

Approximate Inverse Preconditioning using POSIX threads on multicore systems

G.A. Gravvanis^a, C.K. Filelis-Papadopoulos^a, K.M. Giannoutakis^b
and E.A. Lipitakis^c

^aDepartment of Electrical and Computer Engineering, School of Engineering,
Democritus University of Thrace, University Campus, Kimmeria,
GR 67100 Xanthi, Greece

^bCentre for Research and Technology Hellas, Informatics and Telematics Institute,
GR 57001, Thermi, Greece

^cDepartment of Informatics, Athens University of Economics and Business,
76 Patission street, GR 104 34 Athens, Greece
ggravvan@ee.duth.gr, chripapa9@ee.duth.gr, kgiannou@iti.gr,
eal@aueb.gr

Key words: Sparse linear systems, parallel preconditioned conjugate gradient method, parallel computations, POSIX threads, multicore systems.

During the last decades, explicit approximate inverse preconditioning methods have been extensively used for efficiently solving sparse linear systems on multiprocessor systems. The effectiveness of explicit approximate inverse preconditioning schemes relies on the use of efficient preconditioners that are close approximants to the coefficient matrix and are fast to compute in parallel.

In this article, new parallel computational techniques are proposed for the parallelization of explicit preconditioned conjugate gradient type methods, based on Portable Operating System Interface for UniX (POSIX) Threads, for multicore systems. For parallelization purposes, a replication of the parallel explicit preconditioned bi-conjugate conjugate gradient - STAB (PEPBiCG-STAB) method was assigned on each created thread, with different index bands and with proper synchronization points on inner products and matrix-vector multiplications. The excessive overhead produced by the template-based parallel implementations was avoided by using POSIX Threads, maximizing the overall performance of the parallel implementation of the PEPBiCG-STAB method and throttling it close to the corresponding theoretical estimate.

Finally, numerical results for the performance of the PEPBiCG-STAB method for solving characteristic two dimensional boundary value problems on multicore computer systems are presented, which are favorably compared to corresponding results from multiprocessor systems. The implementation issues of the proposed method are also discussed using POSIX Threads on a multicore computer system.