(d) Band Lanczos method (R. Freund)
(e) Jacobi-Davidson methods (G. Sleijpen and H. van der Vorst)
(f) Stability and accuracy assessments (Z. Bai and R. Li)
5. Generalized Hermitian eigenvalue problems (26 pp.)
6. Singular value decomposition (14 pp.)
7. Non-Hermitian eigenvalue problems (82 pp.)
8. Generalized non-Hermitian eigenvalue problems (48 pp.)
9. Nonlinear eigenvalue problems (34 pp.)
10. Common issues (22 pp.)
11. Preconditioning techniques (32 pp.)
12. Appendix: Of things not treated (8 pp.)
13. Bibliography (473 references)

Most of the algorithms presented have been developed over a reasonable period of time and it is likely that they are quite close to their ultimate version. So from this point of view it is appropriate that this book is published now. The book also contains one or two sections on nonstandard material, which is not yet ready to be made into numerical software. In view of the preliminary state of the work, it might have been better to omit the section on preconditioned eigensolvers (Knyazev), and consider it for possible inclusion in a second edition of the book.

The intended readership is stated to be both students and teachers, a general audience of scientists and engineers, and experts in high performance computing who want to solve the most difficult applied problems. In my opinion the book is very useful for all categories mentioned. However, it should be noted that the presentation presupposes that the reader already has a good background in numerical linear algebra.

Most of the algorithms are well known, at least for researchers in numerical analysis, and have been developed and made into numerical software during the last decade. Even if the main part of this material is already available in the literature, it has not been presented in a common framework and it has been difficult to compare different alternative methods. This book, written by some of the best experts in the field, is invaluable for anyone who wants to know the state-of-the-art algorithms for large, sparse eigenvalue problems. The availability of codes at the website of the book will make it possible for many more people to quickly take advantage of the latest research in the area (provided that the website is well maintained). I consider the book as a very important source in this field of scientific computing.

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4[35Q80, 49-01, 53-01, 65D99, 68U10]—*Geometric partial differential equations and image analysis*, by Guillermo Sapiro, Cambridge University Press, New York, NY, 2001, xxv+385 pp., 23 1/2 cm, hardcover $64.95

Introduction. Image analysis is now present and necessary in many different areas and aspects in the sciences, such as internet, compression and transmission, medical imaging, satellite imaging, video surveillance, and many others.

This book addresses important problems and applications in the field of image analysis, via variational methods, geometric partial differential equations, and differential geometry. This research area brings several new concepts into the field, providing a very fundamental and mathematically formalized approach to image analysis. State-of-the-art practical results in a large number of real problems are achieved with the techniques described in this book. These include geometric curve and surface evolution, geodesic curves and minimal surfaces, geometric diffusion of scalar and vector-valued images, diffusion on nonflat manifolds, contrast enhancement, and additional applications to image segmentation, shape analysis, image enhancement, tracking, image repair, interpolation, shape from shading, and blind deconvolution. The book is accompanied by the necessary mathematical background (including numerical analysis notions), making it very clear and self-contained. In addition, each chapter ends with a list of exercises, making it of great use as a textbook for graduate lectures and seminars. The exposition is very clear, and it is also accompanied by many illustrations, pictures, and examples of numerical results, making the explanations clear and easy to understand. The book contains methods originally proposed by the author, but also an extensive description (with adequate citations and references) of methods proposed by other authors in the field.

This book is addressed to applied mathematicians interested in image analysis, to other mathematicians working on geometric partial differential equations and differential geometry, and to researchers, practitioners and graduate students working on image processing. The book also provides excellent material for a graduate course. I think that every person interested in image analysis by partial differential equations or related fields, such as differential geometry and curve evolution, should read this book. The book is also perfectly complementary to the very few existing and related books, and the differential geometry approach makes it unique.

Content description. Chapter 1 is devoted to the basic mathematical background necessary for the reader to well understand the mathematical techniques, notations, and terminology of the book. It contains basic notions of differential geometry, partial differential equations, calculus of variations, and numerical analysis. Chapter 2 is devoted to geometric curve and surface evolution concepts, with a description of the most used geometric flows, computational aspects, and some of the applications. Chapter 3 is devoted to active contours by geometric PDE's, which is one of the most important problems in image processing. Chapters 4 and 5 are devoted to techniques of geometric diffusion of scalar and vector-valued images. Chapter 6 discusses a more recent but very interesting topic of diffusion on nonflat manifolds. Chapter 7 is devoted to contrast enhancement, and the book ends with additional applications in Chapter 8.

The author is an internationally recognized expert in the field. He is a very good lecturer and teacher, and this is reflected in the highly pedagogical style of this book.

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