Guest editorial

Special issue on parallel matrix algorithms and applications

This issue of the journal contains 11 articles selected from invited and contributed presentations made at the Workshop on Parallel Matrix Algorithms and Applications, which was held in Neuchâtel, Switzerland, on August 18–20, 2000. The workshop was well attended with participants from all over Europe and the United States. Papers presented at the workshop covered many aspects of parallel numerical linear algebra algorithms. Most provided results regarding the performance of these algorithms on existing parallel computational platforms. Other presentations, however, provided only theoretical analysis of performance on hypothetical architectures. Moreover, some presentations dealt with whole applications in science or engineering in which the performance of a parallel matrix algorithm dominated the performance of a whole application. It is of interest to note that compared to a decade ago, performance results on existing parallel architectures were presented only on three platforms: the IBM SP2, SGI’s Origin-2000, or on a cluster of workstations.

Papers contained in this issue deal with parallel dense linear algebra kernels and algorithms, issues in dynamic scheduling, algorithms for sparse linear systems of equations and linear least squares problems, as well as parallel matrix algorithms that dominate performance in air pollution modelling codes.

Beaumont, Legrand, Rastello and Robert in Dense Linear Algebra Kernels on Heterogeneous Platforms: Redistribution Issues consider the redistribution of data during the computation of a large numerical kernel, where the speed of processors may vary during execution. The proposed strategy offsets the disadvantages of fully static and dynamic methods. It provides a good load balancing by redistributing data after some well identified static phases.

Schenk and Gärtner present a parallelization strategy based on dynamic two-level scheduling scheme of the PARDISO package in their paper Two-Level Dynamic Scheduling in PARDISO: Improved Scalability on Shared Memory Multiprocessing Systems. This strategy has resulted in an efficient sparse LU decomposition method. Numerical results are provided and the performance of the implementation is investigated.

Mezher and Philippe consider the parallel path following algorithm using triangles (PPAT) for the computation of pseudospectra in their paper Parallel Computation...
of Pseudospectra of Large Sparse Matrices. The PPAT never fails and provides large granularity for parallelism. The implementation of PPAT is shown and numerical results indicate its reliability and efficiency.

Bekas and Gallipoulos propose a parallel method for the computation of pseudospectrum in their paper Parallel Computation of Pseudospectra by Fast Descent. The implementation of the pseudospectrum descent method is described. Experimental results are obtained and used to analyze the performance of the implementation.

A method for the parallel computation of the singular value decomposition is proposed by Bečka, Okša and Vajteršic in Dynamic Ordering for a Parallel Block-Jacobi SVD Algorithm. Dynamic ordering and its incorporation into the parallel two-sided block-Jacobi algorithm is the main characteristic of this method. Computational results on an SGI-Cray Origin 2000 parallel system compare the amount of work required using the dynamic and static cyclic parallel orderings.

In The Chebyshev Iteration Revisited Gutknecht and Röllin consider the Chebyshev iteration method that does not require inner products. This method is well suited for parallel systems with high communication costs. Six parallel implementations of this method are presented and compared with respect to accuracy.

Sameh and Sarin in Parallel Algorithms for Indefinite Linear Systems investigate two algorithms for solving saddle-point problems arising in incompressible fluid simulations. The parallelization of the algorithms on shared-memory architectures are presented. The performance and scalability of the implementations is evaluated.

The block partitioning and scheduling problem for sparse parallel LDL$^T$ factorization without pivoting is considered by Hénon, Ramet and Roman in PaStiX: A High-Performance Parallel Direct Solver for Sparse Symmetric Positive Definite Systems. Numerical results obtained on an IBM SP2 using sparse matrices found in structural mechanics and computational fluid dynamics are provided. The scalability of the parallel factorization is discussed.

The generalized least-squares preconditioning polynomial and its influence on the flexible generalized minimized residual solver are discussed by Liang, Weston and Szularz in their paper Generalized Least-Squares Polynomial Preconditioners for Symmetric Indefinite Linear Equations. A parallel algorithm which efficiently constructs the preconditioning polynomials is presented. Experimental results on an IBM SP2 are analysed. The results are compared with that obtained using the SPI algorithm.

Two parallel algorithms to compute the restricted maximum likelihood estimation of the general linear model with large sparse covariance matrix are presented by Malard in Parallel Restricted Maximum Likelihood Estimation for Linear Models with a Dense Exogenous Matrix. The algorithms have been implemented on distributed memory computers using publicly available tools. Numerical results are provided and the performance of the implementations analyzed.

Owczarz and Zlatev in Parallel Matrix Computations in Air Pollution Modelling consider computational efficient and numerically accurate methods for the solution of a large-scale air pollution model on parallel architectures. The organization of the computations to take advantage of the specific characteristics of a parallel system are emphasized. Experimental results on vector processors, shared and distributed memory systems are presented.
Guest editorial

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