

## nag\_multiple\_conjugate\_hermitian (c06gqc)

### 1. Purpose

**nag\_multiple\_conjugate\_hermitian (c06gqc)** forms the complex conjugates of  $m$  Hermitian sequences, each containing  $n$  data values.

### 2. Specification

```
#include <nag.h>
#include <nagc06.h>
```

```
void nag_multiple_conjugate_hermitian(Integer m, Integer n, double x[],
    NagError *fail)
```

### 3. Description

This is a utility routine for use in conjunction with **nag\_fft\_multiple\_real (c06fpc)** and **nag\_fft\_multiple\_hermitian (c06fqc)** to calculate inverse discrete Fourier transforms.

### 4. Parameters

**m**

Input: the number of Hermitian sequences to be conjugated,  $m$ .  
Constraint: **m**  $\geq 1$ .

**n**

Input: the number of data values in each Hermitian sequence,  $n$ .  
Constraint: **n**  $\geq 1$ .

**x[m\*n]**

Input: the  $m$  data sequences must be stored in **x** consecutively. If the  $n$  data values  $z_j^p$  are written as  $x_j^p + iy_j^p$ ,  $p = 1, 2, \dots, m$ , then for  $0 \leq j \leq n/2$ ,  $x_j^p$  is contained in **x**[( $p-1$ ) \*  $n + j$ ], and for  $1 \leq j \leq (n-1)/2$ ,  $y_j^p$  is contained in **x**[( $p-1$ ) \*  $n + n - j$ ].  
Output: the imaginary parts  $y_j^p$  are negated. The real parts  $x_j^p$  are not referenced.

**fail**

The NAG error parameter, see the Essential Introduction to the NAG C Library.

### 5. Error Indications and Warnings

**NE\_INT\_ARG\_LT**

On entry, **m** must not be less than 1: **m** =  $\langle \text{value} \rangle$ .  
On entry, **n** must not be less than 1: **n** =  $\langle \text{value} \rangle$ .

### 6. Further Comments

#### 6.1. Accuracy

Exact.

### 7. See Also

**nag\_fft\_multiple\_real (c06fpc)**  
**nag\_fft\_multiple\_hermitian (c06fqc)**

### 8. Example

This program reads in sequences of real data values which are assumed to be Hermitian sequences of complex data stored in Hermitian form. The sequences are expanded into full complex form using **nag\_multiple\_hermitian\_to\_complex (c06gsc)** and printed. The sequences are then conjugated (using **nag\_multiple\_conjugate\_hermitian**) and the conjugated sequences are expanded into complex form using **nag\_multiple\_hermitian\_to\_complex (c06gsc)** and printed out.

## 8.1. Program Text

```

/* nag_multiple_conjugate_hermitian(c06gqc) Example Program
 *
 * Copyright 1990 Numerical Algorithms Group.
 *
 * Mark 1, 1990.
 */

#include <nag.h>
#include <stdio.h>
#include <nag_stdlib.h>
#include <nagc06.h>

#define MMAX 5
#define NMAX 20

main()
{
    Integer i, j, m, n;
    double u[MMAX*NMAX], v[MMAX*NMAX], x[MMAX*NMAX];

    Vprintf("c06gqc Example Program Results\n");
    /* Skip heading in data file */
    Vscanf("%*[\n]");
    while (scanf("%ld%ld", &m, &n)!=EOF)
        if (m<=MMAX && n<=NMAX)
        {
            Vprintf("\n\nm = %2ld  n = %2ld\n", m, n);
            /* Read in data and print out. */
            for (j = 0; j<m; ++j)
                for (i = 0; i<n; ++i)
                    Vscanf("%lf", &x[j*n + i]);
            Vprintf("\nOriginal data values\n\n");
            for (j = 0; j<m; ++j)
            {
                Vprintf("      ");
                for (i = 0; i<n; ++i)
                    Vprintf("%10.4f%s", x[j*n + i],
                        (i%6==5 && i!=n-1 ? "\n      " : ""));
                Vprintf("\n");
            }
            /* Convert Hermitian form data to full complex */
            c06gsc(m, n, x, u, v, NAGERR_DEFAULT);
            Vprintf("\nOriginal data written in full complex form\n\n");
            for (j = 0; j<m; ++j)
            {
                Vprintf("Real");
                for (i = 0; i<n; ++i)
                    Vprintf("%10.4f%s", u[j*n + i],
                        (i%6==5 && i!=n-1 ? "\n      " : ""));
                Vprintf("\nImag");
                for (i = 0; i<n; ++i)
                    Vprintf("%10.4f%s", v[j*n + i],
                        (i%6==5 && i!=n-1 ? "\n      " : ""));
                Vprintf("\n\n");
            }
            /* Calculate conjugates of Hermitian data */
            c06gqc(m, n, x, NAGERR_DEFAULT);
            Vprintf("\nConjugated data values\n\n");
            for (j = 0; j<m; ++j)
            {
                Vprintf("      ");
                for (i = 0; i<n; ++i)
                    Vprintf("%10.4f%s", x[j*n + i],
                        (i%6==5 && i!=n-1 ? "\n      " : ""));
                Vprintf("\n");
            }
            /* Convert conjugated Hermitian data to full complex */
            c06gsc(m, n, x, u, v, NAGERR_DEFAULT);

