Utility...Utility....Utility

Linda Kaufman
Bell Labs

It is unwise to

(1) Include a bla which has limited utility but fits in a framework

(2) Discard a useful bla because it does not fit in a framework

Before any Bla is included, its utility must be clearly demonstrated and its limitations understood

Blindly specifying BLAS for sparse/parallel computation withhout taking into consideration the special attributes of the problem/platform is a *waste*.

The Auxiliary routines come in various flavors

Some such as the "norm" , "copy" and elementary reflector routines should have been included

SLACPY called over 110 times in 27 different routines

SLARFG-generates elementary reflectors used in 18 different routines

SLANGE- a norm routine appears in 13 different routines

The blas SPR2 occurs in 2 routines.

Do the specifications for general matrices work for specific structures?

Example : SYRK

$$C \leftarrow \alpha A A^T + \beta C$$

Insists on all positive or all negative update

(1) Not useful in quasi-Newton methods

(2) Can't be used by block and nonblock indefinite linear system codes in LAPACK

Better if had

$$C \leftarrow \beta C + ABA^T$$

or updating triangular portion of

$$C \leftarrow \beta C + UV^T$$

But this might lead to unnecessary storage.

If $V = [V_1 | .... V_t]$
where each block has b columns, one really needs only one block of V at a time and can reuse space for symmetric problem.

The reuse of code was not done in the symmetric indefinite code in LAPACK and required b*n space rather than b*b and was rather user beligerent.

Parallel Blas

(1) Simultaneous decompositions

(a)2 dimensional separable PDE's can be handled by reducing a block banded system to a block diagonal system all of whose blocks are banded
(b) Parallel inverse iteration and bisection

(c) Dividing big linear system among many processors.

Need simultaneous isamax, swaps and saxpys

$$y_i \leftarrow y_i + \alpha_i x_i$$

$$Y \leftarrow Y + XA$$

where A is diagonal

Note isamax is very machine dependent

(2)Simultaneous generation of different Givens rotations

a. Parallel chasing in reduction of narrow banded system to tridiagonal form

b. parallel reduction of narrow banded symm. positive definite $Ax = \lambda Bx$

c. parallel chasing in symmetric tridiagonal eigenvalue problem

d. sparse least squares on independent rows

e. very machine dependent-parallel if’s vs. max

(3) Parallel application of different Givens transformations

(4) Above with Householder-Bruno Lang