NAG C Library Function Document

nag_zhb_norm (f16uec)

1 Purpose

nag_zhb_norm (f16uec) calculates the value of the 1-norm, the infinity-norm, the Frobenius norm, or the maximum absolute value of the elements, of a complex $n$ by $n$ Hermitian band matrix.

2 Specification

```c
void nag_zhb_norm (Nag_OrderType order, Nag_NormType norm, Nag_UploType uplo,
           Integer n, Integer k, const Complex ab[], Integer pdab, double *r,
           NagError *fail)
```

3 Description

Given a complex $n$ by $n$ Hermitian band matrix, $A$, nag_zhb_norm (f16uec) calculates one of the values given by

$$
||A||_1 = \max_j \sum_{i=1}^{n} |a_{ij}|
$$

$$
||A||_\infty = \max_i \sum_{j=1}^{n} |a_{ij}|
$$

$$
||A||_F = \left( \sum_{i=1}^{n} \sum_{j=1}^{n} |a_{ij}|^2 \right)^{1/2}
$$

$$
\max_{i,j} |a_{ij}|
$$

Note that, since $A$ is symmetric, $||A||_1 = ||A||_\infty$.

4 References


5 Parameters

1: `order` – Nag_OrderType

   Input

   On entry: the `order` parameter specifies the two-dimensional storage scheme being used, i.e., row-major ordering or column-major ordering. C language defined storage is specified by `order = Nag_RowMajor`. See Section 2.2.1.4 of the Essential Introduction for a more detailed explanation of the use of this parameter.

   Constraint: `order = Nag_RowMajor` or `Nag_ColMajor`.

2: `norm` – Nag_NormType

   Input

   On entry: specifies the value to be returned:

   - if `norm = Nag_OneNorm`, the 1-norm;
   - if `norm = Nag_Infnorm`, the infinity-norm;
   - if `norm = Nag_FrobeniusNorm`, the Frobenius (or Euclidean) norm;
if \( \text{norm} = \text{Nag\_MaxNorm} \), the value \( \max_{i,j} |a_{ij}| \) (not a norm).

**Constraint:** \( \text{norm} = \text{Nag\_OneNorm}, \text{Nag\_InfNorm}, \text{Nag\_FrobeniusNorm} \) or \( \text{Nag\_MaxNorm} \).

3: \( \text{uplo} \) – Nag\_UploType  
*Input*

*On entry:* specifies whether the upper or lower triangular part of \( A \) is stored as follows:

- if \( \text{uplo} = \text{Nag\_Upper} \), the upper triangular part of \( A \) is stored;
- if \( \text{uplo} = \text{Nag\_Lower} \), the lower triangular part of \( A \) is stored.

**Constraint:** \( \text{uplo} = \text{Nag\_Upper} \) or \( \text{Nag\_Lower} \).

4: \( n \) – Integer  
*Input*

*On entry:* \( n \), the order of the matrix \( A \).

**Constraint:** \( n \geq 0 \).

5: \( k \) – Integer  
*Input*

*On entry:* \( k \), the number of sub-diagonals or super-diagonals of the matrix \( A \).

**Constraint:** \( k \geq 0 \).

6: \( \text{ab}[\text{dim}] \) – const Complex  
*Input*

*Note:* the dimension, \( \text{dim} \), of the array \( \text{ab} \) must be at least \( \max(1, \text{pdab} \times n) \).

*On entry:* the \( n \) by \( n \) Hermitian band matrix \( A \). This is stored as a notional two-dimensional array with row elements or column elements stored contiguously. The storage of elements \( a_{ij} \) depends on the \( \text{order} \) and \( \text{uplo} \) parameters as follows:

- if \( \text{order} = \text{Nag\_ColMajor} \) and \( \text{uplo} = \text{Nag\_Upper} \),
  \( a_{ij} \) is stored in \( \text{ab}[k + i - j + (j - 1) \times \text{pdab}] \), for \( j = 1, \ldots, n \) and
  \( i = \max(1, j - k), \ldots, j \);
- if \( \text{order} = \text{Nag\_ColMajor} \) and \( \text{uplo} = \text{Nag\_Lower} \),
  \( a_{ij} \) is stored in \( \text{ab}[i - j + (j - 1) \times \text{pdab}] \), for \( j = 1, \ldots, n \) and
  \( i = j, \ldots, \min(n, j + k) \);
- if \( \text{order} = \text{Nag\_RowMajor} \) and \( \text{uplo} = \text{Nag\_Upper} \),
  \( a_{ij} \) is stored in \( \text{ab}[j - i + (i - 1) \times \text{pdab}] \), for \( i = 1, \ldots, n \) and
  \( j = i, \ldots, \min(n, i + k) \);
- if \( \text{order} = \text{Nag\_RowMajor} \) and \( \text{uplo} = \text{Nag\_Lower} \),
  \( a_{ij} \) is stored in \( \text{ab}[k + j - i + (i - 1) \times \text{pdab}] \), for \( i = 1, \ldots, n \) and
  \( j = \max(1, i - k), \ldots, i \).

7: \( \text{pdab} \) – Integer  
*Input*

*On entry:* the stride separating row or column elements (depending on the value of \( \text{order} \)) of the matrix \( A \) in the array \( \text{ab} \).

**Constraints:**

- if \( \text{order} = \text{Nag\_ColMajor} \), \( \text{pdab} \geq k + 1 \);
- if \( \text{order} = \text{Nag\_RowMajor} \), \( \text{pdab} \geq \max(1, n) \).

8: \( r \) – double *  
*Output*

*On exit:* the value of the norm specified by \( \text{norm} \).

9: \( \text{fail} \) – NagError *  
*Input/Output*

The NAG error parameter (see the Essential Introduction).
6 Error Indicators and Warnings

**NE_INT**
- On entry, \( n = \langle \text{value} \rangle \).
  - Constraint: \( n \geq 0 \).
- On entry, \( k = \langle \text{value} \rangle \).
  - Constraint: \( k \geq 0 \).
- On entry, \( pdab = \langle \text{value} \rangle \).
  - Constraint: \( pdab \geq k + 1 \).  

**NE_BAD_PARAM**
- On entry, parameter \( \langle \text{value} \rangle \) had an illegal value.

7 Accuracy

The BLAS standard requires accurate implementations which avoid unnecessary over/underflow (see section 2.7 of The BLAS Technical Forum Standard (2001)).

8 Further Comments

None.

9 Example

See Section 9 of the document for nag_zpbcon (f07huc).