Applied Mathematics

McGill
Joint Applied Mathematics/CSE Seminar

March 1, 2002

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Title: Textbook Multigrid Efficiency in Computational Fluid Dynamics

Friday March 1,2002

Time: 2:30 pm

Room: Burnside 1205

Abstract: Full multigrid (FMG) algorithms are the fastest solvers for elliptic problems. These algorithms can solve a general discretized elliptic problem to the discretization accuracy in a computational work that is a small (less than 10) multiple of the operation count in one target-grid residual evaluation. Such efficiency is known as textbook multigrid efficiency (TME). The difficulties associated with extending TME for solution of the Reynolds-averaged Navier-Stokes (RANS) equations relate to the fact that the RANS equations are a system of coupled nonlinear equations that is not, even for subsonic Mach numbers, fully elliptic, but contain hyperbolic partitions. TME for the RANS simulations can be achieved if the different factors contributing to the system could be separated and treated optimally, e.g., by multigrid for elliptic factors and by downstream marching for hyperbolic factors. One of the ways to separate the factors is the distributed relaxation approach.

In this talk, I am going to briefly outline the basic multigrid ideas and their applications to solution of PDE. The concept of distributed relaxation will be discussed in more details. A general framework for achieving TME in solution of the Navier-Stokes equations will be presented. Some numerical results confirming TME for distributed-relaxation solvers will be demonstrated for viscous incompressible and subsonic compressible flows with boundary layers and for inviscid compressible transonic flows with shocks.