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.

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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 to the same, except for in some academic cases. The main emphasis throughout the book is on index 1 and index 2 systems. Often DAE appear in semi-explicit form, i.e. where an algebraic set of equations is appearing separately from the differential part (involving some or all the state variables). Higher index problems may be reduced to lower index ones, although it has a (numerical) price. In chapter 3 multistep methods are treated, with some particular emphasis on BDF methods. The code DASSL of the third author is given a lot of attention in chapter 5, which is anticipated here. Also some of the interesting work of März [2] c.s. is reviewed here. The important class of Runge-Kutta methods is considered in chapter 4, both for index 1 and index 2 systems. Here the material in [3] will be helpful as a more recent update of the state of affairs, as various articles by Petzold, Ascher, Lubich etc. on e.g. projected Runge-Kutta methods will be.

The software in chapter 5 comes in very handy as a reference source for users of the DASSL code. It contains both principles behind the implementation and hints how to use DASSL in various situations.

An application chapter concluded the first version of the book. In the present SIAM edition a new chapter has been added to fill some gaps and make at least the references more up to date. Some of them are really important ones and it is a pity that the authors have not seized the opportunity to rewrite the book for a second edition more thoroughly. As remarked in the beginning there are not many books on numerical ODE and this "SIAM classic" is therefore still a useful introduction and source of references on the subject.

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25[65F10, 65K10]—*Linear and nonlinear conjugate gradient-related methods*, Loyce Adams and J. L. Nazareth (Editors), SIAM, Philadelphia, PA, 1996, xvi + 164 pp., $25\frac{1}{2}$ cm, softcover, \$32.00

This book contains a collection of papers presented at an AMS-IMS-SIAM Summer Research Conference held in July, 1995. Most of the contributions are short notes or surveys containing observations about the conjugate gradient method and its place in optimization and numerical analysis. There are also a few research papers. Most of the authors are from either a sparse linear algebra or an optimization background, and the articles successfully elucidate the many connections between these two areas.

The basic conjugate gradient (CG) algorithm is a method for solving a linear system of equations $Ax = b$, where the coefficient matrix A is symmetric and positive