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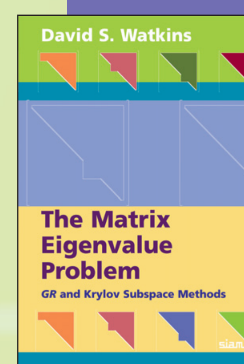
The Matrix Eigenvalue Problem: GR *and Krylov Subspace Methods*

David S. Watkins



"This is an excellent exposition of the state of the art in eigenvalue computations. It systematically combines the theory and the computational methods for structured and unstructured problems in a unique framework."

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This book presents the first in-depth, complete, and unified theoretical discussion of the two most important classes of algorithms for solving matrix eigenvalue problems: QR-like algorithms for dense problems and Krylov subspace methods for sparse problems. The author discusses the theory of the generic *GR* algorithm, including special cases, and the development of Krylov subspace methods. Also addressed are a generic Krylov process and the Arnoldi and various Lanczos algorithms, which are obtained as special cases. The chapter on product eigenvalue problems provides further unification, showing that the generalized eigenvalue problem, the singular value decomposition problem, and other product eigenvalue problems can all be viewed as standard eigenvalue problems.

The author provides theoretical and computational exercises in which the student is guided, step by step, to the results. Some of the exercises refer to a collection of MATLAB® programs compiled by the author that are available on a Web site that supplements the book.

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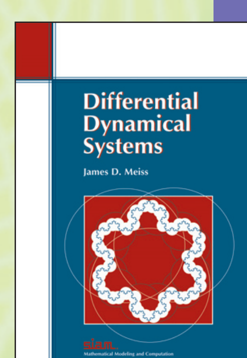
Differential Dynamical Systems

James D. Meiss



Differential equations are the basis for models of any physical systems that exhibit smooth change. This book combines much of the material found in a traditional course on ordinary differential equations with an introduction to the more modern theory of dynamical systems. Applications of this theory to physics, biology, chemistry, and engineering are shown through examples in such areas as population modeling, fluid dynamics, electronics, and mechanics. *Differential Dynamical Systems* begins with coverage of linear systems, including matrix algebra; the focus then shifts to foundational material on nonlinear differential equations, making heavy use of the contraction-mapping theorem. Subsequent chapters deal specifically with dynamical systems concepts.

Throughout the book, the author includes exercises to help students develop an analytical and geometrical understanding of dynamics. Many of the exercises and examples are based on applications and some involve computation; an appendix offers simple codes written in Maple®, Mathematica®, and MATLAB® software to give students practice with computation applied to dynamical systems problems.

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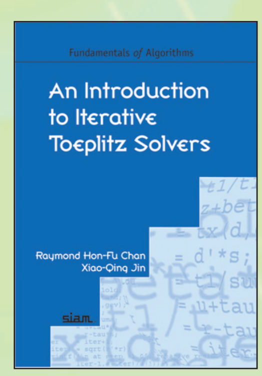
An Introduction to Iterative Toeplitz Solvers

Raymond Hon-Fu Chan and Xiao-Qing Jin



Toeplitz systems arise in a variety of applications in mathematics, scientific computing, and engineering, including numerical partial and ordinary differential equations, numerical solutions of convolution-type integral equations, stationary autoregressive time series in statistics, minimal realization problems in control theory, system identification problems in signal processing, and image restoration problems in image processing. This practical book introduces current developments in using iterative methods for solving Toeplitz systems based on the preconditioned conjugate gradient method. The authors focus on the important aspects of iterative Toeplitz solvers and give special attention to the construction of efficient circulant preconditioners. Applications of iterative Toeplitz solvers to practical problems are addressed, enabling readers to use the book's methods and algorithms to solve their own problems. An appendix containing the MATLAB® programs used to generate the numerical results is included.

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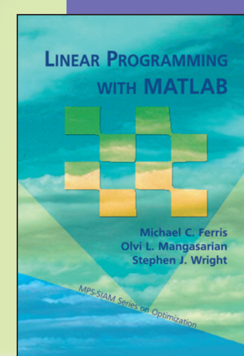

Michael C. Ferris, Olvi L. Mangasarian, and Stephen J. Wright

This textbook provides a self-contained introduction to linear programming using MATLAB® software to elucidate the development of algorithms and theory. Early chapters cover linear algebra basics, the simplex method, duality, the solving of large linear problems, sensitivity analysis, and parametric linear programming. In later chapters, the authors discuss quadratic programming, linear complementarity, interior-point methods, and selected applications of linear programming to approximation and classification problems.

Exercises are interwoven with the theory presented in each chapter, and two appendices provide additional information on linear algebra, convexity, and nonlinear functions and on available MATLAB commands, respectively. Readers can access MATLAB codes and associated mex files at a Web site maintained by the authors.

