Jun Zhang

A Class of Truly Parallel Multilevel ILU Preconditioning Techniques

Department of Computer Science
University of Kentucky
773 Anderson Hall
Lexington
KY 40506-0046
jzhang@cs.uky.edu
Chi Shen

We present a class of parallel preconditioning techniques built on a multilevel block incomplete LU (ILU) factorization strategy to solve large sparse linear systems on distributed memory parallel computers. The preconditioners are constructed by using the concept of block independent sets, block incomplete LU factorization, and Schur complement matrix. The most important step in building such a preconditioner is the construction of the block independent set. Two algorithms for constructing block independent sets of a sparse matrix in a distributed memory environment are proposed.

The new feature of this parallel multilevel preconditioner is the fully parallel construction of the block independent set in a distributed environment. Previous multilevel preconditioners are either using a pseudo-multilevel strategy or limited to two levels, due to the difficulty in constructing the block independent set in a distributed environment.

We compare a few implementations of the parallel multilevel ILU preconditioners with different block independent set construction strategies and different coarse level solution strategies. For stability purpose, we utilize a diagonal thresholding strategy both for the block independent set construction and for the local block Schur complement ILU factorization.

We will comment on the advantages and disadvantages of different strategies in constructing the block independent set, and possible future research directions along this line.

Numerical experiments indicate that our domain based fully parallel multilevel block ILU preconditioners are robust and efficient.

This research was supported in part by the U.S. National Science Foundation under grants CCR-9902022, CCR-9988165, CCR-0092532, and ACI-0202934, by the U.S. Department of Energy Office of Science under grant DE-FG02-02ER45961, by the Japanese Research Organization for Information Science &

Technology, and by the University of Kentucky Research Committee.