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BOOK REVIEWS

Leah Edelstein-Keshet, *Mathematical Models in Biology*, Society for Industrial and Applied Mathematics, Philadelphia, USA, 2005, ISBN: 978-0-89-871-554-5, XXXI+586 pp.

The aim of this book is to present instances of interaction between two major disciplines, biology and mathematics.

The book is structured in three parts: I. Discrete Process in Biology (3 chapters), II. Continuous Process and Ordinary Differential Equations (5 chapters) and III. Spatially Distributed Systems and Partial Differential Equation Models (3 chapters), followed by Selected Answers, Author Index and Subject Index.

In the first four chapters there are introduced basic concepts in modeling, for example steady states, stability and parameter variations, which are encountered within the context of difference equations and reemerge in models based on ordinary and partial differential equations. Chapter five gives several qualitative approaches for understanding ordinary differential equations and systems of such equations. The behavior of solutions are described and the phenomena in the models are better understood by a lot of figures. The sixth chapter contains models for single-species population and there are described and analyzed the Lotka-Volterra predator-prey and species competition models. Similarly with the previous chapter, chapter seven deals with "population dynamics" of molecules rather than whole organisms. Chapter eight is concerned with identifying criteria that point to the existence or nonexistence of limit cycles, then the new mathematical techniques are applied to problems stemming from population fluctuations and oscillations in chemical systems. In the last three chapters there are exposed how spatial variation influences the motion, distribution and persistence of species; there are introduced the concepts underlying spatially dependent processes and the partial differential equations that describe these. There are given examples drawn from molecular, cellular and population levels. Latter, the ideas are applied to more specific cases with the aim of gaining and understanding of phenomena.

Mathematical Models in Biology includes extensive exercises, problems and examples. The biology presented proceeds from subcellular molecular systems, cellular behavior and physiological problems to population biology and developmental biology.

The book is recommended to biologists which will find the text useful as a summary of modern mathematical methods currently used in modeling, as well as, to the mathematicians which will find the benefits from examples of applications of mathematics to real-life problems.

Diana Otrocol

Wim Michiels and Silviu-Iulian Niculescu, *Stability and Stabilization of Time-Delay Systems: an Eigenvalue-Based Approach*, Society for Industrial and Applied Mathematics, Philadelphia, USA, 2007, ISBN: 978-0-898716-32-0, XXI+378 pp.

The aim of this book is to present the stability analysis and synthesis by delayed feedback in the linear case by using a unitary methodology: the eigenvalue based approach.

The book is organized in three parts: I. Stability analysis of linear time-delay systems (6 chapters), II. Stabilization and robust stabilization (4 chapters) and III. Applications (7 chapters), followed by Appendix, Bibliography and Index.

In the first chapter are presented several fundamental definitions, properties and results concerning linear delay differential equations of retarded and neutral type, with the emphasis on their relation with the spectra of appropriately defined operators. The second chapter presents a unified theory for the definition and computation of pseudospectra for the general nonlinear eigenvalue problems and then the application of this theory for time-delay systems. The next three chapters deal with the characterization of stability regions in parameter spaces, both qualitatively (shape of regions, etc) and quantitatively (explicit computational algorithms). In chapter six, extensions of the presented results for systems with constant parameters to systems with periodically varying parameters are briefly discussed. Chapter seven is devoted to an eigenvalue based stabilization approach that is inspired by the classical pole placement method for systems without delay. In chapter eight, a numerical case study is presented to illustrate how delays in the control loop affect the stabilizability with state feedback. The following chapter is devoted to the robust stabilization problem, and corresponds to the chapter on pseudospectra presented in the first part. In chapter ten, a new stabilization approach is presented which is based on recently developed methods for nonsmooth optimization. In the last seven chapters a wide class of applications are presented, from congestion analysis in high-performance networks to output feedback stabilization and the analysis of predictor-type controllers, from consensus problems in traffic flows to the stability analysis of various delay models in biosciences.

The book is recommended to graduate students and researchers in electrical and mechanical engineering, computer science, biology and applied mathematics, that are interested in modern topics in this field.

Diana Otrocol

Germund Dahlquist and Åke Björck, *Numerical Methods in Scientific Computing*, Volume I, Society for Industrial and Applied Mathematics, Philadelphia, USA, 2008, ISBN: 978-0-898716-44-3, XXVII+717 pp.

This book addresses the increasingly important role of numerical methods in science and engineering, treats traditional and well-developed topics and also emphasizes concepts and ideas of importance to the design of accurate and efficient algorithms with applications to scientific computing.

The book is organized in six chapters: 1. Principles of Numerical Calculations, 2. How to Obtain and Estimate Accuracy, 3. Series, Operators, and Continued Fractions, 4. Interpolation and Applications, 5. Numerical Integration and 6. Solving Scalar Nonlinear Equations, followed by Bibliography and Index.

In the first chapter the authors introduce some basic methods in the numerical solution of linear equations and least squares problems, basic techniques for the numerical solution of initial value problems for ordinary differential equations and Monte-Carlo methods.

The second chapter presents floating-point number systems and estimation and control of errors. The last section deals with interval arithmetic, a topic which recently has seen a revival, partly because the directed rounding incorporating in the IEEE standard simplifies the efficient implementation.

In Chapter 3 different uses of infinite power series for numerical computations are studied (including ill-conditioned and semiconvergent series) and various algorithms for computing the coefficients of power series are given. Methods for convergence acceleration of series (sequences) are covered in detail. An exposition of continued fractions and Padé approximation concludes this chapter.

Chapter 4 treats several topics related to interpolation and approximation, function spaces are introduced and the concepts of linear operator and operator norm are extended to general infinite-dimensional vector spaces. The chapter ends with basic formulas and theorems for Fourier series and Fourier transforms.

In Chapter 5, the classical Newton-Cotes rules for equidistant nodes and the Clenshaw-Curtis interpolatory rules for numerical integration are first treated. Next, extrapolation methods and quadrature rules with both free and prescribed nodes are described. The chapter ends with multidimensional integration.

Chapter 6 starts with the bisection method and fixed point iterations. Methods based on interpolation and methods using derivatives are featured in this chapter. The chapter ends with algebraic equations. Several classical methods are described, as well as an efficient and robust modified Newton method due to Madsen and Reid.

An important feature of this book is the large collection of problems and computer exercises included. The Notes and References section containing historical comments and additional references concludes each chapter.

Three Online Appendices are available from the Web page of the book: `www.siam.org/books/ot103`. Online Appendix A is a compact survey of notations and some results in numerical linear algebra. Online Appendix B describes Multiprec, a MATLAB multiple precision package. Online Appendix C is a more complete guide to literature where advice is given on numerical analysis, handbooks, encyclopedias, tables, software, and journals.

This volume is suitable for use in a basic introductory course in a graduate program in numerical analysis but can also be used as a reference for researchers who use numerical methods in science and engineering.

Diana Otrocol