

NAG Toolbox for MATLAB

f07tw

1 Purpose

f07tw computes the inverse of a complex triangular matrix.

2 Syntax

```
[a, info] = f07tw(uplo, diag, a, 'n', n)
```

3 Description

f07tw forms the inverse of a complex triangular matrix A . Note that the inverse of an upper (lower) triangular matrix is also upper (lower) triangular.

4 References

Du Croz J J and Higham N J 1992 Stability of methods for matrix inversion *IMA J. Numer. Anal.* **12** 1–19

5 Parameters

5.1 Compulsory Input Parameters

1: **uplo** – string

Indicates whether A is upper or lower triangular.

uplo = 'U'

A is upper triangular.

uplo = 'L'

A is lower triangular.

Constraint: **uplo** = 'U' or 'L'.

2: **diag** – string

Indicates whether A is a nonunit or unit triangular matrix.

diag = 'N'

A is a nonunit triangular matrix.

diag = 'U'

A is a unit triangular matrix; the diagonal elements are not referenced and are assumed to be 1.

Constraint: **diag** = 'N' or 'U'.

3: **a(lda,*)** – complex array

The first dimension of the array **a** must be at least $\max(1, \mathbf{n})$

The second dimension of the array must be at least $\max(1, \mathbf{n})$

The n by n triangular matrix A .

If **uplo** = 'U', A is upper triangular and the elements of the array below the diagonal are not referenced.

If **uplo** = 'L', A is lower triangular and the elements of the array above the diagonal are not referenced.

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

5.2 Optional Input Parameters

1: **n** – **int32 scalar**

Default: The second dimension of the array **a**.

n , the order of the matrix A .

Constraint: $n \geq 0$.

5.3 Input Parameters Omitted from the MATLAB Interface

lda

5.4 Output Parameters

1: **a(lda,*)** – **complex array**

The first dimension of the array **a** must be at least $\max(1, n)$

The second dimension of the array must be at least $\max(1, n)$

A contains A^{-1} , using the same storage format as described above.

2: **info** – **int32 scalar**

info = 0 unless the function detects an error (see Section 6).

6 Error Indicators and Warnings

Errors or warnings detected by the function:

info = $-i$

If **info** = $-i$, parameter i had an illegal value on entry. The parameters are numbered as follows:

1: **uplo**, 2: **diag**, 3: **n**, 4: **a**, 5: **lda**, 6: **info**.

It is possible that **info** refers to a parameter that is omitted from the MATLAB interface. This usually indicates that an error in one of the other input parameters has caused an incorrect value to be inferred.

info > 0

If **info** = i , $a(i, i)$ is exactly zero; A is singular and its inverse can not be computed.

7 Accuracy

The computed inverse X satisfies

$$|XA - I| \leq c(n)\epsilon|X||A|,$$

where $c(n)$ is a modest linear function of n , and ϵ is the *machine precision*.

Note that a similar bound for $|AX - I|$ cannot be guaranteed, although it is almost always satisfied.

The computed inverse satisfies the forward error bound

$$|X - A^{-1}| \leq c(n)\epsilon|A^{-1}||A||X|.$$

See Du Croz and Higham 1992.

8 Further Comments

The total number of real floating-point operations is approximately $\frac{4}{3}n^3$.

The real analogue of this function is f07tj.

9 Example

```

uplo = 'L';
diag = 'N';
a = [complex(4.78, +4.56), complex(0, 0), complex(0, 0), complex(0, 0);
      complex(2, -0.3), complex(-4.11, +1.25), complex(0, 0), complex(0,
0);
      complex(2.89, -1.34), complex(2.36, -4.25), complex(4.15, +0.8),
complex(0, 0);
      complex(-1.89, +1.15), complex(0.04, -3.69), complex(-0.02, +0.46),
complex(0.33, -0.26)];
[aOut, info] = f07tw(uplo, diag, a)

aOut =
    0.1095 - 0.1045i         0         0         0
    0.0582 - 0.0411i  -0.2227 - 0.0677i         0         0
    0.0032 + 0.1905i   0.1538 - 0.2192i   0.2323 - 0.0448i         0
    0.7602 + 0.2814i   1.6184 - 1.4346i   0.1289 - 0.2250i   1.8697 +
1.4731i
info =
        0

```