Book Reviews

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BOOK REVIEWS

H. Zhang, D. Liu: FUZZY MODELING AND FUZZY CONTROL. Birkhäuser, Boston, 2006, xiii + 416 pages, hardcover, ISBN-10: 0-8176-4491-1, ISBN-13: 978-0-8176-4491-1, price EUR 75/USD 99

The book aims at readers who are at least partly familiar with control theory and wish to get insight into both its coupling with fuzzy set theory and consequent benefits of this merger.

Chapter 1 comprises the elements of classical set theory, fuzzy set theory, and rough set theory. Fundamental notions such as membership function, fuzzy relation, fuzzy logic, and arithmetic operations on fuzzy sets are introduced. Then, in Chapter 2, Takagi-Sugeno (T-S) fuzzy model expressed by particular fuzzy IF-THEN rules is presented with the emphasis on the premise structure and parameters identification. Fuzzy IF-THEN rules play a pivotal role in fuzzy modeling and fuzzy control throughout the book. The model identification topic remains in the focus also in Chapter 3, but the mathematical tool changes to rough set data analysis there.

To avoid drawbacks of the T-S model, different membership and output functions are considered in the respective IF- and THEN-parts of fuzzy rules. In this way, a fuzzy hyperbolic model is established and applied to identification problems in Chapter 4.

The next two chapters are devoted to the analysis of introductory fuzzy control problems. The rest of the book, however, deals with more advanced control problems based on systems of ordinary differential equations.

Attention is paid to fuzzy performance evaluators, that is, fuzzy models that approximate well the controlled dynamical system (Chapter 7). Fuzzy predictive control is the subject of Chapter 8. The next chapter deals with adaptive control methods based on fuzzy basis function vectors. Stemming from and enhancing the results of Chapter 4, Chapter 10 concentrates on the design of controllers based on the fuzzy hyperbolic model. Although attention to systems with time delay is not limited to Chapter 11, only this chapter is fully devoted to modeling delayed systems. Moreover, a fuzzy H_∞ filter is designed and its performance compared with the extended Kalman filter there. Chaotification of the fuzzy hyperbolic model is shown in Chapter 12; the goal is to design a controlled fuzzy hyperbolic model that can track the dynamics of a chaotic system (the Lorenz system, for instance). In the final Chapter 13, a feedforward fuzzy control approach using the Fourier integral is presented.

Each chapter is followed by a bibliography section. A rather detailed index is also included.

Numerical examples constitute a substantial part of the monograph. These span from simple illustrations of the theory to the solutions of industry-oriented control problems.

The first half of the book is accessible to readers unfamiliar with fuzzy sets, fuzzy logic, or control theory. The second half is more demanding, however. Some familiarity with control theory problems, terminology, and techniques is necessary to fully appreciate the richness and merits of the fuzzy modeling and fuzzy control approaches that the authors offer in their monograph.

Jan Chleboun

R. Vandebril, M. Van Barel, N. Mastronardi: MATRIX COMPUTATIONS AND SEMISEPARABLE MATRICES. VOL. 2: EIGENVALUE AND SINGULAR VALUE METHODS. The Johns Hopkins University Press, 2008, ISBN 978-0-8018-9052-9, xv + 498 pages, price USD 75

In Volume 1 of this pair of books, the authors introduce the concept of semiseparable matrices, a specific type of structured matrix that allows for efficient storage and linear algebraic manipulations. While the first volume is concentrated on linear systems involving semi-separable matrices, the second volume treats eigenvalue and singular value problems for semiseparable matrices.

The second volume contains a brief review of the highlights of Volume 1 and hence can be read independently. Contrary to the first volume, no real applications are considered.

The main part of the book is devoted to the development of the implicit QR-algorithm. For this, it is helpful if the reader already has a fair amount of background in the area of the classical QR-algorithm and its most recent variations. The following items are covered: orthogonal reductions to semiseparable matrices and their convergence properties, an implicit Q-theorem, a multi-shift QR-method, but also a new method, called the QH-iteration. At the end of this part, related subjects are touched, such as Rational Krylov methods and Sturm Sequence methods.

The next part of the book is concerned with divide-and-conquer type of methods, and a Lanczos semiseparabilization is presented. More details are given on how reduction to semiseparable matrices can give insight in the rank of the matrix. Finally, in the last part of the book, inverse eigenvalue problems are studied. Here, orthogonal polynomials, orthogonal vectors, and orthogonal rational functions are the main topics.

Much more so than for the first volume, this second volume seems to be for the specialist in the area of numerical linear algebra, due to the high level of technicalities involved.

Jan Brandts