

SuperLU Implementation and Timings

CRS (with implementation help from Xiaoye Li), 9/26/03

- SuperLU is a sparse direct solver package that is part of the ACTS collection—source can be downloaded.
 - Three varieties: serial (Seq_SLU), distributed memory parallel (SLU_DIST), and shared memory.
 - Has minimum degree reordering but can use external ordering routines.
 - Does not assume symmetry.
 - Suggested by Dinesh Kaushik of the PETSc group.
- NIMROD implementation can link to either Seq_SLU or SLU_DIST.
 - Iter_cg_* modules now have routines to convert rblock matrix format to compressed column format (or LAPACK banded format).
 - Can be done for triangles.
 - New makefile system allows user to select the desired solver library.
 - “Link” libraries in the “externals” directory have C routines that interface SuperLU.

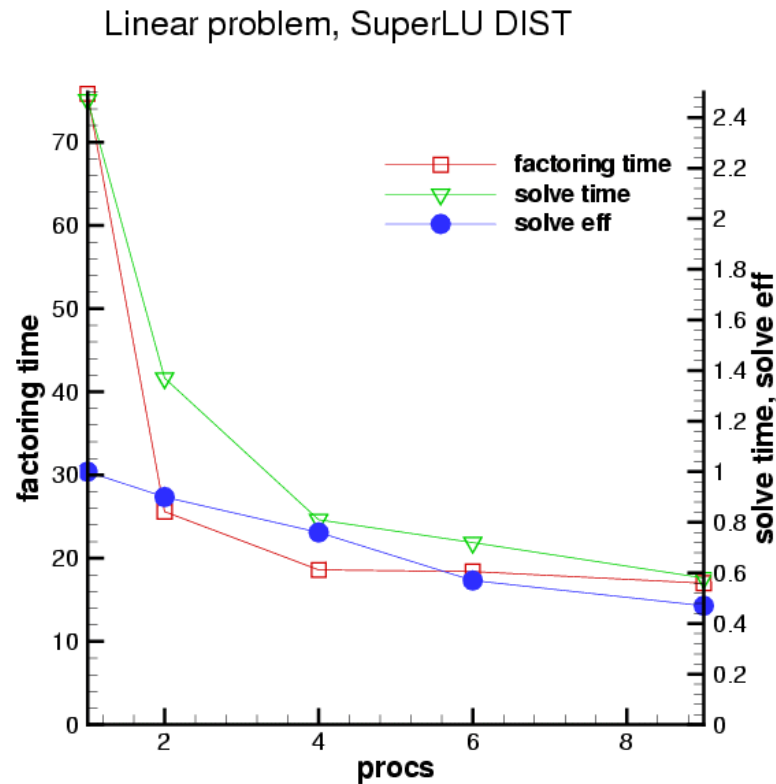
Timing Information

- With sufficient memory, serial linear computations can be 100 times faster than with our preconditioned CG.
 - Systems are ill-conditioned (direct is better but some iteration may still be required to achieve accuracy).
 - Our systems are small due to high-order elements.
 - A bicubic 32×32 linear computation runs 500 time-steps in about 12 minutes on our Pentium IV desktop.

Parallel Timing Information

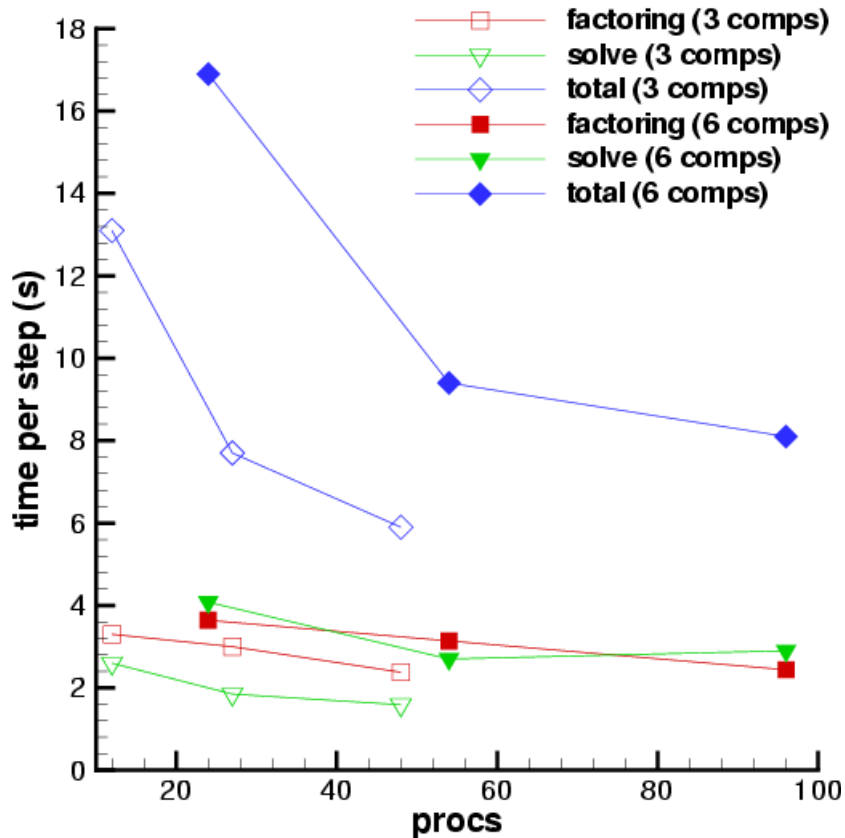
- Fixed-problem size parallel scaling is not as good as PCG, but the starting point is so much better that SLU seldom loses.

