Discretization and Solution Algorithms for Problems in Incompressible Fluid Dynamics

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Abstract

We discuss the discretization and iterative solution of several problems arising in the modeling of incompressible flow. In the first lecture we focus on the convection-diffusion equation.

We show how stabilization is used to overcome limitations of standard finite element discretization arising when boundary layers are present in solutions, and we show how this issue also influences the performance of iterative algorithms for solving the algebraic problems obtained from discretization.

In the second lecture, we explore solution algorithms for the incompressible Navier-Stokes equations. We discuss some effective new preconditioning algorithms that can be used in conjunction with Krylov subspace methods so solve linearized versions of these equations, and we demonstrate that effective methods for subsidiary problems, in particular the convection-diffusion equation, are used to produce algorithms with low computational costs.