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## **NUMERICAL GEOMETRY OF NON-RIGID SHAPES**

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**Springer Science & Business Media Deformable objects are ubiquitous in the world surrounding us, on all levels from micro to macro. The need to study such shapes and model their behavior arises in a wide spectrum of applications, ranging from medicine to security. In recent years, non-rigid shapes have attracted growing interest, which has led to rapid development of the field, where state-of-the-art results from very different sciences - theoretical and numerical geometry, optimization, linear algebra, graph theory, machine learning and computer graphics, to mention several - are applied to find solutions. This book gives an overview of the current state of science in analysis and synthesis of non-rigid shapes. Everyday examples are used to explain concepts and to illustrate different techniques. The presentation unfolds systematically and numerous figures enrich the engaging exposition. Practice problems follow at**

the end of each chapter, with detailed solutions to selected problems in the appendix. A gallery of colored images enhances the text. This book will be of interest to graduate students, researchers and professionals in different fields of mathematics, computer science and engineering. It may be used for courses in computer vision, numerical geometry and geometric modeling and computer graphics or for self-study.

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### **HIGH PERFORMANCE ALGORITHMS AND SOFTWARE IN NONLINEAR OPTIMIZATION**

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**Springer Science & Business Media** This book contains a selection of papers presented at the conference on High Performance Software for Nonlinear Optimization (HPSN097) which was held in Ischia, Italy, in June 1997. The rapid progress of computer technologies, including new parallel architectures, has stimulated a large amount of research devoted to building software environments and defining algorithms able to fully exploit this new computational power. In some sense, numerical analysis has to conform itself to the new tools. The impact of parallel computing in nonlinear optimization, which had a slow start at the beginning, seems now to increase at a fast rate, and it is reasonable to expect an even greater acceleration in the future. As with the first HPSNO conference, the goal of the HPSN097 conference was to supply a broad overview of the more recent developments and trends in nonlinear optimization, emphasizing the algorithmic and high performance software aspects. Bringing together new computational methodologies with theoretical advances and new computer technologies is an exciting challenge that involves all scientists willing to develop high performance numerical software. This book contains several important contributions from different and complementary standpoints. Obviously, the articles in the book do not cover all the areas of the conference topic or all the most recent developments, because of the large number of new theoretical and computational ideas of the last few years.

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### **A FIRST COURSE IN THE NUMERICAL ANALYSIS OF DIFFERENTIAL EQUATIONS**

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**Cambridge University Press** Covers numerical analysis for mathematics students without neglecting practical aspects.

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### **NONLINEAR NUMERICAL METHODS AND RATIONAL APPROXIMATION**

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**Springer Science & Business Media** Approach your problems from the right end It isn't that they can't see the solution. It is and begin with the answers. Then one day, that they can't see the problem. perhaps you will find the final question. G. K. Chesterton. The Scandal of Father 'The Hermit Clad in Crane Feathers' in R. Brown 'The point of a Pin'.

van Gu!ik's The Chinese Maze Murders. Growing specialization and diversification have brought a host of monographs and textbooks on increasingly specialized topics. However, the "tree" of knowledge of mathematics and related fields does not grow only by putting forth new branches. It also happens, quite often in fact, that branches which were thought to be completely disparate are suddenly seen to be related. Further, the kind and level of sophistication of mathematics applied in various sciences has changed drastically in recent years: measure theory is used (non-trivially) in regional and theoretical economics; algebraic geometry interacts with physics; the Minkowsky lemma, coding theory and the structure of water meet one another in packing and covering theory; quantum fields, crystal defects and mathematical programming profit from homotopy theory; Lie algebras are relevant to filtering; use Stein spaces. And in addition to this there are and prediction and electrical engineering can such new emerging subdisciplines as "experimental mathematics", "CFD", "completely integrable systems", "chaos, synergetics and large-scale order", which are almost impossible to fit into the existing classification schemes. They draw upon widely different sections of mathematics.

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### **A FIRST COURSE IN THE NUMERICAL ANALYSIS OF DIFFERENTIAL EQUATIONS**

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Cambridge University Press lead the reader to a theoretical understanding of the subject without neglecting its practical aspects. The outcome is a textbook that is mathematically honest and rigorous and provides its target audience with a wide range of skills in both ordinary and partial differential equations." --Book Jacket.

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### **GROUP THEORY AND NUMERICAL ANALYSIS**

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American Mathematical Soc. The Workshop on Group Theory and Numerical Analysis brought together scientists working in several different but related areas. The unifying theme was the application of group theory and geometrical methods to the solution of differential and difference equations. The emphasis was on the combination of analytical and numerical methods and also the use of symbolic computation. This meeting was organized under the auspices of the Centre de Recherches Mathematiques, Universite de Montreal (Canada). This volume has the character of a monograph and should represent a useful reference book for scientists working in this highly topical field.

