Iterative solvers for heterogeneous Helmholtz problems

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August 19, 2004

Abstract

It appears that robust and efficient parallel iterative solvers are crucial for the solution of the discretized 3 dimensional Helmholtz equation. Two popular classes of iterative solvers are: preconditioned Krylov solvers and multigrid methods.

In this talk we give an introduction to the preconditioned Krylov solvers. We explain the relation between eigenvalues and the convergence of Krylov methods for symmetric and non-symmetric matrices. Furthermore, the relation between the eigenvalues and the wave number shall be given. These insights help us to select the best Krylov method and give guidelines for the development of good preconditioners.

An explanation is given of why the classical multigrid method does not work for the discretized Helmholtz equation. However the multigrid method shows a fast convergence for the solution of the shifted Laplace preconditioner, which is closely related to the Helmholtz operator. This preconditioner combined with a Krylov solver is currently our method of choice. Details and results are given in the talk of Yogi Erlangga.