NAME

ctrsna.f −

SYNOPSIS

Functions/Subroutines

subroutine **ctrsna** (JOB, HOWMNY, SELECT, N, T, LDT, VL, LDVL, VR, LDVR, S, SEP, MM, M, WORK, LDWORK, RWORK, INFO)
CTRSNA

Function/Subroutine Documentation

subroutine ctrsna (characterJOB, characterHOWMNY, logical, dimension(*)SELECT, integerN, complex, dimension(ldt, *)T, integerLDT, complex, dimension(ldvl, *)VL, integerLDVL, complex, dimension(ldvr, *)VR, integerLDVR, real, dimension(*)S, real, dimension(*)SEP, integerMM, integerM, complex, dimension(ldwork, *)WORK, integerLDWORK, real, dimension(*)RWORK, integerINFO)
CTRSNA

Purpose:

CTRSNA estimates reciprocal condition numbers for specified eigenvalues and/or right eigenvectors of a complex upper triangular matrix T (or of any matrix Q*T*Q**H with Q unitary).

Parameters:

JOB

JOB is CHARACTER*1
Specifies whether condition numbers are required for eigenvalues (S) or eigenvectors (SEP):
= ’E’: for eigenvalues only (S);
= ’V’: for eigenvectors only (SEP);
= ’B’: for both eigenvalues and eigenvectors (S and SEP).

HOWMNY

HOWMNY is CHARACTER*1
= ’A’: compute condition numbers for all eigenpairs;
= ’S’: compute condition numbers for selected eigenpairs specified by the array SELECT.

SELECT

SELECT is LOGICAL array, dimension (N)
If HOWMNY = ’S’, SELECT specifies the eigenpairs for which condition numbers are required. To select condition numbers for the j-th eigenpair, SELECT(j) must be set to .TRUE..
If HOWMNY = ’A’, SELECT is not referenced.

N

N is INTEGER
The order of the matrix T. N >= 0.

T

T is COMPLEX array, dimension (LDT,N)
The upper triangular matrix T.

LDT

LDT is INTEGER
The leading dimension of the array T. LDT >= max(1,N).

VL

VL is COMPLEX array, dimension (LDVL,M)
If JOB = ’E’ or ’B’, VL must contain left eigenvectors of T (or of any Q*T*Q**H with Q unitary), corresponding to the

eigenpairs specified by HOWMNY and SELECT. The eigenvectors
must be stored in consecutive columns of VL, as returned by
CHSEIN or CTREVC.
If JOB = ’V’, VL is not referenced.

LDVL

LDVL is INTEGER
The leading dimension of the array VL.
LDVL >= 1; and if JOB = ’E’ or ’B’, LDVL >= N.

VR

VR is COMPLEX array, dimension (LDVR,M)
If JOB = ’E’ or ’B’, VR must contain right eigenvectors of T
(or of any Q*T*Q**H with Q unitary), corresponding to the
eigenpairs specified by HOWMNY and SELECT. The eigenvectors
must be stored in consecutive columns of VR, as returned by
CHSEIN or CTREVC.
If JOB = ’V’, VR is not referenced.

LDVR

LDVR is INTEGER
The leading dimension of the array VR.
LDVR >= 1; and if JOB = ’E’ or ’B’, LDVR >= N.

S

S is REAL array, dimension (MM)
If JOB = ’E’ or ’B’, the reciprocal condition numbers of the
selected eigenvalues, stored in consecutive elements of the
array. Thus S(j), SEP(j), and the j-th columns of VL and VR
all correspond to the same eigenpair (but not in general the
j-th eigenpair, unless all eigenpairs are selected).
If JOB = ’V’, S is not referenced.

SEP

SEP is REAL array, dimension (MM)
If JOB = ’V’ or ’B’, the estimated reciprocal condition
numbers of the selected eigenvectors, stored in consecutive
elements of the array.
If JOB = ’E’, SEP is not referenced.

MM

MM is INTEGER
The number of elements in the arrays S (if JOB = ’E’ or ’B’)
and/or SEP (if JOB = ’V’ or ’B’). MM >= M.

M

M is INTEGER
The number of elements of the arrays S and/or SEP actually
used to store the estimated condition numbers.
If HOWMNY = ’A’, M is set to N.

WORK

WORK is COMPLEX array, dimension (LDWORK,N+6)
If JOB = ’E’, WORK is not referenced.

LDWORK

LDWORK is INTEGER
The leading dimension of the array WORK.
LDWORK >= 1; and if JOB = ’V’ or ’B’, LDWORK >= N.

RWORK

RWORK is REAL array, dimension (N)
If JOB = ’E’, RWORK is not referenced.

INFO

INFO is INTEGER
= 0: successful exit
< 0: if INFO = -i, the i-th argument had an illegal value

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Further Details:

The reciprocal of the condition number of an eigenvalue lambda is defined as

S(lambda) = |v**H*u| / (norm(u)*norm(v))

where u and v are the right and left eigenvectors of T corresponding to lambda; v**H denotes the conjugate transpose of v, and norm(u) denotes the Euclidean norm. These reciprocal condition numbers always lie between zero (very badly conditioned) and one (very well conditioned). If n = 1, S(lambda) is defined to be 1.

An approximate error bound for a computed eigenvalue W(i) is given by

EPS * norm(T) / S(i)

where EPS is the machine precision.

The reciprocal of the condition number of the right eigenvector u corresponding to lambda is defined as follows. Suppose

T = (lambda c)
(0 T22)

Then the reciprocal condition number is

SEP(lambda, T22) = sigma-min(T22 - lambda*I)

where sigma-min denotes the smallest singular value. We approximate the smallest singular value by the reciprocal of an estimate of the one-norm of the inverse of T22 - lambda*I. If n = 1, SEP(1) is defined to be abs(T(1,1)).

An approximate error bound for a computed right eigenvector VR(i) is given by

EPS * norm(T) / SEP(i)

Definition at line 248 of file ctrsna.f.

Author

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