

NAG Library Function Document

nag_ztr_copy (f16tec)

1 Purpose

nag_ztr_copy (f16tec) copies a complex triangular matrix.

2 Specification

```
#include <nag.h>
#include <nagf16.h>

void nag_ztr_copy (Nag_OrderType order, Nag_UploType uplo,
                  Nag_TransType trans, Nag_DiagType diag, Integer n, const Complex a[],
                  Integer pda, Complex b[], Integer pdb, NagError *fail)
```

3 Description

nag_ztr_copy (f16tec) performs the triangular matrix copy operations

$$B \leftarrow A, \quad B \leftarrow A^T \quad \text{or} \quad B \leftarrow A^H$$

where A and B are n by n complex triangular matrices.

4 References

Basic Linear Algebra Subprograms Technical (BLAST) Forum (2001) *Basic Linear Algebra Subprograms Technical (BLAST) Forum Standard* University of Tennessee, Knoxville, Tennessee <http://www.netlib.org/blas/blast-forum/blas-report.pdf>

5 Arguments

- 1: **order** – Nag_OrderType *Input*
On entry: the **order** argument specifies the two-dimensional storage scheme being used, i.e., row-major ordering or column-major ordering. C language defined storage is specified by **order** = Nag_RowMajor. See Section 2.3.1.3 in How to Use the NAG Library and its Documentation for a more detailed explanation of the use of this argument.
Constraint: **order** = Nag_RowMajor or Nag_ColMajor.
- 2: **uplo** – Nag_UploType *Input*
On entry: specifies whether the upper or lower triangular part of A is stored.
uplo = Nag_Upper
The upper triangular part of A is stored.
uplo = Nag_Lower
The lower triangular part of A is stored.
Constraint: **uplo** = Nag_Upper or Nag_Lower.
- 3: **trans** – Nag_TransType *Input*
On entry: specifies the operation to be performed.
trans = Nag_NoTrans
 $B \leftarrow A$.

trans = Nag_Trans
 $B \leftarrow A^T.$

trans = Nag_ConjTrans
 $B \leftarrow A^H.$

Constraint: **trans** = Nag_NoTrans, Nag_Trans or Nag_ConjTrans.

4: **diag** – Nag_DiagType *Input*

On entry: specifies whether A has nonunit or unit diagonal elements.

diag = Nag_NonUnitDiag
 The diagonal elements are stored explicitly.

diag = Nag_UnitDiag
 The diagonal elements are assumed to be 1 and are not referenced.

Constraint: **diag** = Nag_NonUnitDiag or Nag_UnitDiag.

5: **n** – Integer *Input*

On entry: n , the order of the matrices A and B .

Constraint: $n \geq 0$.

6: **a**[dim] – const Complex *Input*

Note: the dimension, dim , of the array **a** must be at least $\max(1, \mathbf{pda} \times \mathbf{n})$.

On entry: the n by n triangular matrix A .

If **order** = Nag_ColMajor, A_{ij} is stored in **a**[($j - 1$) \times **pda** + $i - 1$].

If **order** = Nag_RowMajor, A_{ij} is stored in **a**[($i - 1$) \times **pda** + $j - 1$].

If **uplo** = Nag_Upper, the upper triangular part of A must be stored and the elements of the array below the diagonal are not referenced.

If **uplo** = Nag_Lower, the lower triangular part of A must be stored and the elements of the array above the diagonal are not referenced.

If **diag** = Nag_UnitDiag, the diagonal elements of A are assumed to be 1, and are not referenced.

7: **pda** – Integer *Input*

On entry: the stride separating row or column elements (depending on the value of **order**) of the matrix A in the array **a**.

Constraint: **pda** $\geq \max(1, \mathbf{n})$.

8: **b**[dim] – Complex *Output*

Note: the dimension, dim , of the array **b** must be at least $\max(1, \mathbf{pdb} \times \mathbf{n})$.