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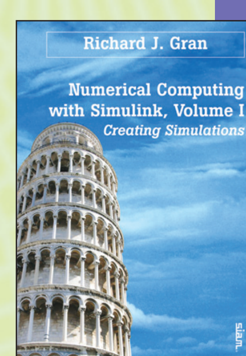

Richard J. Gran

Simulation is the preferred approach for engineers and scientists who design complex systems because it allows them to test a system design's performance standards. This book explores simulation, starting with Galileo and ending with the lunar landing. It provides an introduction to computer-aided system design with Simulink®, a robust, accurate, and easily used simulation tool. The author takes readers on a tour of the Simulink environment that shows how to develop a system model and execute the design steps needed to make the model into a functioning design laboratory. Included along the way is the mathematics of systems: difference equations and *z*-transforms, ordinary differential equations (both linear and nonlinear) and Laplace transforms, and numerical methods for solving differential equations. Volume II will show how to use Simulink in the modeling and analysis of complex systems.

Because specific applications require specific tools, the author introduces additional software packages that work within the Simulink environment. In all, the author covers more than 70 applications taken from several disciplines, and he describes numerous tested, annotated, and reusable models and blocks to help readers apply the book's material to their own applications. The text's supplementary Web page offers additional material about Simulink and its associated tools created by The MathWorks and the author.

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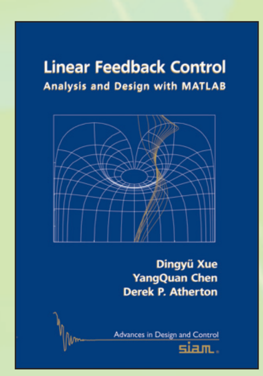
Linear Feedback Control: *Analysis and Design with MATLAB*



Dingyü Xue, YangQuan Chen, and Derek P. Atherton

This book discusses analysis and design techniques for linear feedback control systems using MATLAB® software. By reducing the mathematics, increasing MATLAB working examples, and inserting short scripts and plots within the text, the authors have created a resource suitable for almost any type of user. For beginners, the book provides an efficient entrance into the field; for readers who have already had a first course in control, the text helps bridge the gap between control theory and the use of MATLAB for control systems; for practicing engineers, it serves as a handy reference.

The book begins with a summary of the properties of linear systems and addresses modeling and model reduction issues. In the subsequent chapters on analysis, the authors introduce time domain, complex plane, and frequency domain techniques. Their coverage of design includes discussions on model-based controller designs, PID controllers, and robust control designs. A unique aspect of the book is its inclusion of a chapter on fractional-order controllers, which are useful in control engineering practice.

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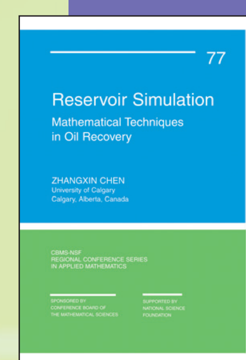
Reservoir Simulation: *Mathematical Techniques in Oil Recovery*

Zhangxin Chen



This book covers and expands upon material presented by the author at a CBMS-NSF Regional Conference during a ten-lecture series on multiphase flows in porous media and their simulation. It begins with an overview of classical reservoir engineering and basic reservoir simulation methods and then progresses through a discussion of types of flows—single-phase, two-phase, black oil (three-phase), single phase with multicomponents, compositional, and thermal.

The author provides a thorough glossary of petroleum engineering terms and their units, along with basic flow and transport equations and their unusual features, and corresponding rock and fluid properties. The practical aspects of reservoir simulation, such as data gathering and analysis, selection of a simulation model, history matching, and reservoir performance prediction, are summarized.

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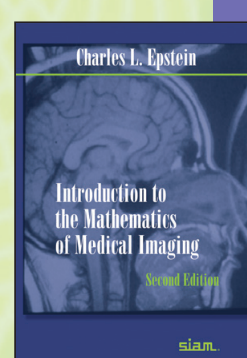
Introduction to the Mathematics of Medical Imaging, *Second Edition*

Charles L. Epstein



At the heart of every medical imaging technology is a sophisticated mathematical model of the measurement process and an algorithm to reconstruct an image from the measured data. This book provides a firm foundation in the mathematical tools used to model the measurements and derive the reconstruction algorithms used in most imaging modalities in current use. In the process, it also covers many important analytic concepts and techniques used in Fourier analysis, integral equations, sampling theory, and noise analysis.

This text uses X-ray computed tomography as a "pedagogical machine" to illustrate important ideas and incorporates extensive discussions of background material making the more advanced mathematical topics accessible to readers with a less formal mathematical education. The mathematical concepts are illuminated with over 200 illustrations and numerous exercises.

New to the second edition are a chapter on magnetic resonance imaging (MRI), a revised section on the relationship between the continuum and discrete Fourier transforms, a new section on Grangreat's formula, an improved description of the gridding method, and a new section on noise analysis in MRI.

