a list of notations, as well as an explanation of numbers and formulae, the author's method of numbering theorems, and an explanation of the author's use of generic constants. These additions are worthwhile to both reader and student.

At the end of the text we find several pages devoted to a bibliography as well as to an index.

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23[41A05, 41A10, 42A15, 65D05, 65M70, 65T10]—*A practical guide to pseudospectral methods*, by Bengt Fornberg, Cambridge Monographs on Applied and Computational Mathematics, Cambridge Univ. Press, New York, NY, 1996, x + 231 pp., $23\frac{1}{2}$ cm, hardcover, $54.95

This is the first book in the series "Cambridge Monographs on Applied and Computational Mathematics". The stated goal of this series is to publish expositions on all aspects of applicable and numerical mathematics, with an emphasis on new developments in this fast-moving area of research. On the whole, this first book in the series is well written and is clearly in line with the stated goal of the series.

Spectral methods have been under rapid development in the last 20 years. There are many books written in this period, most notably the pioneer book by Gottlieb and Orszag in 1977 [1] and the comprehensive book by Canuto, Hussaini, Quarteroni and Zang in 1988 [2]. The book under review is different from all others in the following aspects. It is not a comprehensive book about spectral methods. The content is restricted to the subject of pseudospectral (PS) methods, which are equivalent mathematically to the interpolation, or collocation, methods. Galerkin methods are thus not covered in the book. Also, the author puts his own research experience into the book, notably the relationship between the finite difference (FD) and the PS methods. The approach of using the limit of FD when stencil is widened to define PS methods is advocated by the author. This book is perhaps the best resource for the readers to fully understand this approach.

The book contains eight chapters and eight appendices. After a brief introduction in Chapter 1, the author introduces spectral methods as expansions in orthogonal functions in Chapter 2. Different ways of determining the expansion coefficients are briefly mentioned, and the goal of the book, namely the discussion of the PS method, is stated. Difficulties of using the spectral method to approximate discontinuous functions, namely the Gibbs phenomenon, is also mentioned early in this chapter. Chapter 3 begins the introduction to PS methods via finite differences. The mechanism of finding the interpolation or differentiation matrices is discussed, and examples given for these matrices for different node distributions. The need to choose special node distributions to avoid divergence (Runge phenomenon) is discussed. Chapter 4 is perhaps the main chapter about the methodology. Several important properties of the PS approximations are discussed. This includes discussion about approximations to both smooth and nonsmooth functions. However, the discussion about approximations to nonsmooth functions seems not comprehensive. In practice there are examples requiring more sophisticated strategies than the ones advocated here. See, e.g. [3]. Chapter 5 discusses PS variations and enhancements in implementations. Several useful tricks in applications are discussed here. Chapter 6 describes PS methods in polar and spherical geometries. Chapter 7 compares the costs of FD and PS methods. Finally, in Chapter 8, applications of the PS method to turbulence modeling, nonlinear wave simulation, weather prediction, seismic exploration, and elastic wave solution, are discussed. Certain technical details are left to the appendices.

This is a useful book for practitioners who use PS methods to solve practical problems.

REFERENCES

1. D. Gottlieb and S. Orszag, *Numerical analysis of spectral methods*, SIAM, Philadelphia, PA, 1977. MR **58**:24983
2. C. Canuto, M. Y. Hussaini, A. Quarteroni and T. A. Zang, *Spectral methods in fluid dynamics*, Springer-Verlag, New York, 1988. MR **89m**:76004
3. D. Gottlieb and C.-W. Shu, *On the Gibbs phenomenon V: recovering exponential accuracy from collocation point values of a piecewise analytic function*, Numer. Math. **71** (1995), 511–526. MR **97b**:42005

CHI-WANG SHU

24[65Lxx, 65L06]—*Numerical solution of initial-value problems in differential-algebraic equations*, by K. E. Brenan, S. L. Campbell, and L. R. Petzold, Classics in Applied Mathematics, Vol. 14, SIAM, Philadelphia, PA, 1996, x + 256 pp., 23 cm, softcover, $29.50

This monograph is an updated reprint of a book that appeared with North-Holland earlier in 1989. Although DAE have been studied for some time now their discovery by numerical analysts is rather recent; Gear [1] was one of the first to study their numerical solution. In 1986 Griepentrog and März [2] published a first monograph on numerical treatment of DAE. The latter book together with the (second part) of Hairer and Wanner's ODE book [3] and the present monograph constitute the main textbook resource for the interested researcher.

DAE naturally appear in electric networks (from Kirchhoff's laws) and in multibody mechanics (where the restricted number of degrees of freedom provides for fewer state variables than needed to describe Newton's law of motion, cf. (robotic) arms), etc. In control theory they are indispensable. Interestingly some DAE appear naturally as a limiting case of a singularly perturbed ODE, i.e. the reduced equation. This then explains the strong relationship to numerical methods for stiff ODE (cf. [3]). In particular the work of Gear and also Petzold has been inspired strongly by the celebrated BDF methods, a particular class of multistep methods used for such stiff problems.

The book at hand follows a logical line in treating these DAE. It starts off with an overview of DAE arising in practical situations as mentioned above. In chapter 2 the index notion, related to a matrix pencil, is introduced. Since practical problems usually do not involve constant system matrices and are often even nonlinear in nature this index concept needs improvement. Therefore the solvability notion is first introduced here. In chapter 3 this is compared to an alternative found in [2], viz. transferability. The latter notion is somewhat more technical but appears to be geometrically fairly natural. Then the celebrated notion of (differential) index is given. There are various other index concepts; however, they appear to boil down