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### **THE BILLBOARD ILLUSTRATED HOME RECORDING HANDBOOK**

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Watson-Guptill Publications A comprehensive and accessible guide to creating music on one's home computer covers

all the software and hardware needed to produce any type of music, accompanied by professional tips, detailed explanations, helpful advice, and essential information. Original.

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## **ORTHOGONAL POLYNOMIALS AND SPECIAL FUNCTIONS**

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### **COMPUTATION AND APPLICATIONS**

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Springer Special functions and orthogonal polynomials in particular have been around for centuries. Can you imagine mathematics without trigonometric functions, the exponential function or polynomials? The present set of lecture notes contains seven chapters about the current state of orthogonal polynomials and special functions and gives a view on open problems and future directions.

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### **NUMERICAL ANALYSIS**

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#### **PROCEEDINGS OF THE DUNDEE CONFERENCE ON NUMERICAL ANALYSIS, 1975**

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Springer

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### **DIRECTORY OF AWARDS**

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### **SEE DIRECTORY OF AWARDS**

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### **NUMERICAL ANALYSIS**

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#### **PROCEEDINGS OF THE BIENNIAL CONFERENCE HELD AT DUNDEE, JUNE 28 - JULY 1, 1977**

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Springer

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### **NUMERICAL METHODS IN FLUID MECHANICS**

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American Mathematical Soc. After centuries of research, turbulence in fluids is still an unsolved problem. The graduate-level lectures in this volume cover the state of the art of numerical methods for fluid mechanics. The research in this collection covers wavelet-based methods, the semi-Lagrangian method, the Lagrangian multi-pole

method, continuous adaptation of curvilinear grids, finite volume methods, shock-capturing methods, and ENO schemes. The most recent research on large eddy simulations and Reynolds stress modeling is presented in a way that is accessible to engineers, postdoctoral researchers, and graduate students. Applications cover industrial flows, aerodynamics, two-phase flows, astrophysical flows, and meteorology. This volume would be suitable as a textbook for graduate students with a background in fluid mechanics.

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## **NUMERICAL ANALYSIS AND ITS APPLICATIONS**

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### **6TH INTERNATIONAL CONFERENCE, NAA 2016, LOZENETZ, BULGARIA, JUNE 15-22, 2016, REVISED SELECTED PAPERS**

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**Springer** This book constitutes thoroughly revised selected papers of the 6th International Conference on Numerical Analysis and Its Applications, NAA 2016, held in Lozenetz, Bulgaria, in June 2016. The 90 revised papers presented were carefully reviewed and selected from 98 submissions. The conference offers a wide range of the following topics: Numerical Modeling; Numerical Stochastics; Numerical Approximation and Computational Geometry; Numerical Linear Algebra and Numerical Solution of Transcendental Equations; Numerical Methods for Differential Equations; High Performance Scientific Computing; and also special topics such as Novel methods in computational finance based on the FP7 Marie Curie Action, Project Multi-ITN STRIKE - Novel Methods in Computational Finance, Grant Agreement Number 304617; Advanced numerical and applied studies of fractional differential equations.

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## **NUMERICAL METHODS FOR CONSERVATION LAWS**

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**Birkhäuser** These notes developed from a course on the numerical solution of conservation laws first taught at the University of Washington in the fall of 1988 and then at ETH during the following spring. The overall emphasis is on studying the mathematical tools that are essential in developing, analyzing, and successfully using numerical methods for nonlinear systems of conservation laws, particularly for problems involving shock waves. A reasonable understanding of the mathematical structure of these equations and their solutions is first required, and Part I of these notes deals with this theory. Part II deals more directly with numerical methods, again with the emphasis on general tools that are of broad use. I have stressed the underlying ideas used in various classes of methods rather than presenting the most sophisticated methods in great detail. My aim was to provide a sufficient background that students could then approach the current research literature with the necessary tools and understanding. Without the

wonders of TeX and LaTeX, these notes would never have been put together. The professional-looking results perhaps obscure the fact that these are indeed lecture notes. Some sections have been reworked several times by now, but others are still preliminary. I can only hope that the errors are not too blatant. Moreover, the breadth and depth of coverage was limited by the length of these courses, and some parts are rather sketchy.