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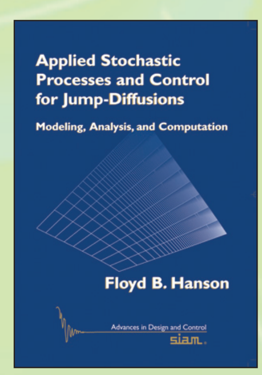
Applied Stochastic Processes and Control for Jump-Diffusions: *Modeling, Analysis, and Computation*

Floyd B. Hanson



This self-contained, practical, entry-level text integrates the basic principles of applied mathematics, applied probability, and computational science for a clear presentation of stochastic processes and control for jump-diffusions in continuous time. The author covers the important problem of controlling these systems and, through the use of a jump calculus construction, discusses the strong role of discontinuous and nonsmooth properties versus random properties in stochastic systems.

The book emphasizes modeling and problem solving and presents sample applications in financial engineering and biomedical modeling. Computational and analytic exercises and examples are included throughout. While classical applied mathematics is used in most of the chapters to set up systematic derivations and essential proofs, the final chapter bridges the gap between the applied and the abstract worlds to give readers an understanding of the more abstract literature on jump-diffusions. An additional 160 pages of online appendices are available on a Web page that supplements the book.

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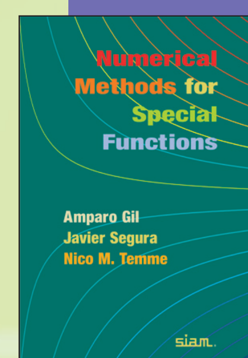
Numerical Methods for Special Functions

Amparo Gil, Javier Segura, and Nico M. Temme



"This book is inventive and original—an exceedingly valuable collection of methods to compute special functions, bringing together material usually found only in disparate sources."

— Van Snyder, Jet Propulsion Laboratory, California Institute of Technology

Special functions arise in many problems of pure and applied mathematics, statistics, physics, and engineering. This book provides an up-to-date overview of methods for computing special functions and discusses when to use them in standard parameter domains, as well as in large and complex domains.

The first part of the book covers convergent and divergent series, Chebyshev expansions, numerical quadrature, and recurrence relations. Its focus is on the computation of special functions. Pseudoalgorithms are given to help students write their own algorithms. In addition to these basic tools, the authors discuss methods for computing zeros of special functions, uniform asymptotic expansions, Padé approximations, and sequence transformations. The book also provides specific algorithms for computing several special functions (Airy functions and parabolic cylinder functions, among others).

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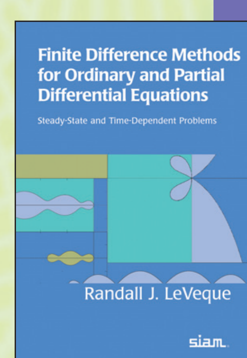
Finite Difference Methods for Ordinary and Partial Differential Equations: *Steady-State and Time-Dependent Problems*

Randall J. LeVeque



"I heartily recommend this text to students who want a solid grounding in the theory and practice of solving differential equations—ordinary and partial. The book well repays serious study."

— Peter Lax, Professor, Courant Institute of Math

This book introduces finite difference methods for both ordinary differential equations (ODEs) and partial differential equations (PDEs) and discusses the similarities and differences between algorithm design and stability analysis for different types of equations. A unified view of stability theory for ODEs and PDEs is presented, and the interplay between ODE and PDE analysis is stressed. The text emphasizes standard classical methods, but several newer approaches also are introduced and are described in the context of simple motivating examples.

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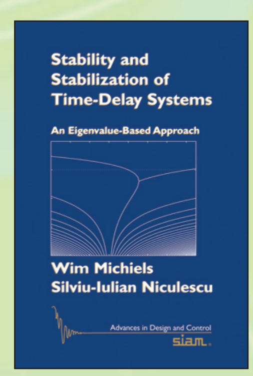
Stability and Stabilization of Time-Delay Systems: *An Eigenvalue-Based Approach*

Wim Michiels and Silviu-Iulian Niculescu



Time-delays are important components of many dynamical systems that describe coupling or interconnection between dynamics, propagation or transport phenomena, and heredity and competition in population dynamics. This monograph addresses the problem of stability analysis and the stabilization of dynamical systems subjected to time-delays. It presents a wide and self-contained panorama of analytical methods and computational algorithms using a unified eigenvalue-based approach illustrated by examples and applications in electrical and mechanical engineering, biology, and complex network analysis.

This text bridges the fields of control (analysis and feedback design, robustness, and uncertainty) and numerical analysis (explicit algorithms and methods). The authors present solutions of the (robust) stability analysis and stabilization problem of linear time-delay systems, which are the result of this cross-fertilization of control theory, numerical linear algebra, numerical bifurcation analysis, and optimization.

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