27[65–02, 65R20].—H. BRUNNER & P. J. VAN DER HOUWEN, *The Numerical Solution of Volterra Equations*, CWI Monographs, vol. 3, North-Holland, Amsterdam, 1986, xvi + 588 pp., $24\frac{1}{2}$ cm. Price \$55.00/Dfl. 150.00.

The numerical solution of Volterra equations (VE's) is a rather new subject. A subclass of VE's are ordinary differential equations (ODE's). The numerical treatment of this class is by now well understood. A commonly used approach, when discussing methods for VE's, is simply to transform results from ODE's to VE's. Concepts like convergence and stability are then inherited directly from the ODE theory without verifying their validity when applied to VE's. This book can be viewed as a milestone, in that it establishes the numerical solution of VE's as a subject on its own. The authors succeed in presenting the latest results for VE's in a readable way. A good background in ODE's, however, would be helpful for the reader. Various numerical concepts introduced are then easier to understand. The preface states that a background in calculus is sufficient as a prerequisite. I would recommend to supplement this with a course in basic numerical analysis.

In addition to dealing with the construction and convergence of multistep and Runge-Kutta type methods, there is a separate chapter on numerical stability. The authors recognize that the question of stability is still in its infancy. Some results are given, but a good deal more needs to be done in that direction.

The last chapter is dealing with software for VE's. An overview over available routines is presented, including an indication of their performance. Since there is very little tradition in writing codes for VE's, the book would have been even better if a discussion had been included on how to write a good code for VE's. For example, how does one treat the lag term in a satisfactory manner?

In the chapter on Runge-Kutta type methods, the Volterra series approach is only referred to. No details are given. In order to understand the construction of these methods, one has to read the appropriate literature. In my opinion, this is an inconvenience to the reader.

The historical notes are of great interest and value, as they provide a flavor of the evolution of the subject.

This monograph is well suited for any reader who wants to gain insight into the latest results on the numerical solution of VE's.

S.P.N.

28[65–01, 65H10].—ALEXANDER MORGAN, *Solving Polynomial Systems Using Continuation for Engineering and Scientific Problems*, Prentice-Hall, Englewood Cliffs, N.J., 1987, xiii + 546 pp., $23\frac{1}{2}$ cm. Price \$40.00.

The topic of this book is the computation of all solutions of a system of n polynomial equations in n variables, where n is assumed to be small. Such problems arise in many applications, and there is much interest in simple and reliable methods which do not require a deeper analysis. This excludes, for instance, Newton's method, since the determination of suitable initial approximations for all the solutions often requires more information about the system than is readily available.

During recent years there has been a considerable research effort on the application of homotopy methods to this problem. The author is one of the most active contributors to this work and presents here an introduction to his methods for a general audience of potential users.

Briefly, let (1) $f(x) = 0$, $f \in \mathbb{C}^n \to \mathbb{C}^n$ be the given system and denote by $d_1, \ldots, d_n$ the degrees of the n components of f. The sum of these degrees is the total degree d of (1). Now an initial system (2) $g(x) = 0$ can be introduced with components $g_j(x) = p_j^{d_j} x_j^{d_j} - q_j^{d_j}$, $j = 1, \ldots, n$, where p_j and q_j are suitable complex constants. Then the desired homotopy is (3) $h(x,t) = (1-t)g(x) + tf(x)$, $0 \leq t \leq 1$, which permits the application of a continuation process to follow the d paths beginning at each of the solutions of (2). Clearly, the implementation of this concept requires much attention to various details, and that takes up a major part of the book.

There are two parts, covering the method and several applications, respectively. More specifically, after two introductory chapters introducing the basic ideas for one- and two-dimensional equations, Chapter 3 describes the general method, which is followed by a chapter on its implementation. The first part then ends with a chapter on scaling techniques and on some alternative continuation methods. The second part begins with Chapter 7, covering practical considerations of systems reduction, while the final Chapters 8 through 10 are devoted to case studies. More specifically, geometric intersection problems, chemical equilibrium systems, and kinematic problems of mechanisms are considered. There are also six appendices, namely five containing additional mathematical details and another one which presents some 200 pages of FORTRAN source code of all the procedures.

As the title already indicates, the book is intended primarily for engineers and scientists who wish to use these techniques. In line with this, an informal approach was adopted and the mathematical prerequisites were kept at the level of a working knowledge of multivariate calculus, linear algebra, and computer programming. The book certainly succeeds well in its aims and offers a nice introduction to these valuable new methods.

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29[65–01].—ANNIE CUYT & LUC WUYTACK, *Nonlinear Methods in Numerical Analysis*, North-Holland Mathematics Studies, vol. 136, North-Holland, Amsterdam, 1987, 278 pp., 24 cm. Price \$53.25/Dfl. 120.00.

This is a textbook based on a graduate course given at the University of Antwerp, a supplement to the many elementary books which mainly treat *linear* techniques. I opened the book with a sense of expectation and curiosity. What is it that can be found here, behind the rather general title?

Quite sensibly (and not unexpectedly) the authors have restricted their presentation to methods based on Padé approximation and "Padé-like" techniques like rational Hermite interpolation. A *Padé approximant* of order (m, n) to a function