

NAG Library Routine Document

F06TSF

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

F06TSF performs a QR or RQ factorization (as a sequence of plane rotations) of a complex upper spiked matrix.

2 Specification

```
SUBROUTINE F06TSF(SIDE, N, K1, K2, C, S, A, LDA)
INTEGER          N, K1, K2, LDA
double precision C(K2-1)
complex*16      S(*), A(LDA,*)
CHARACTER*1      SIDE
```

3 Description

F06TSF transforms an n by n complex upper spiked matrix H to upper triangular form R by applying a complex unitary matrix P from the left or the right. H is assumed to have real diagonal elements except where the spike joins the diagonal; R has real diagonal elements. P is formed as a sequence of plane rotations in planes k_1 to k_2 .

If $SIDE = 'L'$, H is assumed to have a row spike, with nonzero elements $h_{k_2,k}$, for $k = k_1, k_1 + 1, \dots, k_2 - 1$. The rotations are applied from the left:

$$PH = R,$$

where $P = DP_{k_2-1} \cdots P_{k_1+1}P_{k_1}$, P_k is a rotation in the (k, k_2) plane and $D = \text{diag}(1, \dots, 1, d_{k_2}, 1, \dots, 1)$ with $|d_{k_2}| = 1$.

If $SIDE = 'R'$, H is assumed to have a column spike, with nonzero elements h_{k+1,k_1} , for $k = k_1, k_1 + 1, \dots, k_2 - 1$. The rotations are applied from the right:

$$HP^H = R,$$

where $P = DP_{k_1}P_{k_1+1} \cdots P_{k_2-1}$, P_k is a rotation in the $(k_1, k+1)$ plane and $D = \text{diag}(1, \dots, 1, d_{k_1}, 1, \dots, 1)$ with $|d_{k_1}| = 1$.

The 2 by 2 plane rotation part of P_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 Parameters

- 1: SIDE – CHARACTER*1 *Input*
On entry: specifies whether H is operated on from the left or the right.
 SIDE = 'L'
 H is pre-multiplied from the left.
 SIDE = 'R'
 H is post-multiplied from the right.
Constraint: SIDE = 'L' or 'R'.
- 2: N – INTEGER *Input*
On entry: n , the order of the matrix H .
Constraint: $N \geq 0$.
- 3: K1 – INTEGER *Input*
 4: K2 – INTEGER *Input*
On entry: the values k_1 and k_2 .
 If $K1 < 1$ or $K2 \leq K1$ or $K2 > N$, an immediate return is effected.
- 5: C(K2 – 1) – **double precision** array *Output*
On exit: $C(k)$ holds c_k , the cosine of the rotation P_k , for $k = k_1, \dots, k_2 - 1$.
- 6: S(*) – **complex*16** array *Input/Output*
Note: the dimension of the array S must be at least $K2 - K1$.
On entry: the nonzero elements of the spike of H : $S(k)$ must hold $h_{k_2,k}$ if SIDE = 'L', and h_{k+1,k_1} if SIDE = 'R', for $k = k_1, k_1 + 1, \dots, k_2 - 1$.
On exit: $S(k)$ holds s_k , the sine of the rotation P_k , for $k = k_1, \dots, k_2 - 1$; $S(k_2)$ holds d_{k_2} , the k_2 th diagonal element of D , if SIDE = 'L', or d_{k_1} , the k_1 th diagonal element of D , if SIDE = 'R'.
- 7: A(LDA,*) – **complex*16** array *Input/Output*
Note: the second dimension of the array A must be at least N.
On entry: the upper triangular part of the n by n upper spiked matrix H . The imaginary parts of the diagonal elements must be zero, except for the (k_2, k_2) element if SIDE = 'L', or the (k_1, k_1) element if SIDE = 'R'.
On exit: the upper triangular matrix R . The imaginary parts of the diagonal elements are set to zero.
- 8: LDA – INTEGER *Input*
On entry: the first dimension of the array A as declared in the (sub)program from which F06TSF is called.
Constraint: $LDA \geq \max(1, N)$.

6 Error Indicators and Warnings

None.

7 Accuracy

Not applicable.

8 Further Comments

None.

9 Example

None.
