Topic 11
Numerical Algorithms

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Following the traditions of previous Euro-Par Conferences, Euro-Par 2002 includes the topic “Numerical Algorithms”. This topic has been scheduled this year for two afternoon sessions on Thursday, 29 August.

Current research and its applications in nearly all areas of natural sciences involves, with increasing importance, mathematical modelling and numerical simulation. Indeed, such a basis for computation also has been extended to other disciplines like engineering and economics. At the same time, there is a continuously increasing number of requests to solve problems with growing complexity. It is thus nearly superfluous to say that the efficient design of parallel numerical algorithms becomes more and more essential. We have addressed this development by proposing two sessions this year and have accepted over half of all submitted papers. The support of the Euro-Par Organizing Committee is gratefully acknowledged here.

As for previous Euro-Par Conferences, we have accepted only papers in which fundamental numerical algorithms are addressed and which are therefore of a wide range of interest, including parallel numerical algebra with new developments for the Fast Fourier Transform, QR-decomposition, and parallel methods for solving numerically large scale ordinary differential equations. Closely interlinked to these topics we have included recent results on modern solution procedures for partial differential equations, treatment of large sparse linear systems, multigrid and domain decomposition methods.

According to this selection, we have divided the presentations into two sessions. One is mainly devoted to methods of parallel linear algebra and the second to parallel methods for PDEs.

The first paper in the first session for this topic, by R.D. da Cunha, D. Becker and J.C. Patterson presents a new rank-revealing QR-factorization algorithm. The algorithm is integrated into an algorithm due to Golub and van Loan to determine the rank. Coded in F90 with MPI and running on several parallel systems, the authors obtained good parallel performance of the resulting algorithm which, as is well known, has so many important applications. Having in mind applications to control theory, the next paper by J.M. Badia, P. Benner, R. Mayo and E.S. Quintana-Orti presents a new parallel method for solving Lyapunov's equation, extending existing methods for the corresponding small-scale problem with dense matrices to the large scale case with sparse matrices. This paper is then followed by a new parallel blocking procedure for a very large scale FFT given by D. Takahashi, T. Boku and M. Sato who investigated the challenging problem of a parallel version. Based on a block nine-step idea, the authors were able to reduce the number of global communications. The paper by S.H.M. Bui-

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jssen and S. Turek discusses the loss of efficiency of the multigrid method when only block smoothers are allowed, as is the case for complex applications on parallel systems. The analysis is carried out for a parallel finite-element program which solves the Navier-Stokes equations and which has been applied successfully to a variety of industrial problems. As an alternative approach to the parallel multigrid method, the second session starts with a contribution by I.G. Graham, A. Spence and E. Vainikko who use a domain decomposition method combined with a block-preconditioned GMRES version for parallelizing a Navier-Stokes solver. The preconditioner, based on a recent proposal of Kay, Loghin and Wathen, has been generalized here to the case of block-systems. In addition, the authors discuss the stability of the flow problem by applying their linear solver. The resulting generalized eigenvalue problem (large scale with indefinite matrices) is then iteratively solved by the abovementioned variant of GMRES. These last two contributions on PDEs are supplemented by a paper on a parallel 3D-multifrontal mesh generator written by D. Bouattoura, J.-P. Boufflet, P. Breitkopf, A. Rassineux and P. Villon. The method presented by these authors is based on existing corresponding sequential programs for subdomains and is thus attractive for both the parallel multigrid and the domain decomposition approach. The method is constructed for very large scale problems on complex domains. Finally, in the paper of M. Koch, T. Rauber and G. Rünger a parallel implementation is given for solving numerically large scale ordinary differential equations. The authors constructed a parallel version of an embedded Runge-Kutta method and discussed the improvements in efficiency of different variants of their program.

We hope and we believe again that the sessions contain a highly interesting mix of parallel numerical algorithms. We would like to take this opportunity of thanking all contributing authors as well as all reviewers for their work. We owe special thanks to Jan Hungershöfer, Rainer Feldmann and Bernard Bauer from the staff in Paderborn for their patience and assistance.