NAG Library Routine Document

F08FLF (DDISNA)

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

F08FLF (DDISNA) 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 Specification

```
SUBROUTINE F08FLF (JOB, M, N, D, SEP, INFO)
INTEGER             M, N, INFO
REAL (KIND=nag_wp) D(*), SEP(*)
CHARACTER(1)        JOB
```

The routine may be called by its LAPACK name ***ddisna***.

3 Description

The bound on the error, measured by the angle in radians, for the ith 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 Arguments

1: JOB – CHARACTER(1) *Input*

On entry: 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 – INTEGER *Input*

On entry: m, the number of rows of the matrix A.

Constraint: M ≥ 0.

3: N – INTEGER *Input*

On entry: 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', $\mathrm{N} \geq 0$.

4: D(∗) – REAL (KIND=nag_wp) array *Input*

Note: the dimension of the array D must be at least $\max(1, \mathrm{M})$ if JOB = 'E' and at least $\max(1, \min(\mathrm{M}, \mathrm{N}))$ if JOB = 'L' or 'R'.

On entry: the eigenvalues if JOB = 'E', or singular values if JOB = 'L' or 'R' of the matrix A.

Constraints:

the elements of the array D must be in either increasing or decreasing order;
if JOB = 'L' or 'R' the elements of D must be non-negative.

5: SEP(∗) – REAL (KIND=nag_wp) array *Output*

Note: the dimension of the array SEP must be at least $\max(1, \mathrm{M})$ if JOB = 'E' and at least $\max(1, \min(\mathrm{M}, \mathrm{N}))$ if JOB = 'L' or 'R'.

On exit: the reciprocal condition numbers of the vectors.

6: INFO – INTEGER *Output*

On exit: INFO = 0 unless the routine detects an error (see Section 6).

6 Error Indicators and Warnings

INFO < 0

If INFO $= -i$, argument i had an illegal value. An explanatory message is output, and execution of the program is terminated.

7 Accuracy

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

8 Parallelism and Performance

F08FLF (DDISNA) is not threaded in any implementation.

9 Further Comments

F08FLF (DDISNA) 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.

10 Example

The use of F08FLF (DDISNA) in computing error bounds for eigenvectors of the symmetric eigenvalue problem is illustrated in Section 10 in F08FAF (DSYEV); its use in computing error bounds for singular vectors is illustrated in Section 10 in F08KBF (DGESVD); and its use in computing error bounds for eigenvectors of the generalized symmetric definite eigenvalue problem is illustrated in Section 10 in F08SAF (DSYGV).