PACKAGE SPECIFICATION

HSL ARCHIVE

**Warning:** Subroutine EC09 performs functions which are adequately treated by routines in other standard subroutine libraries (for example, LAPACK). The use of this routine is not recommended, and it may be removed from future releases of this library.

#### 1 SUMMARY

Finds all the eigenvalues of a complex Hermitian tri-diagonal matrix, i.e. finds the eigenvalues  $\lambda_i$ , i=1,2,...,m from the solutions of the equation

$$\det(\mathbf{A} - \lambda \mathbf{I}) = 0$$

for a matrix of the form

$$\mathbf{A} = \begin{bmatrix} a_1 & b_2 \\ \bar{b}_2 & a_2 & b_3 \\ & \bar{b}_3 & a_3 & b_4 \\ & * & * & * \\ & & \bar{b}_{m-1} & a_{m-1} & b_m \\ & & & \bar{b}_m & a_m \end{bmatrix}$$

where  $\bar{b}_j$  is assumed to be the complex conjugate of  $b_j$ , j=2,3,...,m. The matrix is transformed into a real form by a unitary diagonal transformation. The subroutine for the real case EA09 is then used.

ATTRIBUTES — Version: 1.0.0. Types: EC09CD. Calls: EA09. Language: EC09CD uses COMPLEX\*16. Original date: September 1971. Origin: S.Marlow, Harwell.

# 2 HOW TO USE THE PACKAGE

### 2.1 The argument list

The single precision version

CALL EC09C(A,B,VALUE,M,W)

The double precision version

CALL EC09CD(A,B,VALUE,M,W)

- A is a COMPLEX (COMPLEX\*16 in the D version) (see §2.2) array of length at least m which must be set by the user to the diagonal elements  $a_i$ , i=1,2,...,m of the matrix.
- is a COMPLEX (COMPLEX\*16 in the D version) (see §2.2) array of length at least m which the user must set to the upper off-diagonal elements  $b_i$ , i=2,3,...,m of the matrix as defined in §1. The lower off-diagonal elements  $\bar{b}_i$  are assumed to be the complex conjugates of the elements  $b_i$ , i=2,3,...,m.

VALUE is a REAL (DOUBLE PRECISION in the D version) array of length at least m which will be set by the subroutine to the eigenvalues  $\lambda_i$ , i=1,2,...,m

- M is an INTEGER variable which must be set by the user to m the order of the matrix.
- W is a COMPLEX (COMPLEX\*16 in the D version) (see  $\S 2.2$ ) array of length at least m which is used by the subroutine as workspace.

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### 2.2 The COMPLEX argument types

To conform to the Fortran 77 standard the array arguments listed as COMPLEX (COMPLEX\*16 in the D version) in §2.1 should strictly be REAL (DOUBLE PRECISION in the D version) arrays with an extra first dimension of 2, e.g.

```
REAL A(2,10),B(2,10),W(2,10)
REAL VALUE(10)
- - - CALL EC09C(A,B,VALUE,5,W)
```

Most implementations of Fortran allow such arguments to be passed in the more convenient form of COMPLEX (COMPLEX $^{*}$ 16 in the D version).

### **3 GENERAL INFORMATION**

**Use of common:** None.

**Workspace:** See argument W.

Other routines called directly: EA09C/CD.

Input/output: None.

**Portability:** EC09CD uses COMPLEX\*16 facility.

# 4 METHOD

The Hermitian tri-diagonal matrix is transformed into a real form by a unitary diagonal transformation. The subroutine EA09C/CD for the real case is then used.

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