among others. All three approaches to bifurcation theory are presented in the book by Marsden and McCracken, including two recent papers by D. S. Schmidt and S. N. Chow and J. Mallet-Paret on the method of averaging. However the main emphasis is based on the Center Manifold Theorem.

The book also deals with more complicated phenomena associated with secondary bifurcations such as those that occur when an unstable periodic solution bifurcates into a torus. For secondary bifurcations and for the study of problems more general than Hopf bifurcations, in the opinion of these reviewers, the method based on the method of averaging has great potential, and we regret the fact that relatively small amount of space is given in this book to this approach.

The book is divided into 12 major sections, and many of these sections contain appendices, some written by other authors, which amplify the major themes of the book. First, there is an introductory section with several interesting illustrative examples of bifurcation phenomena. Next there is a statement and proof of the Center Manifold Theorem for smooth C^{k+1} mappings ($k \geq 1$) on a Banach space. Then the Center Manifold Theorem for smooth semiflows is stated without proof. Next the authors state and prove the Hopf bifurcation theorem for ordinary differential equations in R^2 and $R^n (n \geq 2)$. The new results on the stability of the bifurcating periodic orbits then follows with a very lengthy and complicated derivation of a term $v^3(0)$ which depends on the coefficients of the differential system. After a section containing a translation of the original paper of Hopf, the authors then present the Hopf bifurcation theorem for diffeomorphisms. This result is useful in showing the existence of secondary bifurcations from periodic trajectories to invarient torii. Next, there is a section on bifurcations with symmetries. This is then followed by the main sections of the book, namely, bifurcations for partial differential equations with special applications to fluid dynamics and the problem of turbulence. The book concludes with several reports written by other authors which includes some applications to biological phenomena.

Writing such a book is a monumental and laudable task since most of the techniques appear only in research papers and many of the results are new in this volume. However, it is not a polished work. Our major objections to the book are the following. The authors shift from the finite dimensional to the infinite dimensional systems with bewildering speed. Often the hypotheses of a theorem do not make it clear whether the ambient space is finite or infinite dimensional. In several places the authors distinguish between "diffeomorphisms and mappings." The choice of terminology is a bit unfortunate because it does suggest that in one case the mapping may be smooth and in the other it need not be smooth. Generally this is not what is meant. In general the authors mean to distinguish between smooth functions (in both cases) but in one case the function is locally a homoeomorphism and in the other case it is not. As stated previously, the authors main approach to the bifurcation theory is to reduce a high-dimensional problem to a two-dimensional problem by means of the Center Manifold Theorem. Unfortunately, they do not exercise enough care in applying this theorem, and as a result, their proof of the Hopf bifurcation theorem for dimension $n > 2$ is not complete unless one makes the added assumption that the eigenvalues of $A(\mu)$, other than $\lambda(\mu)$ and $\bar{\lambda}(\mu)$, remain away from the imaginary axis at $\mu = \mu_0$.

We have some less serious, but nevertheless nontrivial criticisms. For example, we could not locate the definition of the concept of a C^∞ -norm which is stated in Theorem 2.7. (The role of a C^∞ -norm, whether crucial or not, is certainly obscured in Section 4 and the very important Section 8 on bifurcation theorems for partial differential equations.) This may be simply an oversight.

The authors primary objective appears to be to write a book that brings together the latest results on bifurcation theory and in particular those results related to partial differential equations. As just stated this is a laudable task. Furthermore there is strong and desirable emphasis on applications. The subject matter treated should be of great interest to individuals involved in research in the field of mechanics or applied mathematics. Many of the present applications of the theory are in the fields of fluid mechanics, chemical processes, and biological systems. It is quite clear that the methods of analysis

will also be of central importance in many areas of solid mechanics. The necessity of such a book has been felt for some time. The subject treated, however, is mathematically very challenging, even for the better trained engineers and applied mathematicians.

The book has an excellent list of references.

The Component Element Method in Dynamics. By S. Levy and J. P. D. Wilkinson. McGraw-Hill Book Co., New York. Pages xiv–361. Price $29.50.

REVIEWED BY W. T. THOMSON[16]

The objective of this book is the presentation of methods for the numerical calculation for the response of dynamical systems by the digital computer. The first chapter presents the finite-difference method. The authors utilize the central difference method, although other forward and backward difference techniques including the Newmark and Wilson's methods are discussed. The treatment of initial conditions and nonlinear elements is presented as well as the authors developed criteria for calculation stability.

Chapter 2 deals with computations for the single-degree-of-freedom nonlinear systems. A basic computing method based on the first chapter is systematized into a computing program. Nonlinear springs, dampers, stops, and gaps are handled and the response for several systems compared to known solutions are presented.

Systems of many degrees of freedom are discussed in the third chapter. Stiffness and mass matrices of beams as well as discrete elements are developed. For systematic computation, computer programs and flow diagrams are given for the response of systems as high as 65 degrees of freedom.

Application of the general computer programs to various problems of vehicle dynamics is given in Chapter 4. Chapter 5 introduces the finite-element method for dynamic systems modeled by a continuum. Two and three-dimensional continuum are treated.

The vibration of continuous systems is the subject of Chapter 6. Structures are broken up into finite elements as described in Chapter 5 and stiffness and mass matrices are assembled for solving the eigenvalue problem. Chapter 7 represents a case study of an aircraft turbofan engine.

Response of buildings to earthquakes is the topic of Chapter 8. The response spectra method for determining upper bound solutions is described. The presentation of a component element model for a nuclear reactor is given for a more detailed computation.

The book ends with a chapter on the vibration of structures submerged in water. Increased mass of elements due to the motion of water is developed from potential theory and finite-element methods.

The text presents a wealth of examples of interest to practicing engineers who need to obtain numerical results for their structural dynamics problems. Problems are included throughout the book and the text would be useful for instruction to advanced students interested in computer techniques for large structural dynamics systems.

Review of Fundamental Principles of Heat Transfer. By S. Whitaker. Pergamon Press. 1977. Pages 556. Price $50.

REVIEWED BY C. L. TIEN[17]

This book which provides a fundamental treatment of various heat transfer processes is intended as a textbook for the introductory

[16] Professor Emeritus, Department of Mechanical and Environmental Engineering, University of California, Santa Barbara, Calif.

[17] Professor and Chairman, Mechanical Engineering Department, University of California, Berkeley, Calif.

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