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## **MATHEMATICAL ANALYSIS OF PARTIAL DIFFERENTIAL EQUATIONS MODELING ELECTROSTATIC MEMS**

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American Mathematical Soc. Micro- and nanoelectromechanical systems (MEMS and NEMS), which combine electronics with miniature-size mechanical devices, are essential components of modern technology. It is the mathematical model describing “electrostatically actuated” MEMS that is addressed in this monograph. Even the simplified models that the authors deal with still lead to very interesting second- and fourth-order nonlinear elliptic equations (in the stationary case) and to nonlinear parabolic equations (in the dynamic case). While nonlinear eigenvalue problems--where the stationary MEMS models fit--are a well-developed field of PDEs, the type of inverse square nonlinearity that appears here helps shed a new light on the class of singular supercritical problems and their specific challenges. Besides the practical considerations, the model is a rich source of interesting mathematical phenomena. Numerics, formal asymptotic analysis, and ODE methods give lots of information and point to many conjectures. However, even in the simplest idealized versions of electrostatic MEMS, one essentially needs the full available arsenal of modern PDE techniques to do the required rigorous mathematical analysis, which is the main objective of this volume. This monograph could therefore be used as an advanced graduate text for a motivational introduction to many recent methods of nonlinear analysis and PDEs through the analysis of a set of equations that have enormous practical significance.

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## **ANALYSIS AS A TOOL IN MATHEMATICAL PHYSICS**

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### **IN MEMORY OF BORIS PAVLOV**

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Springer Nature Boris Pavlov (1936-2016), to whom this volume is dedicated, was a prominent specialist in analysis, operator theory, and mathematical physics. As one of the most influential members of the St. Petersburg Mathematical School, he was one of the founders of the Leningrad School of Non-self-adjoint Operators. This volume collects research papers originating from two conferences that were organized in memory of Boris Pavlov: “Spectral Theory and Applications”, held in Stockholm, Sweden, in March 2016, and “Operator Theory, Analysis and Mathematical

Physics - OTAMP2016" held at the Euler Institute in St. Petersburg, Russia, in August 2016. The volume also includes water-color paintings by Boris Pavlov, some personal photographs, as well as tributes from friends and colleagues.

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### **THE 2011 GUIDE TO FREE OR NEARLY-FREE E-BOOKS**

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Lulu.com One of the problems which face all librarians adding e-books to their collections is that of bibliographic control: there is no legal deposit for e-books and consequently there is no single place from which new titles can be found. If this is true of commercially published e-books, it is most certainly also true of free e-books... and there are many thousands of free e-books available over the Internet, many of which are of a quality such that librarians might wish to have them in their collections. The 2011 Guide to Free or Nearly-Free e-Books is offered as a tool for librarians and others involved in book selection (e.g. teachers in schools) in all sectors - school, further and higher education, public and special libraries - to facilitate easy access to free e-books and e-book collections which can enhance their digital library.

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### **MATHEMATICAL ANALYSIS OF URBAN SPATIAL NETWORKS**

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Springer Science & Business Media Cities can be considered to be among the largest and most complex artificial networks created by human beings. Due to the numerous and diverse human-driven activities, urban network topology and dynamics can differ quite substantially from that of natural networks and so call for an alternative method of analysis. The intent of the present monograph is to lay down the theoretical foundations for studying the topology of compact urban patterns, using methods from spectral graph theory and statistical physics. These methods are demonstrated as tools to investigate the structure of a number of real cities with widely differing properties: medieval German cities, the webs of city canals in Amsterdam and Venice, and a modern urban structure such as found in Manhattan. Last but not least, the book concludes by providing a brief overview of possible applications that will eventually lead to a useful body of knowledge for architects, urban planners and civil engineers.

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### **TOTAL LEAST SQUARES AND ERRORS-IN-VARIABLES MODELING**

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### **ANALYSIS, ALGORITHMS AND APPLICATIONS**

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Springer Science & Business Media In response to a growing interest in Total Least Squares (TLS) and Errors-In-

Variables (EIV) modeling by researchers and practitioners, well-known experts from several disciplines were invited to prepare an overview paper and present it at the third international workshop on TLS and EIV modeling held in Leuven, Belgium, August 27-29, 2001. These invited papers, representing two-thirds of the book, together with a selection of other presented contributions yield a complete overview of the main scientific achievements since 1996 in TLS and Errors-In-Variables modeling. In this way, the book nicely completes two earlier books on TLS (SIAM 1991 and 1997). Not only computational issues, but also statistical, numerical, algebraic properties are described, as well as many new generalizations and applications. Being aware of the growing interest in these techniques, it is a strong belief that this book will aid and stimulate users to apply the new techniques and models correctly to their own practical problems.

