# NAG Fortran Library Routine Document

# F06QWF

**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

F06QWF transforms an $n$ by $n$ real upper triangular matrix $U$ to an upper spiked matrix $H$, by applying a given sequence of plane rotations from either the left or the right, in planes $k_1$ to $k_2$.

If SIDE = 'L', $H$ has a row spike, with non-zero elements $h_{k_2,k}$ for $k = k_1, k_1+1, \ldots, k_2-1$. The rotations are applied from the left:

$$H = PU, \quad \text{where} \quad P = P_{k_1} P_{k_1+1} \cdots P_{k_2-1},$$

and $P_k$ is a rotation in the $(k, k_2)$ plane.

If SIDE = 'R', $H$ has a column spike, with non-zero elements $h_{k+1,k_1}$ for $k = k_1, k_1+1, \ldots, k_2-1$. The rotations are applied from the right:

$$HP^T = R, \quad \text{where} \quad P = P_{k_2-1} \cdots P_{k_1+1} P_{k_1},$$

and $P_k$ is a rotation in the $(k_1, k+1)$ plane.

The 2 by 2 plane rotation part of $P_k$ has the form

$$\begin{pmatrix} c_k & s_k \\ -s_k & c_k \end{pmatrix}.$$

## 2 Specification

```
SUBROUTINE F06QWF (SIDE, N, K1, K2, C, S, A, LDA)
INTEGER            N, K1, K2, LDA
double precision   C(*), S(*), A(LDA,*)
CHARACTER*1        SIDE
```

## 3 Description

None.

## 4 References

None.

## 5 Parameters

1: SIDE – CHARACTER*1 *Input*

*On entry*: specifies whether $U$ is operated on from the left or the right, as follows:

if SIDE = 'L', $U$ is pre-multiplied from the left;
if SIDE = 'R', $U$ is post-multiplied from the right.

*Constraint*: SIDE = 'L' or 'R'.

2: N – INTEGER *Input*

*On entry*: $n$, the order of the matrices $U$ and $H$.

*Constraint*: N $\geq$ 0.

3: K1 – INTEGER *Input*
4: K2 – INTEGER *Input*

*On entry*: the values $k_1$ and $k_2$.

5: C($*$) – ***double precision*** array *Input*

*On entry*: C($k$) must hold $c_k$, the cosine of the rotation $P_k$, for $k = k_1, \ldots, k_2 - 1$.

6: S($*$) – ***double precision*** array *Input/Output*

*On entry*: S($k$) must hold $s_k$, the sine of the rotation $P_k$, for $k = k_1, \ldots, k_2 - 1$.

*On exit*: S($k$) holds a non-zero element of the spike of $H$: $h_{k_2,k}$ if SIDE = 'L', or $h_{k+1,k_1}$ if SIDE = 'R', for $k = k_1, k_1 + 1, \ldots, k_2 - 1$.

7: A(LDA,$*$) – ***double precision*** array *Input/Output*

**Note**: the second dimension of the array A must be at least max(1, N).

*On entry*: the $n$ by $n$ upper triangular matrix $U$.

*On exit*: the upper triangular part of the upper spiked matrix $H$.

8: LDA – INTEGER *Input*

*On entry*: the first dimension of the array A as declared in the (sub)program from which F06QWF is called.

*Constraint*: LDA $\geq$ max(1, N).

## 6 Error Indicators and Warnings

None.