sults readily accessible. I believe the book will provide an excellent reference to students and applied mathematicians working in a broad number of areas. It is certainly a welcome addition to the literature. It will not fit the bill of all existing courses on applied functional analysis, because the choice of topics (as is true of all textbooks) reveals the personal biases and experiences of the author. But this book will be a valuable reference for most of them.

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Lie Groups. *By J. J. Duistermaat and J. A. C. Kolk.* Springer-Verlag, New York, 2000. $48.00. viii+344 pp., softcover. ISBN 3-540-15293-8.

The book under review constitutes the first of a projected two-volume work devoted to the basic theory of Lie groups and Lie algebras. The present volume starts out by introducing the key concepts in Lie group and Lie algebra theory. The remaining three chapters then concentrate on compact Lie groups and proper actions. Other aspects of the theory will appear in the subsequent volume; indeed, there are many forward references already included in the present text.

Even though it claims to require only basic geometric and analytic prerequisites, this book is not an elementary text. The mathematical sophistication and demands of rigor make this appropriate only for the truly dedicated student who wishes to acquire a deep and rigorous foundation in Lie group theory. Despite the level of exposition, I found the book well written and eminently readable. While the initial sections include some very nice, elementary examples to illustrate the theory—and include additional less commonly known details in many cases—the later, more complicated material would be more easily digested if a comparable range of simple illustrative examples were included. Each chapter concludes with several pages of excellent historical remarks and references to the original literature. The authors have included a wide selection of exercises, many of which also require significant mathematical sophistication and effort.

Highlights include an innovative proof of the global form of Lie's third fundamental theorem (every Lie algebra corresponds to a unique connected, simply connected Lie group) that avoids the detailed Lie algebraic structure theory, but instead relies on the geometric theory of infinite-dimensional Banach Lie groups and the characterization of the Lie group as a suitable equivalence class in the space of paths in the Lie algebra. The second chapter contains a wealth of details on the orbit stratification of proper actions not previously available in texts. While this volume does not get up to the Killing–Cartan classification of semisimple Lie groups, its treatment of the structure theory of compact Lie groups and their representations introduces many of the important tools and culminates in the Weyl integration and covering theory. The final chapter develops the highest weight classification of representations of compact Lie groups, culminating in the Peter–Weyl theorem that generalizes Fourier analysis to arbitrary compact groups and the Borel–Weil theory that realizes each representation on the space of sections of a certain line bundle.

The book is very much in the pure mathematical mold, concentrating on the inner beauty and symmetry of the subject. As an advanced mathematical monograph, it forms a welcome addition to the literature on Lie group theory. However, it is of less immediate relevance to applied practitioners of Lie theory. Thus, the very comprehensive treatment of the theoretical foundations and ramifications of the justly famous Peter–Weyl theorem in the representation theory of compact groups never exposes their tremendous impact in quantum mechanics or in the theory of special functions. Similarly, while the basic theory on transformation groups is reviewed, the text then goes off into rather sophisticated results on compact actions, slices, orbit stratifications, and so on. One would never know that Lie groups can be used to solve differential equations arising in a broad range of applications or to classify differential invariants such as curvature, which is of importance in many current applications in geometry, physics, mechanics, and image processing.

For the right audience, the book could be profitably adopted in an advanced topics course on pure Lie group theory. The prerequisites would be a sufficiently mature and motivated group of students and a sufficiently dedicated instructor. However, as an applied mathematician, my own inclination would be to devote such a topics course to genuine applications of Lie theory, and this book would not be as appropriate. In summary, the book would not be the text to recommend to someone interested in applications of Lie groups in physical systems and applied mathematics, but it does form a solid and praiseworthy account of the more advanced and fascinating realms of mathematical Lie group theory.

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Numerical Bifurcation Analysis for Reaction-Diffusion Equations. *By Zhen Mei.* Springer-Verlag, New York, 2000. $84.00. xiv+414 pp., hardcover. ISBN 3-540-67296-6.

Reaction-diffusion equations $\frac{\partial u}{\partial t} = D\Delta u + f(u, \lambda)$ arise as mathematical models in many scientific problem areas, such as in chemical reactions, biological systems, population dynamics, or nuclear reactor physics. At least since a pioneering article by A. Turing in 1952, it has been well known that the solutions of these systems often exhibit spontaneous formation of various spatial or spatial-temporal patterns. These changes under variation of the control parameters reflect a wealth of possible bifurcation phenomena, and their study has now become the topic of a large and ever growing literature. A wide spectrum of mathematical approaches has been applied in these studies, but for practical applications computational methods frequently remain the only feasible avenue. This monograph aims to present an overview of the numerical analysis of bifurcation problems in reaction-diffusion equations. It appears to have grown out of the author's work on his habilitation thesis, that is, the second thesis required in Germany for entrance into an academic teaching career.

The book consists essentially of two almost equal parts although they are not identified as such. The first part covers Chapters 2–8 and provides background material from bifurcation theory and related computational aspects required in the second part. This begins with a summary of numerical methods for continuing solution branches of stationary, finite-dimensional equations $G(x, \lambda) = 0$, for the construction of test functions to detect certain bifurcations on such solution branches, and for switching branches at simple bifurcation points. Then some basic properties of symmetries are presented followed by an introduction to Liapunov–Schmidt reductions and to the principal results of center manifold theory. Finally, numerical aspects relating to (quasi-) periodic solutions near a homoclinic orbit of equations $\dot{x} = f(x, \lambda)$ are addressed.

As is not surprising with such a wide range of material, the presentation in these seven chapters is often fairly brief and refers the reader to the literature for further details and motivations. While most of this material is available in a number of texts and monographs, a distinguishing feature may be an emphasis on computational aspects and some use of informal algorithms for defining various methods.

While in the first part reaction-diffusion equations are mentioned only occasionally, the remaining chapters, 9–16, concentrate on the topic in the title of the book and form its principal part. The presentation is mainly centered on systems of one or two equations in one or two space dimensions and, in the latter case, usually with the unit square as the domain. Polynomial growth conditions are used for the reaction term $f(u, \lambda)$ to ensure classical solutions. In the case of scalar equations, interest centers on the preservation of multiplicities in the discretized problems and the use of continuation for tracing solution branches. For systems of two equations on a square, Liapunov–Schmidt reduction is used to analyze the diagrams at simple and double bifurcation points. Then, for the same class of systems, normal forms are developed that cover both reducible and irreducible representations of the symmetry group. The next two chapters concern steady/steady state and Hopf/steady state mode interactions for reaction-diffusion equations. From here on the presentation appears to follow mainly