

NAG Toolbox for MATLAB

f08bv

1 Purpose

f08bv reduces the m by n ($m \leq n$) complex upper trapezoidal matrix A to upper triangular form by means of unitary transformations.

2 Syntax

```
[a, tau, info] = f08bv(a, 'm', m, 'n', n)
```

3 Description

The m by n ($m \leq n$) complex upper trapezoidal matrix A given by

$$A = \begin{pmatrix} R_1 & R_2 \end{pmatrix},$$

where R_1 is an m by m upper triangular matrix and R_2 is an m by $(n - m)$ matrix, is factorized as

$$A = \begin{pmatrix} R & 0 \end{pmatrix} Z,$$

where R is also an m by m upper triangular matrix and Z is an n by n unitary matrix.

4 References

Anderson E, Bai Z, Bischof C, Blackford S, Demmel J, Dongarra J J, Du Croz J J, Greenbaum A, Hammarling S, McKenney A and Sorensen D 1999 *LAPACK Users' Guide* (3rd Edition) SIAM, Philadelphia URL: <http://www.netlib.org/lapack/lug>

5 Parameters

5.1 Compulsory Input Parameters

1: **a(lda,*)** – complex array

The first dimension of the array **a** must be at least $\max(1, \mathbf{m})$

The second dimension of the array must be at least $\max(1, \mathbf{n})$

The leading m by n upper trapezoidal part of the array **a** must contain the matrix to be factorized.

5.2 Optional Input Parameters

1: **m** – int32 scalar

Default: The first dimension of the array **a**.

m , the number of rows of the matrix A .

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

2: **n** – int32 scalar

Default: The second dimension of the array **a**.

n , the number of columns of the matrix A .

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

5.3 Input Parameters Omitted from the MATLAB Interface

lda, work, lwork

5.4 Output Parameters

1: **a(lda,*)** – complex array

The first dimension of the array **a** must be at least $\max(1, \mathbf{m})$

The second dimension of the array must be at least $\max(1, \mathbf{n})$

The leading m by m upper triangular part of **a** contains the upper triangular matrix R , and elements $\mathbf{m} + 1$ to $\mathbf{n}$ of the first m rows of **a**, with the array **tau**, represent the unitary matrix Z as a product of m elementary reflectors.

2: **tau(*)** – complex array

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

The scalar factors of the elementary reflectors.

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: **m**, 2: **n**, 3: **a**, 4: **lda**, 5: **tau**, 6: **work**, 7: **lwork**, 8: **info**.

It is possible that **info** refers to a parameter that is omitted from the MATLAB interface. This usually indicates that an error in one of the other input parameters has caused an incorrect value to be inferred.

7 Accuracy

The computed factorization is the exact factorization of a nearby matrix $A + E$, where

$$\|E\|_2 = O\epsilon \|A\|_2$$

and ϵ is the *machine precision*.

8 Further Comments

The total number of floating point operations is approximately $16m^2(n - m)$.

The real analogue of this function is f08bh.

9 Example

```
a = [complex(-2.287006777427649, +0), complex(-0.7238719256713585,
+0.5605142987122405), ...
      complex(0.7569719587570255, +0.4519444411802575), complex(-
0.5562729470486875, -1.014688728911479);
      complex(-0.1419878310874442, +0.008154310665875074),
complex(1.895002152020932, ...
      +0), complex(-0.3620421070808373, -0.4786572403052535),
```

```

complex(0.1854758695356538, -0.5741437411041758);
      complex(-0.09061318086343964, -0.05909460446106325), complex(-
0.4734396725777993, ...
      +0.1684395728926726), complex(0.9392829364710314, +0), complex(-
0.5317908073812145, +0.5694161471865474)];
[aOut, tau, info] = f08bv(a)

```

```

aOut =
      2.5031              0.4809 - 0.6802i  -0.3516 - 1.0496i   0.0243 -
0.2110i
      -0.1420 + 0.0082i  -1.9697              0.6274 + 0.2048i  -0.0617 +
0.1246i
      -0.0906 - 0.0591i  -0.4734 + 0.1684i  -1.2204              -0.2462 -
0.2637i
tau =
      1.9137
      1.9621
      1.7697
info =
      0

```