NAG Library Routine Document

F06HRF

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

F06HRF generates a complex elementary reflection.

2 Specification

```
SUBROUTINE F06HRF (N, ALPHA, X, INCX, TOL, THETA)

INTEGER                 N, INCX
REAL (KIND=nag_wp)      TOL
COMPLEX (KIND=nag_wp) ALPHA, X(*), THETA
```

3 Description

F06HRF generates details of a complex elementary reflection (Householder matrix), P, such that

$$P\begin{pmatrix}\alpha\\ x\end{pmatrix} = \begin{pmatrix}\beta\\ 0\end{pmatrix}$$

where P is unitary, α is a complex scalar, β is a real scalar, and x is an n-element complex vector.

P is given in the form

$$P = I - \gamma\begin{pmatrix}\zeta\\ z\end{pmatrix}\begin{pmatrix}\zeta & z^{\mathrm{H}}\end{pmatrix},$$

where z is an n-element complex vector, γ is a complex scalar such that $\mathrm{Re}(\gamma) = 1$, and ζ is a real scalar. γ and ζ are returned in a single complex value $\theta = (\zeta, \mathrm{Im}(\gamma))$. Thus $\zeta = \mathrm{Re}(\theta)$ and $\gamma = (1, \mathrm{Im}(\theta))$.

If x is such that

$$\max(|\mathrm{Re}(x_i)|, |\mathrm{Im}(x_i)|) \leq \max(tol, \epsilon \max(|\mathrm{Re}(\alpha)|, |\mathrm{Im}(\alpha)|)),$$

where ϵ is the ***machine precision*** and *tol* is a user-supplied tolerance, then:

either θ is set to 0, in which case P can be taken to be the unit matrix;

or θ is set so that $\mathrm{Re}(\theta) \leq 0$ and $\theta \neq 0$, in which case

$$P = \begin{pmatrix}\theta & 0\\ 0 & I\end{pmatrix}.$$

Otherwise $1 \leq \mathrm{Re}(\theta) \leq \sqrt{2}$.

4 References

None.

5 Parameters

1: N – INTEGER *Input*

On entry: n, the number of elements in x and z.

2: ALPHA – COMPLEX (KIND=nag_wp) *Input/Output*

On entry: the scalar α.

On exit: the scalar β.

3: X$(*)$ – COMPLEX (KIND=nag_wp) array *Input/Output*

Note: the dimension of the array X must be at least $\max(1, 1 + (\mathrm{N} - 1) \times \mathrm{INCX})$.

On entry: the n-element vector x. x_i must be stored in X$(1 + (i - 1) \times \mathrm{INCX})$, for $i = 1, 2, \ldots, \mathrm{N}$. Intermediate elements of X are not referenced.

On exit: the referenced elements are overwritten by details of the complex elementary reflection.

4: INCX – INTEGER *Input*

On entry: the increment in the subscripts of X between successive elements of x.

Constraint: INCX > 0.

5: TOL – REAL (KIND=nag_wp) *Input*

On entry: the value *tol*.

6: THETA – COMPLEX (KIND=nag_wp) *Output*

On exit: the scalar θ.

6 Error Indicators and Warnings

None.

7 Accuracy

Not applicable.

8 Further Comments

None.

9 Example

None.