



Navier-Stokes Equations in Planar Domains

Matania Ben-Artzi, Jean-Pierre Croisille, Dalia Fishelov

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This volume deals with the classical Navier-Stokes system of equations governing the planar flow of incompressible, viscous fluid. It is a first-of-its-kind book, devoted to all aspects of the study of such flows, ranging from theoretical to numerical, including detailed accounts of classical test problems such as “driven cavity” and “double-driven cavity”.

A comprehensive treatment of the mathematical theory developed in the last 15 years is elaborated, heretofore never presented in other books. It gives a detailed account of the modern compact schemes based on a “pure streamfunction” approach. In particular, a complete proof of convergence is given for the full nonlinear problem.

This volume aims to present a variety of numerical test problems. It is therefore well positioned as a reference for both theoretical and applied mathematicians, as well as a text that can be used by graduate students pursuing studies in (pure or applied) mathematics, fluid dynamics and mathematical physics.

Contents:

• *Basic Theory:*

- Introduction
- Existence and Uniqueness of Smooth Solutions
- Estimates for Smooth Solutions
- Extension of the Solution Operator
- Measures as Initial Data
- Asymptotic Behavior for Large Time
- Some Theorems from Functional Analysis

• *Approximate Solutions:*

- Introduction
- Notation
- Finite Difference Approximation to Second-Order Boundary-Value Problems
- From Hermitian Derivative to the Compact Discrete Biharmonic Operator
- Polynomial Approach to the Discrete Biharmonic Operator
- Compact Approximation of the Navier–Stokes Equations in Streamfunction Formulation
- Fully Discrete Approximation of the Navier–Stokes Equations
- Numerical Simulations of the Driven Cavity Problem

Readership: Graduate students and researchers in applied mathematics (particularly computational fluid dynamics), partial differential equations, and mathematical physics (specifically nonlinear evolution equations).

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