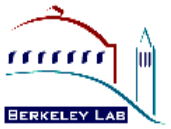
SAP – parallel preconditioning (1/2)



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- We are developing a numerically-stable hybrid solver
  - **It is based on Domain Decomposition: interior domains are solved directly using SuperLU_DIST, while the interface (Schur complement) is solved iteratively, with an incomplete LU factor (ILU) as preconditioner.**
  - **Its numerical properties are independent of number of CPUs.**
  - **Implementation: extension of the state-of-the-art software**
    - **Use existing graph partitioning software (e.g., ParMetis, Scotch) to obtain a multilevel hierarchical interface decomposition**
    - **Modify SuperlU_DIST to do parallel ILU**
  - **Preliminary evaluation shows that for medium sized matrices (e.g. matrix121 of M3D-C1), the hybrid solver uses 30% of memory, and is 2-3 times faster with 4-8 CPUs.**

SAP – parallel preconditioning (2/2)

- ILU enhancement to SuperLU
  - **Use both level-of-fill and threshold-dropping heuristics to constrain memory growth.**
  - **Retain supernode (dense matrix) structure while dropping, so to maintain good time efficiency.**
- We are also developing linear-complexity factorization-based preconditioners (with Ming Gu (UCB), Panayot Vassilevski (LLNL))
  - **Use accurate low-rank approximation for semi-separable submatrices appeared throughout the course of factorization. The resulting approximate factorization has nearly linear complexity both in time and in memory.**
  - **Can perform block factorization with direction preserving property, which should be an effective interpolation matrix in an Algebraic Multigrid method.**
- Plan in half a year
  - **Make available a prototype parallel ILU and hybrid solver.**
  - **Tune the algorithm/code for the matrices from M3D-C1 and NIMROD.**