[4] J. Renegar, *A polynomial-time algorithm, based on Newton's method for linear programming*, Math. Programming **40** (1988), 59–93. MR **89b:**90130

[5] C. Roos, T. Terlaky, and J. P. Vial, *Theory and algorithms for linear optimization: An interior point approach*, John Wiley, Chichester, 1997. CMP 97:13

[6] R. Saigal, *Linear programming: A modern integrated analysis*, Kluwer Academic Publishers, Boston, 1995. MR **97h:**90003

[7] R. J. Vanderbei, *Linear programming: Foundations and extensions*, Kluwer Academic Publishers, Boston, 1996. MR **97i:**90002

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9[65-01, 65-04]—*Computational mathematics in engineering and applied science: ODEs, DAEs, and PDEs*, by William E. Schiesser, CRC Press, Boca Raton, FL, 1994, xii+587 pp., 26 cm, $74.95

This is an engineering book on scientific computation, a book on computing by Fortran programming. More than half of the contents are source codes (with many comment lines), data files, and output information. There are no convergent theories.

The main stream of the book is the method of lines. The basic idea in the method of lines for PDEs is to replace the spatial derivatives with algebraic approximations, thereby leaving only the time derivatives. The procedure produces an ODE at each spatial grid, and the resulting system of ODEs can be solved by a known ODE solver. Basically, the method of lines is a systematical way of using ODE solvers to integrate PDEs.

The methodology is illustrated through detailed examples in Fortran 77 coding. The underlying mathematics of the methods are not discussed in detail, and theoretical analyses are not provided. Effectiveness and validity of the methods are discussed through observation from the output of the computation, and the error analyses of computed solutions are presented numerically as part of the example applications.

All examples are coded in the same format and presented in the following structure: (1) start from an example which includes a differential equation and initial and/or boundary conditions; (2) explain the coding, list all subroutines and data files, and comment on their purposes; (3) list some output and draw some conclusions from computing experience. Almost every example calls for some library routines, usually, differential routines and integration routines. Instead of writing an entire code from the very beginning, the author proposes to use quality library routines which have achieved the status of international standards. However, the author does not recommend the uninformed use of library routines, since some knowledge of differential equation characteristics and numerical methods will invariably lead to more effective use of existing packages.

The intention of the book is not to provide the state-of-art methods, rather it is to introduce some practical methods proved to be effective in dealing with some typical problems. Therefore, the book is a source of some practical tools for numerical methods of ODEs and PDEs. Because of its elementary contents, the book is also suitable for beginners.

The reader may request Fortran source codes from the author for problems and library routines discussed in the book. Since the codes are for PCs, a Unix user may need some minor editing after downloading a source code, for example, to get rid of

^M

at the end of each line.

The organization of the book is according to equations' types, rather than methods. Chapter 1 is a brief summary (only 16 pages) of various types of ODEs, DAEs, and PDEs. Chapter 2 occupies almost one third of the contents of the book which covers the numerical solution of ODEs and DAEs. The Runge-Kutta methods are introduced and discussed in detail. The use of a nonlinear algebraic equations solver SNSQE and the use of a library routine RKF45 are illustrated by an orbit problem. The issue of stability is briefly discussed. Multiple-step methods of both explicit (for nonstiff equations) and implicit (for stiff equations) are discussed in some detail. This chapter also includes some examples of unconventional uses of ODE integrators.

The remaining three chapters are devoted to PDEs. Chapters 3 and 4 discuss the PDE with first order time derivative while Chapter 5 considers PDEs with zero or second order in time. Chapter 3 has only two sections with the first one for PDEs containing first order spatial derivative and the second one for PDEs having second order spatial derivatives.

Chapter 4 is the longest chapter of the book with almost 200 pages. Many examples are demonstrated including diffusion equations, convective diffusion equations, the one-dimensional Burgers' equation and its modification, a PDE with mixed partial derivatives (this is an example with two spatial variables), an example that has strong nonlinearity, and others. A variety of topics are discussed in this chapter, including nonlinear PDE solutions with DAE solvers, nonuniform spatial grids in one-dimension, diffusion in two regions, and band-width reduction in the method of lines. Other than the finite difference method, this chapter also discusses the finite volume method briefly and linear finite elements in detail for a model parabolic equation with one spatial variable.

Chapter 5 basically considers wave equations with one spatial variable and the two-dimensional Poisson equation. For the latter, a time derivative is added to the equation in order to apply the method of lines.

In addition, Appendix C lists some applications in practice using the methods discussed in the book.

The book contains many interesting examples, including some nonlinear problems from practical applications. However, most examples for PDEs have only one spatial variable. For those examples with two spatial derivatives, domains are all regular. Nonrectangular domains and general meshes are not addressed. There is no example for three spatial derivatives.

As a final remark, the book does not have enough subsections and the arrangement of the material makes it a little difficult to locate the needed information later.

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