NAG Library Routine Document

C09DDF

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

C09DDF computes the inverse one-dimensional multi-level maximal overlap discrete wavelet transform (MODWT). This routine reconstructs data from (possibly filtered or otherwise manipulated) wavelet transform coefficients calculated by C09DCF from an original set of data. The initialization routine C09AAF must be called first to set up the MODWT options.

2 Specification

```
SUBROUTINE C09DDF (NWLINV, KEEPA, LENC, C, N, Y, ICOMM, IFAIL)
INTEGER            NWLINV, LENC, N, ICOMM(100), IFAIL
REAL (KIND=nag_wp) C(LENC), Y(N)
CHARACTER(1)       KEEPA
```

3 Description

C09DDF performs the inverse operation of C09DCF. That is, given a set of wavelet coefficients computed by C09DCF using a MODWT as set up by the initialization routine C09AAF on a real array of length n, C09DDF will reconstruct the data array y_i, for $i = 1, 2, \ldots, n$, from which the coefficients were derived.

4 References

Percival D B and Walden A T (2000) *Wavelet Methods for Time Series Analysis* Cambridge University Press

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_{fwd}, which has the value of argument NWL as used in the computation of the wavelet coefficients using C09DCF. The data will be reconstructed to level (NWL − NWLINV), where level 0 is the original input dataset provided to C09DCF.

Constraint: $1 \leq \text{NWLINV} \leq \text{NWL}$, where NWL is the value used in a preceding call to C09DCF.

2: KEEPA – CHARACTER(1) *Input*

On entry: determines whether the approximation coefficients are stored in array C for every level of the computed transform or else only for the final level. In both cases, the detail coefficients are stored in C for every level computed.

KEEPA = 'A'
Retain approximation coefficients for all levels computed.

KEEPA = 'F'
Retain approximation coefficients for only the final level computed.

Constraint: KEEPA = 'A' or 'F'.

3: LENC – INTEGER *Input*

On entry: the dimension of the array C as declared in the (sub)program from which C09DDF is called.

Constraints:

if KEEPA = 'F', LENC $\geq (n_l + 1) \times n_a$;
if KEEPA = 'A', LENC $\geq 2 \times n_l \times n_a$, where n_a is the number of approximation or detail coefficients at each level and is unchanged from the preceding call to C09DCF.

4: C(LENC) – REAL (KIND=nag_wp) array *Input*

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

The coefficients are stored in C as follows:

If KEEPA = 'F',

C$(1 : n_a)$
Contains the level n_l approximation coefficients;

C$(n_a + (i-1) \times n_d + 1 : n_a + i \times n_d)$
Contains the level $(n_l - i + 1)$ detail coefficients, for $i = 1, 2, \ldots, n_l$;

If KEEPA = 'A',

C$((i-1) \times n_a + 1 : i \times n_a)$
Contains the level $(n_l - i + 1)$ approximation coefficients, for $i = 1, 2, \ldots, n_l$;

C$(n_l \times n_a + (i-1) \times n_d + 1 : n_l \times n_a + i \times n_d)$
Contains the level i detail coefficients, for $i = 1, 2, \ldots, n_l$.

The values n_a and n_d denote the numbers of approximation and detail coefficients respectively, which are equal. This number is returned as output in NA from a preceding call to C09DCF. See C09DCF for details.

5: 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.

6: Y(N) – REAL (KIND=nag_wp) array *Output*

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

7: 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 C09DCF.

8: IFAIL – INTEGER *Input/Output*

On entry: IFAIL must be set to 0, -1 or 1. If you are unfamiliar with this argument you should refer to Section 3.4 in How to Use the NAG Library and its Documentation for details.

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 argument, the recommended value is 0. **When the value -1 or 1 is used it is essential to test the value of IFAIL on exit.**

On exit: IFAIL = 0 unless the routine detects an error or a warning has been flagged (see Section 6).

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, NWLINV $= \langle value \rangle$.
Constraint: NWLINV ≥ 1.

On entry, NWLINV is larger than the number of levels computed by the preceding call to C09DCF: NWLINV $= \langle value \rangle$, expected $\langle value \rangle$.

IFAIL $= 2$

On entry, KEEPA $= \langle value \rangle$ was an illegal value.

IFAIL $= 3$

On entry, LENC is set too small: LENC $= \langle value \rangle$.
Constraint: LENC $\geq \langle value \rangle$.

IFAIL $= 5$

On entry, N is inconsistent with the value passed to the initialization routine: N $= \langle value \rangle$, N should be $\langle value \rangle$.

IFAIL $= 7$

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

IFAIL $= -99$

An unexpected error has been triggered by this routine. Please contact NAG.

See Section 3.9 in How to Use the NAG Library and its Documentation for further information.

IFAIL $= -399$

Your licence key may have expired or may not have been installed correctly.

See Section 3.8 in How to Use the NAG Library and its Documentation for further information.

IFAIL $= -999$

Dynamic memory allocation failed.

See Section 3.7 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

C09DDF is not threaded in any implementation.

9 Further Comments

None.

10 Example

See Section 10 in C09DCF.