

NAG Toolbox for MATLAB

f07jr

1 Purpose

f07jr computes the modified Cholesky factorization of a complex n by n Hermitian positive-definite tridiagonal matrix A .

2 Syntax

```
[d, e, info] = f07jr(d, e, 'n', n)
```

3 Description

f07jr factorizes the matrix A as

$$A = LDL^H,$$

where L is a unit lower bidiagonal matrix and D is a diagonal matrix with positive diagonal elements. The factorization may also be regarded as having the form $U^H DU$, where U is a unit upper bidiagonal matrix.

4 References

None.

5 Parameters

5.1 Compulsory Input Parameters

1: **d(*)** – double array

Note: the dimension of the array **d** must be at least $\max(1, \mathbf{n})$.

Must contain the n diagonal elements of the matrix A .

2: **e(*)** – complex array

Note: the dimension of the array **e** must be at least $\max(1, \mathbf{n} - 1)$.

Must contain either the $(n - 1)$ subdiagonal elements, or the $(n - 1)$ superdiagonal elements, of the matrix A .

5.2 Optional Input Parameters

1: **n** – int32 scalar

Default: The dimension of the array **d**.

n , the order of the matrix A .

Constraint: $\mathbf{n} \geq 0$.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

1: **d(*)** – **double array**

Note: the dimension of the array **d** must be at least $\max(1, \mathbf{n})$.

Contains the n diagonal elements of the diagonal matrix D from the LDL^H factorization of A .

2: **e(*)** – **complex array**

Note: the dimension of the array **e** must be at least $\max(1, \mathbf{n} - 1)$.

If the subdiagonal elements of A were supplied, then **e** contains the $(n - 1)$ subdiagonal elements of the lower bidiagonal matrix L .

If the superdiagonal elements of A were supplied, then **e** overwritten by the $(n - 1)$ superdiagonal elements of the upper bidiagonal matrix U .

3: **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: **n**, 2: **d**, 3: **e**, 4: **info**.

info > 0

If **info** = i , the leading minor of order i is not positive-definite. If $i < \mathbf{n}$, the factorization could not be completed, while if $i = \mathbf{n}$, the factorization was completed, but $\mathbf{d}(\mathbf{n}) \leq 0$.

7 Accuracy

The computed factorization satisfies an equation of the form

$$A + E = LDL^H,$$

where

$$\|E\|_{\infty} = O(\epsilon)\|A\|_{\infty}$$

and ϵ is the *machine precision*.

Following the use of this function, f07js can be used to solve systems of equations $AX = B$, and f07ju can be used to estimate the condition number of A .

8 Further Comments

The total number of floating-point operations required to factorize the matrix A is proportional to n .

The real analogue of this function is f07jd.

9 Example

```
d = [16;
      41;
      46;
```

```
21];  
e = [complex(16, +16);  
     complex(18, -9);  
     complex(1, -4)];  
[dOut, eOut, info] = f07jr(d, e)
```

```
dOut =  
    16  
     9  
     1  
     4  
eOut =  
    1.0000 + 1.0000i  
    2.0000 - 1.0000i  
    1.0000 - 4.0000i  
info =  
      0
```
