NAG Fortran Library Routine Document

C06GBF

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

C06GBF forms the complex conjugate of a Hermitian sequence of n data values.

2 Specification

```
SUBROUTINE C06GBF(X, N, IFAIL)
INTEGER          N, IFAIL
real             X(N)
```

3 Description

This is a utility routine for use in conjunction with C06EAF, C06EBF, C06FAF or C06FBF to calculate inverse discrete Fourier transforms (see the C06 Chapter Introduction).

4 References

None.

5 Parameters

1: X(N) – **_real_** array   *Input/Output*

On entry: if the data values z_j are written as $x_j + iy_j$ and if X is declared with bounds $(0 : N - 1)$ in the (sub)program from which C06GBF is called, then for $0 \le j \le n/2$, $X(j)$ must contain x_j $(= x_{n-j})$, while for $n/2 < j \le n - 1$, $X(j)$ must contain $-y_j$ $(= y_{n-j})$. In other words, X must contain the Hermitian sequence in Hermitian form. (See also Section 2.1.2 of the C06 Chapter Introduction.)

On exit: the imaginary parts y_j are negated. The real parts x_j are not referenced.

2: N – INTEGER   *Input*

On entry: the number of data values, n.

Constraint: $N \ge 1$.

3: IFAIL – INTEGER   *Input/Output*

On entry: IFAIL must be set to 0, -1 or 1. Users who are unfamiliar with this parameter should refer to Chapter P01 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, for users 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 $= 1$

> $N < 1$.

7 Accuracy

Exact.

8 Further Comments

The time taken by the routine is negligible.

9 Example

This program reads in a sequence of real data values, calls C06EAF followed by C06GBF to compute their inverse discrete Fourier transform, and prints this after expanding it from Hermitian form into a full complex sequence.

9.1 Program Text

Note: the listing of the example program presented below uses ***bold italicised*** terms to denote precision-dependent details. Please read the Users' Note for your implementation to check the interpretation of these terms. As explained in the Essential Introduction to this manual, the results produced may not be identical for all implementations.

```
*     C06GBF Example Program Text
*     Mark 14 Revised.  NAG Copyright 1989.
*     .. Parameters ..
      INTEGER          NMAX
      PARAMETER        (NMAX=20)
      INTEGER          NIN, NOUT
      PARAMETER        (NIN=5,NOUT=6)
*     .. Local Scalars ..
      INTEGER          IFAIL, J, N, N2, NJ
*     .. Local Arrays ..
      real             A(0:NMAX-1), B(0:NMAX-1), X(0:NMAX-1)
*     .. External Subroutines ..
      EXTERNAL         C06EAF, C06GBF
*     .. Intrinsic Functions ..
      INTRINSIC        MOD
*     .. Executable Statements ..
      WRITE (NOUT,*) 'C06GBF Example Program Results'
*     Skip heading in data Ûle
      READ (NIN,*)
   20 READ (NIN,*,END=100) N
      IF (N.GT.1 .AND. N.LT.NMAX) THEN
         DO 40 J = 0, N - 1
            READ (NIN,*) X(J)
   40    CONTINUE
         IFAIL = 0
*
         CALL C06EAF(X,N,IFAIL)
         CALL C06GBF(X,N,IFAIL)
*
         WRITE (NOUT,*)
         WRITE (NOUT,*)
     +     'Components of inverse discrete Fourier transform'
         WRITE (NOUT,*)
         WRITE (NOUT,*) '          Real      Imag'
         WRITE (NOUT,*)
```

```
         A(0) = X(0)
         B(0) = 0.0e0
         N2 = (N-1)/2
         DO 60 J = 1, N2
            NJ = N - J
            A(J) = X(J)
            A(NJ) = X(J)
            B(J) = X(NJ)
            B(NJ) = -X(NJ)
  60     CONTINUE
         IF (MOD(N,2).EQ.0) THEN
            A(N2+1) = X(N2+1)
            B(N2+1) = 0.0e0
         END IF
         DO 80 J = 0, N - 1
            WRITE (NOUT,99999) J, A(J), B(J)
  80     CONTINUE
         GO TO 20
      ELSE
         WRITE (NOUT,*) 'Invalid value of N'
      END IF
  100 STOP
*
99999 FORMAT (1X,I6,2F10.5)
      END
```

9.2   Program Data

```
C06GBF Example Program Data
   7
 0.34907
 0.54890
 0.74776
 0.94459
 1.13850
 1.32850
 1.51370
```

9.3   Program Results

```
 C06GBF Example Program Results

 Components of inverse discrete Fourier transform

          Real       Imag

     0   2.48361    0.00000
     1  -0.26599   -0.53090
     2  -0.25768   -0.20298
     3  -0.25636   -0.05806
     4  -0.25636    0.05806
     5  -0.25768    0.20298
     6  -0.26599    0.53090
```