 1, 2, \ldots, n$, from which the coefficients were derived.

4 References

None.

5 Parameters

1: NWL – INTEGER *Input*

On entry: the number, n_l, of levels to be used in the inverse multi-level transform. The number of levels must be the same as the number used in the computation of the wavelet coefficients.

Constraint: NWL $= n_l$, where n_l is the value of NWL used in a preceding call to C09CCF.

2: LENC – INTEGER *Input*

On entry: the dimension of the array C as declared in the (sub)program from which C09CDF is called.

Constraint: LENC $\geq n_c$, where n_c is the number of approximation and detail coefficients that correspond to a transform with NWL levels and is unchanged from the preceding call to C09CCF.

3: C(LENC) – ***double precision*** array *Input*

On entry: the coefficients of a multi-level wavelet transform of the dataset.

If $n\left(a_{n_l}\right)$ and $n(d_i)$, for $i = n_l, n_l - 1, \ldots, 1$, are the numbers of approximation and detail coefficients, then setting $k_1 = n\left(a_{n_l}\right)$ and $k_{j+1} = n\left(a_{n_l}\right) + \sum_{i=1}^{j} n\left(d_{n_l - i + 1}\right)$, for $j = 1, 2, \ldots, n_l$, the coefficients are stored in C as follows:

C$(1 : k_1)$
Contains the level n_l approximation coefficients, a_{n_l}.

C($k_1 + 1 : k_2$)
Contains the level n_l detail coefficients d_{n_l}.

C($k_j + 1 : k_{j+1}$)
Contains the level $n_l - j + 1$ detail coefficients, for $j = 2, \ldots, n_l$.

The values $n\left(a_{n_l}\right)$ and $n\left(d_{n_l-i+1}\right)$, for $i = 1, 2, \ldots, n_l$ are contained in DWTLEV which is produced as output by a preceding call to C09CCF. See C09CCF for details.

4: N – INTEGER *Input*

On entry: n, the length of the data array, y, to be reconstructed.

Constraint: This must be the same as the value N passed to the initialization routine C09AAF.

5: Y(N) – ***double precision*** array *Output*

On exit: the dataset reconstructed from the multi-level wavelet transform coefficients and the transformation options supplied to the initialization routine C09AAF.

6: ICOMM(100) – INTEGER array *Communication Array*

On entry: contains details of the discrete wavelet transform and the problem dimension for the forward transform previously computed by C09CCF.

7: IFAIL – INTEGER *Input/Output*

On entry: IFAIL must be set to 0, -1 or 1. If you are unfamiliar with this parameter you should refer to Section 3.3 in the Essential Introduction for details.

On exit: IFAIL $= 0$ unless the routine detects an error (see Section 6).

For environments where it might be inappropriate to halt program execution when an error is detected, the value -1 or 1 is recommended. If the output of error messages is undesirable, then the value 1 is recommended. Otherwise, if you are not familiar with this parameter, the recommended value is 0. **When the value -1 or 1 is used it is essential to test the value of IFAIL on exit.**

6 Error Indicators and Warnings

If on entry IFAIL $= 0$ or -1, explanatory error messages are output on the current error message unit (as defined by X04AAF).

Errors or warnings detected by the routine:

IFAIL $= 1$

On entry, NWL < 1,
or NWL $> n_l$, the maximum number of levels as returned in NWL by the call to the initialization routine C09AAF.
or NWL $>$ the number of levels used in the computation of the wavelet coefficients by a call to C09CCF.

IFAIL $= 2$

On entry, LENC is too small. LENC must be at least the number of wavelet coefficients required for a transform operating on NWL levels. If NWL $= n_l$, the maximum number of levels as returned in NWL by the initial call to C09AAF, then LENC must be at least n_c, the value returned in NWC by the same call to C09AAF.

IFAIL $= 4$

On entry, N is inconsistent with the value passed in the call to the initialization routine C09AAF.

IFAIL = 6

On entry, the initialization routine C09AAF has not been called first or it has been called with WTRANS = 'S', or the communication array ICOMM has become corrupted.

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 Further Comments

None.

9 Example

See Section 9 in C09CCF.