

NAG Library Function Document

nag_fft_init_trig (c06gzc)

1 Purpose

nag_fft_init_trig (c06gzc) calculates the trigonometric coefficients required for the computation of discrete Fourier transforms.

2 Specification

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

void nag_fft_init_trig (Integer n, double trig[], NagError *fail)
```

3 Description

This is a utility function for use in conjunction with nag_fft_multiple_real (c06fpc) and nag_fft_multiple_hermitian (c06fqc). nag_fft_init_trig (c06gzc) initializes the array **trig** with trigonometric coefficients according to the value of **n** and must be called prior to the first call of one of the above listed functions.

4 References

None.

5 Arguments

- | | | |
|----|---|---------------------|
| 1: | n – Integer | <i>Input</i> |
| | <i>On entry:</i> the value of n in the Fourier transform function being called. | |
| | <i>Constraint:</i> $n \geq 1$. | |
| 2: | trig [$2 \times n$] – double | <i>Output</i> |
| | <i>On exit:</i> the trigonometric coefficients are stored in trig . | |
| 3: | fail – NagError * | <i>Input/Output</i> |
| | The NAG error argument (see Section 2.7 in How to Use the NAG Library and its Documentation). | |

6 Error Indicators and Warnings

NE_INT_ARG_LT

On entry, **n** = $\langle value \rangle$.
 Constraint: $n \geq 1$.

7 Accuracy

Exact.

8 Parallelism and Performance

nag_fft_init_trig (c06gzc) is not threaded in any implementation.

9 Further Comments

None.

10 Example

The program reads in 3 real data sequences and prints their discrete Fourier transforms in Hermitian format as calculated by nag_fft_multiple_real (c06fpc). A call is made to nag_fft_init_trig (c06gzc) to initialize the array **trig** prior to calling nag_fft_multiple_real (c06fpc). The transforms are then printed out in full complex form after a call to nag_multiple_hermitian_to_complex (c06gsc).

10.1 Program Text

```
/* nag_fft_init_trig (c06gzc) Example Program.
 *
 * NAGPRODCODE Version.
 *
 * Copyright 2016 Numerical Algorithms Group.
 *
 * Mark 26, 2016.
 */

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

int main(void)
{
    Integer exit_status = 0, i, j, m, n;
    NagError fail;
    double *trig = 0, *u = 0, *v = 0, *x = 0;

    INIT_FAIL(fail);

    printf("nag_fft_init_trig (c06gzc) Example Program Results\n");
#ifdef _WIN32
    scanf_s("%*[\n]"); /* Skip heading in data file */
#else
    scanf("%*[\n]"); /* Skip heading in data file */
#endif
#ifdef _WIN32
    while (scanf_s("%" NAG_IFMT "%" NAG_IFMT "", &m, &n) != EOF)
#else
    while (scanf("%" NAG_IFMT "%" NAG_IFMT "", &m, &n) != EOF)
#endif
    {
        if (m >= 1 && n >= 1) {
            if (!(trig = NAG_ALLOC(2 * n, double)) ||
                !(u = NAG_ALLOC(m * n, double)) ||
                !(v = NAG_ALLOC(m * n, double)) || !(x = NAG_ALLOC(m * n, double)))
            {
                printf("Allocation failure\n");
                exit_status = -1;
                goto END;
            }
        }
        else {
            printf("Invalid m or n.\n");
            exit_status = 1;
        }
        printf("\n\nm = %2" NAG_IFMT "    n = %2" NAG_IFMT "\n", m, n);
        /* Read in data and print out. */
    }
}
```

```

        for (j = 0; j < m; ++j)
            for (i = 0; i < n; ++i)
#ifdef _WIN32
                scanf_s("%lf", &x[j * n + i]);
#else
                scanf("%lf", &x[j * n + i]);
#endif
    printf("\nOriginal data values\n\n");
    for (j = 0; j < m; ++j) {
        printf("    ");
        for (i = 0; i < n; ++i)
            printf("%10.4f%s", x[j * n + i],
                (i % 6 == 5 && i != n - 1 ? "\n    " : ""));
        printf("\n");
    }
    /* nag_fft_init_trig (c06gzc).
     * Initialization function for other c06 functions
     */
    nag_fft_init_trig(n, trig, &fail);
    if (fail.code != NE_NOERROR) {
        printf("Error from nag_fft_init_trig (c06gzc).\n%s\n", fail.message);
        exit_status = 1;
        goto END;
    }
    /* Initialize trig array */
    /* Calculate transform */
    /* nag_fft_multiple_real (c06fpc).
     * Multiple one-dimensional real discrete Fourier transforms
     */
    nag_fft_multiple_real(m, n, x, trig, &fail);
    if (fail.code != NE_NOERROR) {
        printf("Error from nag_fft_multiple_real (c06fpc).\n%s\n",
            fail.message);
        exit_status = 1;
        goto END;
    }

    printf("\nDiscrete Fourier transforms in Hermitian format\n\n");
    for (j = 0; j < m; ++j) {
        printf("    ");
        for (i = 0; i < n; ++i)
            printf("%10.4f%s", x[j * n + i],
                (i % 6 == 5 && i != n - 1 ? "\n    " : ""));
        printf("\n");
    }
    /* Convert Hermitian form to full complex */
    /* nag_multiple_hermitian_to_complex (c06gsc).
     * Convert Hermitian sequences to general complex sequences
     */
    nag_multiple_hermitian_to_complex(m, n, x, u, v, &fail);
    if (fail.code != NE_NOERROR) {
        printf("Error from nag_multiple_hermitian_to_complex"
            " (c06gsc).\n%s\n", fail.message);
        exit_status = 1;
        goto END;
    }

    printf("\nFourier transforms in full complex form\n\n");
    for (j = 0; j < m; ++j) {
        printf("Real");
        for (i = 0; i < n; ++i)
            printf("%10.4f%s", u[j * n + i],
                (i % 6 == 5 && i != n - 1 ? "\n    " : ""));
        printf("\nImag");
        for (i = 0; i < n; ++i)
            printf("%10.4f%s", v[j * n + i],
                (i % 6 == 5 && i != n - 1 ? "\n    " : ""));
        printf("\n\n");
    }
}
END:
    NAG_FREE(trig);

```

```

    NAG_FREE(u);
    NAG_FREE(v);
    NAG_FREE(x);
}

return exit_status;
}

```

10.2 Program Data

nag_fft_init_trig (c06gzc) 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

10.3 Program Results

nag_fft_init_trig (c06gzc) 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

Discrete Fourier transforms in Hermitian format

1.0737	-0.1041	0.1126	-0.1467	-0.3738	-0.0044
1.3961	-0.0365	0.0780	-0.1521	-0.0607	0.4666
1.1237	0.0914	0.3936	0.1530	0.3458	-0.0508

Fourier transforms in full complex form

Real	1.0737	-0.1041	0.1126	-0.1467	0.1126	-0.1041
Imag	0.0000	-0.0044	-0.3738	0.0000	0.3738	0.0044
Real	1.3961	-0.0365	0.0780	-0.1521	0.0780	-0.0365
Imag	0.0000	0.4666	-0.0607	0.0000	0.0607	-0.4666
Real	1.1237	0.0914	0.3936	0.1530	0.3936	0.0914
Imag	0.0000	-0.0508	0.3458	0.0000	-0.3458	0.0508