On exit: the n by n triangular matrix B .

If **order** = Nag_ColMajor, B_{ij} is stored in **b**[($j - 1$) \times **pdb** + $i - 1$].

If **order** = Nag_RowMajor, B_{ij} is stored in **b**[($i - 1$) \times **pdb** + $j - 1$].

If **uplo** = Nag_Upper and **trans** = Nag_NoTrans or if **uplo** = Nag_Lower and **trans** = Nag_Trans or **trans** = Nag_ConjTrans, B is upper triangular and the elements of the array below the diagonal are not set.

If **uplo** = Nag_Lower and **trans** = Nag_NoTrans or if **uplo** = Nag_Upper and **trans** = Nag_Trans or **trans** = Nag_ConjTrans, B is lower triangular and the elements of the array above the diagonal are not set.

- 9: **pdb** – Integer *Input*
 On entry: the stride separating row or column elements (depending on the value of **order**) in the array **b**.
 Constraint: **pdb** $\geq \max(1, \mathbf{n})$.
- 10: **fail** – NagError * *Input/Output*
 The NAG error argument (see Section 2.7 in How to Use the NAG Library and its Documentation).

6 Error Indicators and Warnings

NE_ALLOC_FAIL

Dynamic memory allocation failed.
 See Section 2.3.1.2 in How to Use the NAG Library and its Documentation for further information.

NE_BAD_PARAM

On entry, argument $\langle value \rangle$ had an illegal value.

NE_INT

On entry, **n** = $\langle value \rangle$.
 Constraint: **n** ≥ 0 .

NE_INT_2

On entry, **pda** = $\langle value \rangle$, **n** = $\langle value \rangle$.
 Constraint: **pda** $\geq \max(1, \mathbf{n})$.
 On entry, **pdb** = $\langle value \rangle$, **n** = $\langle value \rangle$.
 Constraint: **pdb** $\geq \max(1, \mathbf{n})$.

NE_INTERNAL_ERROR

An unexpected error has been triggered by this function. Please contact NAG.
 See Section 2.7.6 in How to Use the NAG Library and its Documentation for further information.

NE_NO_LICENCE

Your licence key may have expired or may not have been installed correctly.
 See Section 2.7.5 in How to Use the NAG Library and its Documentation for further information.

7 Accuracy

The BLAS standard requires accurate implementations which avoid unnecessary over/underflow (see Section 2.7 of Basic Linear Algebra Subprograms Technical (BLAST) Forum (2001)).

8 Parallelism and Performance

nag_ztr_copy (f16tec) is not threaded in any implementation.

9 Further Comments

None.

10 Example

Initializes a 4 by 4 lower triangular matrix A and copies its conjugate transpose to the upper triangular part of B .