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### **ACTA NUMERICA 2002: VOLUME 11**

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Cambridge University Press An annual volume presenting substantive survey articles in numerical mathematics and scientific computing.

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### **INTRODUCTION TO MATHEMATICAL ANALYSIS**

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McGraw-Hill College

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### **THE AMERICAN MATHEMATICAL MONTHLY**

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### **THE OFFICIAL JOURNAL OF THE MATHEMATICAL ASSOCIATION OF AMERICA**

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### **AN EXCURSION THROUGH DISCRETE DIFFERENTIAL GEOMETRY**

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### **AMS SHORT COURSE, DISCRETE DIFFERENTIAL GEOMETRY, JANUARY 8-9, 2018, SAN DIEGO, CALIFORNIA**

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American Mathematical Soc. Discrete Differential Geometry (DDG) is an emerging discipline at the boundary between mathematics and computer science. It aims to translate concepts from classical differential geometry into a language that is purely finite and discrete, and can hence be used by algorithms to reason about geometric data. In contrast to standard numerical approximation, the central philosophy of DDG is to faithfully and exactly preserve key invariants of geometric objects at the discrete level. This process of translation from smooth to discrete helps to both illuminate the fundamental meaning behind geometric ideas and provide useful algorithmic guarantees. This volume is based on

lectures delivered at the 2018 AMS Short Course "Discrete Differential Geometry," held January 8-9, 2018, in San Diego, California. The papers in this volume illustrate the principles of DDG via several recent topics: discrete nets, discrete differential operators, discrete mappings, discrete conformal geometry, and discrete optimal transport.

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## **SECOND SUMMER SCHOOL IN ANALYSIS AND MATHEMATICAL PHYSICS**

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### **TOPICS IN ANALYSIS : HARMONIC, COMPLEX, NONLINEAR, AND QUANTIZATION : SECOND SUMMER SCHOOL IN ANALYSIS AND MATHEMATICAL PHYSICS, CUERNAVACA MORELOS, MEXICO, JUNE 12-22, 2000**

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American Mathematical Soc. For the second time, a Summer School in Analysis and Mathematical Physics took place at the Universidad Nacional Autonoma de Mexico in Cuernavaca. The purpose of the schools is to provide a bridge from standard graduate courses in mathematics to current research topics, particularly in analysis. The lectures are given by internationally recognized specialists in the fields. The topics covered in this Second Summer School include harmonic analysis, complex analysis, pseudodifferential operators, the mathematics of quantum chaos, and non-linear analysis.

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## **CATALOG OF COPYRIGHT ENTRIES. THIRD SERIES**

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### **1971: TITLE INDEX**

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## **RIGOROUS NUMERICS IN DYNAMICS**

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American Mathematical Soc. This volume is based on lectures delivered at the 2016 AMS Short Course "Rigorous Numerics in Dynamics", held January 4-5, 2016, in Seattle, Washington. Nonlinear dynamics shapes the world around us, from the harmonious movements of celestial bodies, via the swirling motions in fluid flows, to the complicated biochemistry in the living cell. Mathematically these phenomena are modeled by nonlinear dynamical systems, in the form of ODEs, PDEs and delay equations. The presence of nonlinearities complicates the analysis, and the difficulties are even greater for PDEs and delay equations, which are naturally defined on infinite dimensional function spaces. With the availability of powerful computers and sophisticated software, numerical simulations have quickly become the primary tool to study the models. However, while the pace of progress increases, one may ask: just how reliable

are our computations? Even for finite dimensional ODEs, this question naturally arises if the system under study is chaotic, as small differences in initial conditions (such as those due to rounding errors in numerical computations) yield wildly diverging outcomes. These issues have motivated the development of the field of rigorous numerics in dynamics, which draws inspiration from ideas in scientific computing, numerical analysis and approximation theory. The articles included in this volume present novel techniques for the rigorous study of the dynamics of maps via the Conley-index theory; periodic orbits of delay differential equations via continuation methods; invariant manifolds and connecting orbits; the dynamics of models with unknown nonlinearities; and bifurcations diagrams.

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## **MATHEMATICAL METHODS**

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### **FOR STUDENTS OF PHYSICS AND RELATED FIELDS**

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Springer Science & Business Media Intended to follow the usual introductory physics courses, this book contains many original, lucid and relevant examples from the physical sciences, problems at the ends of chapters, and boxes to emphasize important concepts to help guide students through the material.