```

```

Vprintf("\nConjugated data written in full complex form\n\n");
for (j = 0; j<m; ++j)
{
    Vprintf("Real");
    for (i = 0; i<n; ++i)
        Vprintf("%10.4f%s", u[j*n + i],
            (i%6==5 && i!=n-1 ? "\n      " : ""));
    Vprintf("\nImag");
    for (i = 0; i<n; ++i)
        Vprintf("%10.4f%s", v[j*n + i],
            (i%6==5 && i!=n-1 ? "\n      " : ""));
    Vprintf("\n\n");
}
}
else
{
    Vfprintf(stderr, "\nInvalid value of m or n.\n\n");
    exit(EXIT_FAILURE);
}
exit(EXIT_SUCCESS);
}

```

## 8.2. Program Data

c06gqc Example Program Data

|        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|
| 3      | 6      |        |        |        |        |
| 0.3854 | 0.6772 | 0.1138 | 0.6751 | 0.6362 | 0.1424 |
| 0.5417 | 0.2983 | 0.1181 | 0.7255 | 0.8638 | 0.8723 |
| 0.9172 | 0.0644 | 0.6037 | 0.6430 | 0.0428 | 0.4815 |

## 8.3. Program Results

c06gqc Example Program Results

m = 3 n = 6

Original data values

|        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|
| 0.3854 | 0.6772 | 0.1138 | 0.6751 | 0.6362 | 0.1424 |
| 0.5417 | 0.2983 | 0.1181 | 0.7255 | 0.8638 | 0.8723 |
| 0.9172 | 0.0644 | 0.6037 | 0.6430 | 0.0428 | 0.4815 |

Original data written in full complex form

|      |        |        |        |        |         |         |
|------|--------|--------|--------|--------|---------|---------|
| Real | 0.3854 | 0.6772 | 0.1138 | 0.6751 | 0.1138  | 0.6772  |
| Imag | 0.0000 | 0.1424 | 0.6362 | 0.0000 | -0.6362 | -0.1424 |
| Real | 0.5417 | 0.2983 | 0.1181 | 0.7255 | 0.1181  | 0.2983  |
| Imag | 0.0000 | 0.8723 | 0.8638 | 0.0000 | -0.8638 | -0.8723 |
| Real | 0.9172 | 0.0644 | 0.6037 | 0.6430 | 0.6037  | 0.0644  |
| Imag | 0.0000 | 0.4815 | 0.0428 | 0.0000 | -0.0428 | -0.4815 |

Conjugated data values

|        |        |        |        |         |         |
|--------|--------|--------|--------|---------|---------|
| 0.3854 | 0.6772 | 0.1138 | 0.6751 | -0.6362 | -0.1424 |
| 0.5417 | 0.2983 | 0.1181 | 0.7255 | -0.8638 | -0.8723 |
| 0.9172 | 0.0644 | 0.6037 | 0.6430 | -0.0428 | -0.4815 |

Conjugated data written in full complex form

|      |        |         |         |        |        |        |
|------|--------|---------|---------|--------|--------|--------|
| Real | 0.3854 | 0.6772  | 0.1138  | 0.6751 | 0.1138 | 0.6772 |
| Imag | 0.0000 | -0.1424 | -0.6362 | 0.0000 | 0.6362 | 0.1424 |
| Real | 0.5417 | 0.2983  | 0.1181  | 0.7255 | 0.1181 | 0.2983 |
| Imag | 0.0000 | -0.8723 | -0.8638 | 0.0000 | 0.8638 | 0.8723 |
| Real | 0.9172 | 0.0644  | 0.6037  | 0.6430 | 0.6037 | 0.0644 |
| Imag | 0.0000 | -0.4815 | -0.0428 | 0.0000 | 0.0428 | 0.4815 |