

# NAG Library Function Document

## nag\_zhp\_norm (f16udc)

### 1 Purpose

nag\_zhp\_norm (f16udc) calculates the value of the 1-norm, the  $\infty$ -norm, the Frobenius norm or the maximum absolute value of the elements of a complex  $n$  by  $n$  Hermitian matrix, stored in packed form.

### 2 Specification

```
#include <nag.h>
#include <nagf16.h>

void nag_zhp_norm (Nag_OrderType order, Nag_NormType norm,
                  Nag_UploType uplo, Integer n, const Complex ap[], double *r,
                  NagError *fail)
```

### 3 Description

Given a complex  $n$  by  $n$  Hermitian matrix,  $A$ , in packed storage, nag\_zhp\_norm (f16udc) calculates one of the values given by

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

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

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

or

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

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

### 4 References

Basic Linear Algebra Subprograms Technical (BLAST) Forum (2001) *Basic Linear Algebra Subprograms Technical (BLAST) Forum Standard* University of Tennessee, Knoxville, Tennessee <http://www.netlib.org/blas/blast-forum/blas-report.pdf>

### 5 Arguments

1: **order** – Nag\_OrderType *Input*

*On entry:* the **order** argument 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 2.3.1.3 in How to Use the NAG Library and its Documentation for a more detailed explanation of the use of this argument.

*Constraint:* **order** = Nag\_RowMajor or Nag\_ColMajor.

- 2: **norm** – Nag\_NormType *Input*  
*On entry:* specifies the value to be returned.  
**norm** = Nag\_OneNorm  
The 1-norm.  
**norm** = Nag\_InfNorm  
The  $\infty$ -norm.  
**norm** = Nag\_FrobeniusNorm  
The Frobenius (or Euclidean) norm.  
**norm** = Nag\_MaxNorm  
The value  $\max_{i,j} |a_{ij}|$  (not a norm).  
*Constraint:* **norm** = Nag\_OneNorm, Nag\_InfNorm, Nag\_FrobeniusNorm or Nag\_MaxNorm.
- 3: **uplo** – Nag\_UploType *Input*  
*On entry:* specifies whether the upper or lower triangular part of  $A$  is stored.  
**uplo** = Nag\_Upper  
The upper triangular part of  $A$  is stored.  
**uplo** = Nag\_Lower  
The lower triangular part of  $A$  is stored.  
*Constraint:* **uplo** = Nag\_Upper or Nag\_Lower.
- 4: **n** – Integer *Input*  
*On entry:*  $n$ , the order of the matrix  $A$ .  
If  $n = 0$ , then **n** is set to zero.  
*Constraint:* **n**  $\geq 0$ .
- 5: **ap**[*dim*] – const Complex *Input*  
**Note:** the dimension, *dim*, of the array **ap** must be at least  $\max(1, \mathbf{n} \times (\mathbf{n} + 1)/2)$ .  
*On entry:* the  $n$  by  $n$  Hermitian matrix  $A$ , packed by rows or columns.  
The storage of elements  $A_{ij}$  depends on the **order** and **uplo** arguments as follows:  
if **order** = Nag\_ColMajor and **uplo** = Nag\_Upper,  
 $A_{ij}$  is stored in **ap**[( $j - 1$ )  $\times$   $j/2 + i - 1$ ], for  $i \leq j$ ;  
if **order** = Nag\_ColMajor and **uplo** = Nag\_Lower,  
 $A_{ij}$  is stored in **ap**[( $2n - j$ )  $\times$  ( $j - 1$ )/2 +  $i - 1$ ], for  $i \geq j$ ;  
if **order** = Nag\_RowMajor and **uplo** = Nag\_Upper,  
 $A_{ij}$  is stored in **ap**[( $2n - i$ )  $\times$  ( $i - 1$ )/2 +  $j - 1$ ], for  $i \leq j$ ;  
if **order** = Nag\_RowMajor and **uplo** = Nag\_Lower,  
 $A_{ij}$  is stored in **ap**[( $i - 1$ )  $\times$   $i/2 + j - 1$ ], for  $i \geq j$ .
- 6: **r** – double \* *Output*  
*On exit:* the value of the norm specified by **norm**.
- 7: **fail** – NagError \* *Input/Output*  
The NAG error argument (see Section 2.7 in How to Use the NAG Library and its Documentation).

## 6 Error Indicators and Warnings

### NE\_ALLOC\_FAIL

Dynamic memory allocation failed.

See Section 3.2.1.2 in How to Use the NAG Library and its Documentation for further information.

### NE\_BAD\_PARAM

On entry, argument  $\langle value \rangle$  had an illegal value.

### NE\_INT

On entry,  $n = \langle value \rangle$ .

Constraint:  $n \geq 0$ .

### NE\_INTERNAL\_ERROR

An unexpected error has been triggered by this function. Please contact NAG.

See Section 3.6.6 in How to Use the NAG Library and its Documentation for further information.

### NE\_NO\_LICENCE

Your licence key may have expired or may not have been installed correctly.

See Section 3.6.5 in How to Use the NAG Library and its Documentation for further information.

## 7 Accuracy

The BLAS standard requires accurate implementations which avoid unnecessary over/underflow (see Section 2.7 of Basic Linear Algebra Subprograms Technical (BLAST) Forum (2001)).

## 8 Parallelism and Performance

nag\_zhp\_norm (f16udc) is not threaded in any implementation.

## 9 Further Comments

None.

## 10 Example

See Section 10 in nag\_zppcon (f07guc) and nag\_zhpcon (f07puc).

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