

NAG Toolbox for MATLAB

f07aw

1 Purpose

f07aw computes the inverse of a complex matrix A , where A has been factorized by f07ar.

2 Syntax

```
[a, info] = f07aw(a, ipiv, 'n', n)
```

3 Description

f07aw is used to compute the inverse of a complex matrix A , the function must be preceded by a call to f07ar, which computes the LU factorization of A as $A = PLU$. The inverse of A is computed by forming U^{-1} and then solving the equation $XPL = U^{-1}$ for X .

4 References

Du Croz J J and Higham N J 1992 Stability of methods for matrix inversion *IMA J. Numer. Anal.* **12** 1–19

5 Parameters

5.1 Compulsory Input Parameters

1: **a(lda,*)** – complex array

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

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

The LU factorization of A , as returned by f07ar.

2: **ipiv(*)** – int32 array

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

The pivot indices, as returned by f07ar.

5.2 Optional Input Parameters

1: **n** – int32 scalar

Default: The second dimension of the array **a** The dimension of the array **ipiv**.
 n , the order 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 $\max(1, \mathbf{n})$

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

The factorization contains the n by n matrix A^{-1} .

2: **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: **a**, 3: **lda**, 4: **ipiv**, 5: **work**, 6: **lwork**, 7: **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.

info > 0

If **info** = i , the i th diagonal element of the factor U is zero, U is singular, and the inverse of A cannot be computed.

7 Accuracy

The computed inverse X satisfies a bound of the form:

$$|XA - I| \leq c(n)\epsilon|X|P|L||U|,$$

where $c(n)$ is a modest linear function of n , and ϵ is the *machine precision*.

Note that a similar bound for $|AX - I|$ cannot be guaranteed, although it is almost always satisfied. See Du Croz and Higham 1992.

8 Further Comments

The total number of real floating-point operations is approximately $\frac{16}{3}n^3$.

The real analogue of this function is f07aj.

9 Example

```
a = [complex(-3.29, -2.39), complex(-1.91, +4.42), complex(-0.14, -1.35),
      complex(1.72, +1.35);
      complex(0.2376120269469406,      +0.2559596521570857),
      complex(4.895180634002975, ...
      -0.711362223485444), complex(-0.462279846639494, +1.696610587680362),
      ...
      complex(1.226852844063328, +0.6189731619114427);
      complex(-0.1019520808892006, -0.7010135339437114), complex(-
      0.6691496431943212, ...
      +0.3688698547971655),      complex(-5.141410913810232, -
      1.129969734660953), ...
      complex(0.9982579915199449, +0.3850152275763778);
      complex(-0.5358546703595748, +0.2707272529359829), complex(-
      0.2040217794587079, ...
      +0.8601180679984047),      complex(0.008233047063940025,
      +0.1210636819910635), ...
      complex(0.1482391810748419, -0.1252239986075848)];
ipiv = [int32(3);
        int32(2);
```

```
int32(3);  
int32(4)];  
[aOut, info] = f07aw(a, ipiv)
```

```
aOut =  
    0.0757 - 0.4324i    1.6512 - 3.1342i    1.2663 + 0.0418i    3.8181 +  
1.1195i  
   -0.1942 + 0.0798i   -1.1900 - 0.1426i   -0.2401 - 0.5889i   -0.0101 -  
1.4969i  
   -0.0957 - 0.0491i    0.7371 - 0.4290i    0.3224 + 0.0776i    0.6887 +  
0.7891i  
    0.3702 - 0.5040i    3.7253 - 3.1813i    1.7014 + 0.7267i    3.9367 +  
3.3255i  
info =  
      0
```