- 32×32 biquartic.
- Run on seaborg.

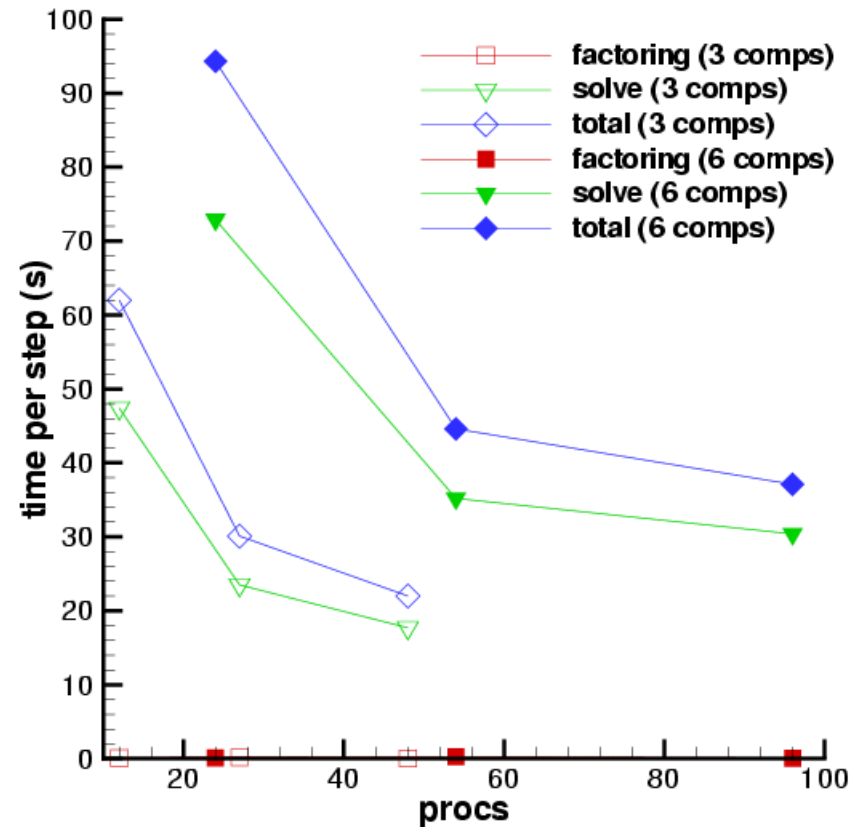


SLU_D is also effective for nonlinear problems.

Nonlinear problem, SuperLU DIST



Nonlinear Problem: native cg solver



- 32×32 biquartic D3D computation, all factors recomputed ~ 1 in 8 steps.
- Solve time includes 3D solves with SLU_D as the preconditioner.

Next Steps

- A fortran utility for direct nonsymmetric solves with SuperLU.
 - **UPDATE 9/26/03:** complete iter_dir_nonsym.f
 - Also made residual computations, norms, and dot products for all iterative solves into a separate module, iter_utils.
 - Now used for implicit equilibrium flow.
 - New Hall advance is next.
- Try a sparse solver designed for Hermitian systems.
 - But not SPOOLES—at least not yet (Esmond Ng).
 - Mike Heroux recommends DSCPACK.