on embedding the 2D space periodic NSE into a larger system of reaction-diffusion type, for which the gap condition is less severe. However, after the publication of this book it was found that this argument is incomplete, and it is still unknown whether the NSE possess an inertial manifold or not. The gap in the proof is related to the fact that the linear part of the new system is no longer self-adjoint, as will be explained in the forthcoming second printing of the text.

I think that Temam has achieved his goal: using these notes a reader with a good background in functional analysis will go quickly to some advanced topics in the Navier-Stokes equations. With its ample bibliographical comments the text is also a nice survey of interesting questions, techniques, and results.

STIG LARSSON
CHALMERS UNIVERSITY OF TECHNOLOGY AND GÖTEBORG UNIVERSITY
S-41296 GÖTEBORG, SWEDEN
E-mail address: stig@math.chalmers.se

16[76-02, 76D05, 76Mxx, 65Mxx]—*Numerical solution of the incompressible Navier-Stokes equations*, by L. Quartapelle, International Series of Numerical Mathematics, Vol. 113, Birkhäuser, Basel, 1993, xii + 291 pp., 24 cm, $100.00

The professed aim of this book is to "give a unitary (unified?) view of the methods which reduce the equations for viscous incompressible flows to a system of second-order equations of parabolic and elliptic type". Such methods are popular especially with engineers and have the advantage of avoiding the approximation of the incompressibility condition and the numerical stability issues associated with such approximations. These "nonprimitive variable" methods on the other hand suffer from the difficulty of providing meaningful boundary conditions for the new variables, such as the vorticity, that are introduced. Much of the original work contained in this book consists in deriving appropriate conditions which turn out to be of integral type. Additionally, the equivalence of these various formulations with the original primitive variable equations is demonstrated.

Chapter 1 is introductory in nature and contains a short but interesting discussion of the issue of compatibility of initial data. Chapter 2 is concerned exclusively with two-dimensional flows. The classical vorticity-stream function formulation is derived. The lack of boundary conditions for the vorticity ζ motivates the elimination of ζ and the formulation of a fourth-order (biharmonic) equation for the stream function ψ. Alternatively, integral vorticity conditions are derived which allow the uncoupling of ζ and ψ. The integral nature of these conditions is compatible with the fact that ζ is less regular than the velocity $\mathbf{u}$. Implementations of these integral conditions by means of finite difference, finite element and spectral methods are also given.

In chapter 3, the discussion is extended to three-dimensional flows. The technical issues are vastly different since both the vorticity and stream function are now vector variables. Indeed, there are six unknowns now instead of four in the original formulation.

Chapter 4 is devoted to vorticity-velocity formulations in both 2 and 3 dimensions. Even though there are several advantages associated with them, such "hybrid" formulations have remained relatively unexplored.

In chapter 5 a method for obtaining a system in the primitive variables $\mathbf{u}$ and p is presented. One starts from a semidiscretization in time of the Navier-Stokes equations by means of a time stepping method; then the continuity equation is eliminated to obtain a Poisson equation for the pressure. An integral condition for the pressure is then derived supplementing the system. Chapter 7 is devoted to a discussion of the fractional-step projection method for the primitive-variable Navier-Stokes equations. Chapter 8 is concerned with the incompressible Euler equations the emphasis being placed on discretizations by Taylor-Galerkin methods. Finally, a set of appendices provide expressions for vector differential operators in orthogonal curvilinear coordinates and other useful vector identities.

The book succeeds in achieving its intended goal. It gathers a wealth of useful information some of which is new while the rest is scattered in the literature. Although the mathematical background required is such that the book is accessible to students and beginning researchers, a significant amount of the material included can be only appreciated by the more experienced practitioner. There are however a great number of typos and minor grammatical offences which fortunately do not manage to destroy the otherwise flowing narrative.

Ohannes Karakashian
Department of Mathematics
University of Tennessee
Knoxville, TN 37996-1300

17[65-02, 65Lxx, 65Mxx]—*Theory and numerics of ordinary and partial differential equations*, by M. Ainsworth, J. Levesley, W. A. Light and M. Marletta, Oxford University Press, Oxford, 1995, xiii + 333 pp., 24 cm, $62.00

This book, the fourth in the series Advances in Numerical Analysis, consists of lecture notes by six invited speakers at the SERC Summer School in Numerical Analysis that was held at the University of Leicester in July of 1994. The topics presented fall into two categories: ordinary and partial differential equations. The stated aim of the lectures is "to be accessible to beginning graduate students and to progress to a point where, by the final lectures, current research problems could be described". In my opinion the lectures have succeeded admirably in this regard. Of particular note is the effort to make ancillary materials available to the reader. For example, Professor Corliss provides the reader with an anonymous ftp address for the LaTeX source file, MAPLE worksheets, and bibliography used in his lecture notes. Professor Johnson gives an anonymous ftp site and a WWW URL for various versions of the Femlab software package used in solving initial/boundary problems for ODE's and PDE's. Similarly, Professor Petzold provides electronic Internet references (via Netlib) to software for solving ODE's and DAE's.

In the area of ordinary differential equations the speakers and the title of their lectures are as follows:

1. George Corliss: *Guaranteed Error Bounds for Ordinary Differential Equations*, pp. 1–75.
2. Linda Petzold: *Numerical Solution of Differential-Algebraic Equations*, pp. 123–142.
3. Marino Zennaro: *Delay Differential Equations: Theory and Numerics*, pp. 291–333.