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Schnelle Löser für Partielle Differentialgleichungen

Organised by
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May 22nd – May 28th, 2011

Abstract. The workshop *Schnelle Löser für partielle Differentialgleichungen*, organised by Randolph E. Bank (La Jolla), Wolfgang Hackbusch (Leipzig), and Gabriel Wittum (Frankfurt am Main), was held May 22nd – May 28th, 2011. This meeting was well attended by 54 participants with broad geographic representation from 7 countries and 3 continents. This workshop was a nice blend of researchers with various backgrounds.

Mathematics Subject Classification (2000): 65N55, 65M55, 65M60, 65N30, 65N50, 65F10, 65F50, 65H10, 65K10.

Introduction by the Organisers

The conference was organized by Randolph E. Bank, UCSD, La Jolla, Wolfgang Hackbusch, MPI Leipzig, and Gabriel Wittum, University of Frankfurt. This was the fifth one in a series of conferences on fast solvers held at Oberwolfach since 1999. The idea of these workshops is to bring together experts from the different thriving areas of solvers and offer a platform for scientific exchange and progress.

The field of solvers for the algebraic systems arising from the discretization of partial differential equations has developed to a major area of numerical mathematics and scientific computing. Solvers are the essential part of simulation codes for problems from science and technology, in many cases determining the complexity of the whole simulation. By virtue of that, the choice of the solver can decide on the realiability of a simulation and if it can be done at all. Thus, solvers are a substantial mathematical component of most simulation tools and a major contribution of mathematics to quite a lot of applied disciplines. This has increased

the interest in mathematics of colleagues from the applied sciencies over the last decade substantially.

Major areas of solvers represented at the workshop are: Multigrid methods, H-matrices, domain decomposition methods, and conjugate gradient methods and their scalable parallelization on huge numbers of cores. Often these methods are combined, e.g. conjugate gradient like methods are used as accelerator for multigrid. Besides that, several talks were given on other aspects of solving partial differential equations, such as discretization schemes and the algebraic properties of the resulting stiffness matrices, overall solution strategies, and application areas where solving plays a crucial rle. The question of the right solver for critical application problems is still open, but new approaches have been developed in recent years. New light is shed on the solver question by the recent change of paradigm in computer architecture. The modern multicore processors with additional strong GPU and MIC accelerators pose a new and serious challenge for the development of fast solvers. A total of ... presentations gave a nice overview over the current research, open problems and new developments. Intense discussions provided the opportunity to go into details of novel algorithms and approaches. In multigrid methods, a lot of research is going in the direction of developing robust methods for special applications. This is a challenging topic requiring mathematical expertise as well as understanding of the model and the application process itself. Another major topic is Algebraic Multigrid. AMG methods are already wide spread in several applied communities. However, a lot of open problems remains and the final algorithm is not yet in sight. Several talks also were related to performance issues of multigrid on certain computer architectures such as super scalar or parallel computers. Multigrid research is thriving more than ever. Another bunch of talks were about domain decomposition methods. These methods are of particular interest for multiphysics problems and parallelization issues. Several new developments have been reported and discussed, giving interesting future perspectives. Often techiques from domain decomposition analysis can be used to analyze other methods e.g. multigrid. A novel technique useful together with domain decomposition and multigrid, but can also stand on its own, are hierarchical matrices (H-matrices). Here, several talks have shown the impressive level of development these methods already have obtained. Tensor representation and solving the corresponding equations was discussed in several talks at the conference. This novel class of numerical reduction methods got a lot of attention. It comes from solving high dimensional problems, but can be used to reduce also low dimenisonal ones. Further talks have discussed solver techniques for application problems as well as other problem areas like optimization. In total, the workshop was very successful in bringing together international-level experts from different areas and disciplines. Meanwhile, the Oberwolfach workshop on *Schnelle Löser für partielle Differentialgleichungen* is established as major event in the solver community and a mainstay for novel developments.