10.1 Program Text

```
/* nag_ztr_copy (f16tec) Example Program.
 *
 * NAGPRODCODE Version.
 *
 * Copyright 2016 Numerical Algorithms Group.
 *
 * Mark 26, 2016.
 */

#include <stdio.h>
#include <nag.h>
#include <nag_stdlib.h>
#include <nagf16.h>
#include <nagx04.h>

int main(void)
{
    /* Scalars */
    Complex alpha, diag;
    Integer exit_status, n, pda, pdb;

    /* Arrays */
    Complex *a = 0, *b = 0;
    char nag_enum_arg[40];

    /* Nag Types */
    NagError fail;
    Nag_OrderType order;
    Nag_UploType uplo;
    Nag_MatrixType matrix;

#ifdef NAG_COLUMN_MAJOR
    order = Nag_ColMajor;
#else
    order = Nag_RowMajor;
#endif

    exit_status = 0;
    INIT_FAIL(fail);

    printf("nag_ztr_copy (f16tec) Example Program Results\n\n");

    /* Skip heading in data file */
#ifdef _WIN32
    scanf_s("%*[\n] ");
#else
    scanf("%*[\n] ");
#endif

    /* Read the problem dimension */
#ifdef _WIN32
    scanf_s("%" NAG_IFMT "%*[\n] ", &n);
#else
    scanf("%" NAG_IFMT "%*[\n] ", &n);
#endif

    /* Read the uplo parameter */
#ifdef _WIN32
    scanf_s("%39s%*[\n] ", nag_enum_arg, (unsigned)_countof(nag_enum_arg));
#else
    scanf("%39s%*[\n] ", nag_enum_arg);
#endif
}
```

```

#endif
/* nag_enum_name_to_value (x04nac).
 * Converts NAG enum member name to value
 */
uplo = (Nag_UploType) nag_enum_name_to_value(nag_enum_arg);

/* Read scalar parameters */
#ifdef _WIN32
    scanf_s(" ( %lf , %lf ) ( %lf , %lf )%*[\n] ",
            &alpha.re, &alpha.im, &diag.re, &diag.im);
#else
    scanf(" ( %lf , %lf ) ( %lf , %lf )%*[\n] ",
            &alpha.re, &alpha.im, &diag.re, &diag.im);
#endif

pda = n;
pdb = n;

if (n > 0) {
    /* Allocate memory */
    if (!(a = NAG_ALLOC(n * n, Complex)) || !(b = NAG_ALLOC(n * n, Complex)))
    {
        printf("Allocation failure\n");
        exit_status = -1;
        goto END;
    }
}
else {
    printf("Invalid n\n");
    exit_status = 1;
    return exit_status;
}

/* nag_ztr_load (f16tgc).
 * Initialize complex triangular matrix.
 */
nag_ztr_load(order, uplo, n, alpha, diag, a, pda, &fail);
if (fail.code != NE_NOERROR) {
    printf("Error from nag_ztr_load.\n%s\n", fail.message);
    exit_status = 1;
    goto END;
}

/* nag_ztr_copy (f16tec).
 * Copies a complex triangular matrix.
 */
nag_ztr_copy(order, uplo, Nag_ConjTrans, Nag_NonUnitDiag, n, a, pda, b, pdb,
            &fail);
if (fail.code != NE_NOERROR) {
    printf("Error from nag_ztr_copy (f16tec).\n%s\n", fail.message);
    exit_status = 1;
    goto END;
}

if (uplo == Nag_Upper) {
    matrix = Nag_LowerMatrix;
}
else {
    matrix = Nag_UpperMatrix;
}

/* Print generated matrix A */
/* nag_gen_complx_mat_print_comp (x04dbc).
 * Print complex general matrix (comprehensive)
 */
fflush(stdout);
nag_gen_complx_mat_print_comp(order, matrix, Nag_NonUnitDiag, n, n, b, pdb,
                            Nag_BracketForm, "%5.2f", "Copied Matrix B",
                            Nag_IntegerLabels, 0, Nag_IntegerLabels, 0,

```

```

                                80, 0, 0, &fail);
if (fail.code != NE_NOERROR) {
    printf("Error from nag_gen_complx_mat_print_comp (x04dbc).\n%s"
           "\n", fail.message);
    exit_status = 1;
    goto END;
}

END:
    NAG_FREE(a);
    NAG_FREE(b);

    return exit_status;
}

```

10.2 Program Data

```

nag_ztr_copy (f16tec) Example Program Data
4              : n the dimension of matrix A
Nag_Lower      : uplo
( 0.5,-0.3) ( 9.0, 0.0) : alpha, diag

```

10.3 Program Results

nag_ztr_copy (f16tec) Example Program Results

```

Copied Matrix B
      1          2          3          4
1 ( 9.00,-0.00) ( 0.50, 0.30) ( 0.50, 0.30) ( 0.50, 0.30)
2          ( 9.00,-0.00) ( 0.50, 0.30) ( 0.50, 0.30)
3          ( 9.00,-0.00) ( 0.50, 0.30)
4          ( 9.00,-0.00)

```
