

NAG Toolbox for MATLAB

f07pw

1 Purpose

f07pw computes the inverse of a complex Hermitian indefinite matrix A , where A has been factorized by f07pr, using packed storage.

2 Syntax

```
[ap, info] = f07pw(uplo, ap, ipiv, 'n', n)
```

3 Description

f07pw is used to compute the inverse of a complex Hermitian indefinite matrix A , the function must be preceded by a call to f07pr, which computes the Bunch–Kaufman factorization of A , using packed storage.

If **uplo** = 'U', $A = PUDU^H P^T$ and A^{-1} is computed by solving $U^H P^T X P U = D^{-1}$ for X .

If **uplo** = 'L', $A = PLDL^H P^T$ and A^{-1} is computed by solving $L^H P^T X P L = D^{-1}$ 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: **uplo** – string

Indicates how A has been factorized.

uplo = 'U'

$A = PUDU^H P^T$, where U is upper triangular.

uplo = 'L'

$A = PLDL^H P^T$, where L is lower triangular.

Constraint: **uplo** = 'U' or 'L'.

2: **ap**(*) – complex array

Note: the dimension of the array **ap** must be at least $\max(1, \mathbf{n} \times (\mathbf{n} + 1)/2)$.

The factorization of A stored in packed form, as returned by f07pr.

3: **ipiv**(*) – int32 array

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

Details of the interchanges and the block structure of D , as returned by f07pr.

5.2 Optional Input Parameters

1: **n** – int32 scalar

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

n , the order of the matrix A .

Constraint: $n \geq 0$.

5.3 Input Parameters Omitted from the MATLAB Interface

work

5.4 Output Parameters

1: **ap**(*) – complex array

Note: the dimension of the array **ap** must be at least $\max(1, n \times (n + 1)/2)$.

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

More precisely,

if **uplo** = 'U', the upper triangle of $\{A\}^{-1}$ must be stored with element A_{ij} in **ap**($i + j(j - 1)/2$) for $i \leq j$;
 if **uplo** = 'L', the lower triangle of $\{A\}^{-1}$ must be stored with element A_{ij} in **ap**($i + (2n - j)(j - 1)/2$) for $i \geq j$.

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: **uplo**, 2: **n**, 3: **ap**, 4: **ipiv**, 5: **work**, 6: **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 , $d(i, i)$ is exactly zero; D is singular and the inverse of A cannot be computed.

7 Accuracy

The computed inverse X satisfies a bound of the form

if **uplo** = 'U', $|DU^T P^T X P U - I| \leq c(n)\epsilon(|D||U^T|P^T|X|P|U| + |D||D^{-1}|)$;
 if **uplo** = 'L', $|DL^T P^T X P L - I| \leq c(n)\epsilon(|D||L^T|P^T|X|P|L| + |D||D^{-1}|)$,

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

8 Further Comments

The total number of real floating-point operations is approximately $\frac{8}{3}n^3$.

The real analogue of this function is f07pj.

9 Example

```
uplo = 'L';
ap = [complex(-1.36, +0);
      complex(3.91, -1.5);
      complex(0.3100287981271241, +0.04333020743962702);
      complex(-0.1518120207240102, +0.3742958425613706);
      complex(-1.84, +0);
      complex(0.5637050486508776, +0.2850349501519716);
      complex(0.339658279960361, +0.03031451811355637);
      complex(-5.417624387291579, +0);
      complex(0.2997244646075835, +0.1578268372785777);
      complex(-7.102809895801842, +0)];
ipiv = [int32(-4);
        int32(-4);
        int32(3);
        int32(4)];
[apOut, info] = f07pw(uplo, ap, ipiv)
```

```
apOut =
    0.0826
   -0.0335 + 0.0440i
    0.0603 - 0.0105i
    0.2391 - 0.0926i
   -0.1408
    0.0422 - 0.0222i
    0.0304 + 0.0203i
   -0.2007
    0.0982 - 0.0635i
    0.0073
info =
      0
```