

NAG Toolbox for MATLAB

f08fl

1 Purpose

f08fl computes the reciprocal condition numbers for the eigenvectors of a real symmetric or complex Hermitian m by m matrix A , or for the left or right singular vectors of a general m by n matrix A .

2 Syntax

```
[sep, info] = f08fl(job, m, n, d)
```

3 Description

The bound on the error, measured by the angle in radians, for the i th computed vector is given by $\epsilon\|A\|_2/\text{sep}_i$, where ϵ is the *machine precision* and sep_i is the reciprocal condition number for the vectors, returned in the array element **sep**(i). **sep**(i) is restricted to be at least $\epsilon\|A\|_2$ in order to limit the size of the error bound.

4 References

Golub G H and Van Loan C F 1996 *Matrix Computations* (3rd Edition) Johns Hopkins University Press, Baltimore

5 Parameters

5.1 Compulsory Input Parameters

1: **job** – string

Specifies for which problem the reciprocal condition number should be computed.

job = 'E'

The eigenvectors of a symmetric or Hermitian matrix.

job = 'L'

The left singular vectors of a general matrix.

job = 'R'

The right singular vectors of a general matrix.

Constraint: **job** = 'E', 'L' or 'R'.

2: **m** – int32 scalar

m , the number of rows of the matrix A .

Constraint: **m** ≥ 0 .

3: **n** – int32 scalar

n , the number of columns of the matrix when **job** = 'L' or 'R'.

If **job** = 'E', **n** is not referenced.

Constraint: if **job** = 'L' or 'R', **n** ≥ 0 .

4: **d(*) – double array**

Note: the dimension of the array **d** must be at least $\max(1, m)$ if **job** = 'E' and at least $\max(1, \min(m, n))$ if **job** = 'L' or 'R'.

The eigenvalues if **job** = 'E', or singular values if **job** = 'L' or 'R' of the matrix *A*, in either increasing or decreasing order. If **job** = 'L' or 'R' they must be nonnegative.

5.2 Optional Input Parameters

None.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters1: **sep(*) – double array**

Note: the dimension of the array **sep** must be at least $\max(1, m)$ if **job** = 'E' and at least $\max(1, \min(m, n))$ if **job** = 'L' or 'R'.

The reciprocal condition numbers of the vectors.

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: **job**, 2: **m**, 3: **n**, 4: **d**, 5: **sep**, 6: **info**.

7 Accuracy

The reciprocal condition numbers are computed to *machine precision* relative to the size of the eigenvalues, or singular values.

8 Further Comments

f08fl may also be used towards computing error bounds for the eigenvectors of the generalized symmetric or Hermitian definite eigenproblem. See Golub and Van Loan 1996 for further details on the error bounds.

9 Example

```
job = 'Eigenvectors';
m = int32(4);
n = int32(4);
d = [-2.053115763536997;
     -0.5146427793906143;
     -0.2943264517738021;
     12.86208499470141];
[sep, info] = f08fl(job, m, n, d)

sep =
```

```
1.5385
0.2203
0.2203
13.1564
info = 0
```
