

NAG Library Routine Document

F06TQF

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

F06TQF performs a QR factorization (as a sequence of plane rotations) of a complex upper triangular matrix that has been augmented by a full row.

2 Specification

```
SUBROUTINE F06TQF (N, ALPHA, X, INCX, A, LDA, C, S)
INTEGER          N, INCX, LDA
REAL (KIND=nag_wp) C(N)
COMPLEX (KIND=nag_wp) ALPHA, X(*), A(LDA,*), S(N)
```

3 Description

F06TQF performs the factorization

$$\begin{pmatrix} U \\ \alpha x^T \end{pmatrix} = Q \begin{pmatrix} R \\ 0 \end{pmatrix}$$

where U and R are n by n complex upper triangular matrices, x is an n -element complex vector, α is a complex scalar, and Q is a complex unitary matrix. If U has real diagonal elements, then so does R .

Q is formed as a sequence of plane rotations

$$Q^H = Q_n \cdots Q_2 Q_1$$

where Q_k is a rotation in the $(k, n+1)$ plane, chosen to annihilate x_k .

The 2 by 2 plane rotation part of Q_k has the form

$$\begin{pmatrix} c_k & \bar{s}_k \\ -s_k & c_k \end{pmatrix}$$

with c_k real.

4 References

None.

5 Arguments

- | | | |
|----|--|--------------|
| 1: | N – INTEGER | <i>Input</i> |
| | <i>On entry:</i> n , the order of the matrices U and R . | |
| | <i>Constraint:</i> $N \geq 0$. | |
| 2: | ALPHA – COMPLEX (KIND=nag_wp) | <i>Input</i> |
| | <i>On entry:</i> the scalar α . | |

- 3: X(*) – COMPLEX (KIND=nag_wp) array Input/Output
Note: the dimension of the array X must be at least $\max(1, 1 + (N - 1) \times \text{INCX})$.
On entry: the n -element vector x . x_i must be stored in $X(1 + (i - 1) \times \text{INCX})$, for $i = 1, 2, \dots, N$.
 Intermediate elements of X are not referenced.
On exit: the referenced elements are overwritten by details of the sequence of plane rotations.
- 4: INCX – INTEGER Input
On entry: the increment in the subscripts of X between successive elements of x .
Constraint: $\text{INCX} > 0$.
- 5: A(LDA,*) – COMPLEX (KIND=nag_wp) array Input/Output
Note: the second dimension of the array A must be at least N.
On entry: the n by n upper triangular matrix U .
On exit: the upper triangular matrix R .
- 6: LDA – INTEGER Input
On entry: the first dimension of the array A as declared in the (sub)program from which F06TQF is called.
Constraint: $\text{LDA} \geq \max(1, N)$.
- 7: C(N) – REAL (KIND=nag_wp) array Output
On exit: the values c_k , the cosines of the rotations Q_k , for $k = 1, 2, \dots, n$.
- 8: S(N) – COMPLEX (KIND=nag_wp) array Output
On exit: the values s_k , the sines of the rotations Q_k , for $k = 1, 2, \dots, n$.

6 Error Indicators and Warnings

None.

7 Accuracy

Not applicable.

8 Parallelism and Performance

F06TQF is not threaded in any implementation.

9 Further Comments

None.

10 Example

None.
