

NAG Toolbox for MATLAB

f01cw

1 Purpose

f01cw adds two complex matrices, each one optionally transposed and multiplied by a scalar.

2 Syntax

```
[c, ifail] = f01cw(transa, transb, m, n, alpha, a, beta, b)
```

3 Description

f01cw performs one of the operations

$$C := \alpha A + \beta B,$$

$$C := \alpha A^T + \beta B,$$

$$C := \alpha A^H + \beta B,$$

$$C := \alpha A + \beta B^T,$$

$$C := \alpha A^T + \beta B^T,$$

$$C := \alpha A^H + \beta B^T,$$

$$C := \alpha A + \beta B^H,$$

$$C := \alpha A^T + \beta B^H \text{ or}$$

$$C := \alpha A^H + \beta B^H,$$

where A , B and C are matrices, α and β are scalars, T denotes transposition and H denotes conjugate transposition. For efficiency, the function contains special code for the cases when one or both of α , β is equal to zero, unity or minus unity. The matrices, or their transposes, must be compatible for addition. A and B are either m by n or n by m matrices, depending on whether they are to be transposed before addition. C is an m by n matrix.

4 References

None.

5 Parameters

5.1 Compulsory Input Parameters

1: **transa** – string

2: **transb** – string

transa and **transb** must specify whether or not the matrix A and the matrix B , respectively, are to be transposed before addition.

transa or **transb** = 'N'

The matrix will not be transposed.

transa or **transb** = 'T'

The matrix will be transposed.

transa or **transb** = 'C'

The matrix will be transposed and conjugated.

Constraint: **transa** and **transb** must be one of 'N', 'T' or 'C'.

3: **m – int32 scalar**

m , the number of rows of the matrices A and B or their transposes. Also the number of rows of the matrix C .

Constraint: $m \geq 0$.

4: **n – int32 scalar**

n , the number of columns of the matrices A and B or their transposes. Also the number of columns of the matrix C .

Constraint: $n \geq 0$.

5: **alpha – complex scalar**

The scalar α , by which matrix A is multiplied before addition.

6: **a(lda,*) – complex array**

The first dimension, **lda**, of the array **a** must satisfy

if **transa** = 'N', $\text{lda} \geq \max(1, m)$;
 $\text{lda} \geq \max(1, n)$ otherwise.

The second dimension of the array must be at least $\max(1, n)$ if **alpha** $\neq 0$ and **transa** = 'N', $\max(1, m)$ if **alpha** $\neq 0$ and **transa** = 'T' or 'C' and at least 1 if **alpha** = 0

The matrix A . If $\alpha = 0$, the array **a** is not referenced.

7: **beta – complex scalar**

The scalar β , by which matrix B is multiplied before addition.

8: **b(ldb,*) – complex array**

The first dimension, **ldb**, of the array **b** must satisfy

if **transb** = 'N', $\text{ldb} \geq \max(1, m)$;
 $\text{ldb} \geq \max(1, n)$ otherwise.

The second dimension of the array must be at least $\max(1, n)$ if **beta** $\neq 0$ and **transb** = 'N', $\max(1, m)$ if **beta** $\neq 0$ and **transb** = 'T' or 'C' and at least 1 if **alpha** = 0

The matrix B . If $\beta = 0$, the array **b** is not referenced.

5.2 Optional Input Parameters

None.

5.3 Input Parameters Omitted from the MATLAB Interface

lda, ldb, ldc

5.4 Output Parameters

1: **c(ldc,*)** – **complex array**

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

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

The elements of the m by n matrix C .

2: **ifail** – **int32 scalar**

0 unless the function detects an error (see Section 6).

6 Error Indicators and Warnings

Errors or warnings detected by the function:

ifail = 1

On entry, one or both of **transa** or **transb** is not equal to 'N', 'T' or 'C'.

ifail = 2

On entry, one or both of **m** or **n** is less than 0.

ifail = 3

On entry, **lda** < $\max(1, P)$, where $P = \mathbf{m}$ if **transa** = 'N', and $P = \mathbf{n}$ otherwise.

ifail = 4

On entry, **ldb** < $\max(1, P)$, where $P = \mathbf{m}$ if **transb** = 'N', and $P = \mathbf{n}$ otherwise.

ifail = 5

On entry, **ldc** < $\max(1, \mathbf{m})$.

7 Accuracy

The results returned by f01cw are accurate to *machine precision*.

8 Further Comments

The time taken for a call of f01cw varies with **m**, **n** and the values of α and β . The function is quickest if either or both of α and β are equal to zero, or plus or minus unity.

9 Example

```
transa = 'N';
transb = 'N';
m = int32(4);
n = int32(3);
alpha = complex(1, +0);
a = [complex(1, +2), complex(2.5, -1.5), complex(2.5, -1);
      complex(-2, -2), complex(2, -1), complex(-1.5, -1);
      complex(3.5, -1.5), complex(2, +1.5), complex(2, +3);
      complex(-2.5, +0), complex(-3, +2.5), complex(-2, +2)];
beta = complex(1, +0);
b = [complex(2, +1), complex(-2.5, +3), complex(-0.5, +0);
      complex(1, +0), complex(1, -1.5), complex(1.5, -1.5);
      complex(-1.5, -0.5), complex(2.5, -2), complex(-0.5, +1);
      complex(2.5, -1.5), complex(-1, +1.5), complex(2, +3)];
```

```
[c, ifail] = f01cw(transa, transb, m, n, alpha, a, beta, b)
```

```
c =  
    3.0000 + 3.0000i      0 + 1.5000i    2.0000 - 1.0000i  
   -1.0000 - 2.0000i    3.0000 - 2.5000i      0 - 2.5000i  
    2.0000 - 2.0000i    4.5000 - 0.5000i    1.5000 + 4.0000i  
      0 - 1.5000i   -4.0000 + 4.0000i      0 + 5.0000i  
ifail =  
      0
```