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### **A COURSE IN MATHEMATICAL ANALYSIS: PT.2. DIFFERENTIAL EQUATIONS. [C1917**

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### **MATHEMATICAL METHODS FOR ANALYSIS OF A COMPLEX DISEASE**

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American Mathematical Soc. Complex diseases involve most aspects of population biology, including genetics, demographics, epidemiology, and ecology. Mathematical methods, including differential, difference, and integral equations, numerical analysis, and random processes, have been used effectively in all of these areas. The aim of this book is to provide sufficient background in such mathematical and computational methods to enable the reader to better understand complex systems in biology, medicine, and the life sciences. It introduces concepts in mathematics to study population phenomena with the goal of describing complicated aspects of a disease, such as malaria, involving several species. The book is based on a graduate course in computational biology and applied mathematics taught at the Courant Institute of Mathematical Sciences in fall 2010. The mathematical level is kept to essentially advanced undergraduate mathematics, and the results in the book are intended to provide readers with tools for performing more in-depth analysis of population phenomena.

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## **LYAPUNOV FUNCTIONALS AND STABILITY OF STOCHASTIC FUNCTIONAL DIFFERENTIAL EQUATIONS**

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Springer Science & Business Media Stability conditions for functional differential equations can be obtained using Lyapunov functionals. Lyapunov Functionals and Stability of Stochastic Functional Differential Equations describes the general method of construction of Lyapunov functionals to investigate the stability of differential equations with delays. This work continues and complements the author's previous book Lyapunov Functionals and Stability of Stochastic Difference Equations, where this method is described for difference equations with discrete and continuous time. The text begins with both a description and a delineation of the peculiarities of deterministic and stochastic functional differential equations. There follows basic definitions for stability theory of stochastic hereditary systems, and the formal procedure of Lyapunov functionals construction is presented. Stability investigation is conducted for stochastic linear and nonlinear differential equations with constant and distributed delays. The proposed method is used for stability investigation of different mathematical models such as: • inverted controlled pendulum; • Nicholson's blowflies equation; • predator-prey relationships; • epidemic development; and • mathematical models that describe human behaviours related to addictions and obesity. Lyapunov Functionals and Stability of Stochastic Functional Differential Equations is primarily addressed to experts in stability theory but will also be of interest to professionals and students in pure and computational mathematics, physics, engineering, medicine, and biology.

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## **GENERATINGFUNCTIONOLOGY**

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Elsevier Generatingfunctionology provides information pertinent to generating functions and some of their uses in discrete mathematics. This book presents the power of the method by giving a number of examples of problems that can be profitably thought about from the point of view of generating functions. Organized into five chapters, this book begins with an overview of the basic concepts of a generating function. This text then discusses the different kinds of series that are widely used as generating functions. Other chapters explain how to make much more precise estimates of the sizes of the coefficients of power series based on the analyticity of the function that is represented by the series. This book discusses as well the applications of the theory of generating functions to counting problems. The final chapter deals with the formal aspects of the theory of generating functions. This book is a valuable resource for mathematicians and students.

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## LECTURE NOTES ON FUNCTIONAL ANALYSIS

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### WITH APPLICATIONS TO LINEAR PARTIAL DIFFERENTIAL EQUATIONS

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**American Mathematical Society** This textbook is addressed to graduate students in mathematics or other disciplines who wish to understand the essential concepts of functional analysis and their applications to partial differential equations. The book is intentionally concise, presenting all the fundamental concepts and results but omitting the more specialized topics. Enough of the theory of Sobolev spaces and semigroups of linear operators is included as needed to develop significant applications to elliptic, parabolic, and hyperbolic PDEs. Throughout the book, care has been taken to explain the connections between theorems in functional analysis and familiar results of finite-dimensional linear algebra. The main concepts and ideas used in the proofs are illustrated with a large number of figures. A rich collection of homework problems is included at the end of most chapters. The book is suitable as a text for a one-semester graduate course.

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## NUMERICAL ANALYSIS

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**Cengage Learning** This well-respected text gives an introduction to the theory and application of modern numerical approximation techniques for students taking a one- or two-semester course in numerical analysis. With an accessible treatment that only requires a calculus prerequisite, Burden and Faires explain how, why, and when approximation techniques can be expected to work, and why, in some situations, they fail. A wealth of examples and exercises develop students' intuition, and demonstrate the subject's practical applications to important everyday problems in math, computing, engineering, and physical science disciplines. The first book of its kind built from the ground up to serve a diverse undergraduate audience, three decades later Burden and Faires remains the definitive introduction to a vital and practical subject. **Important Notice:** Media content referenced within the product description or the product text may not be available in the ebook version.

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## MATHEMATICAL METHODS IN IMMUNOLOGY

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**American Mathematical Soc.** Any organism, to survive, must use a variety of defense mechanisms. A relatively recent evolutionary development is that of the adaptive immune system, carried to a quite sophisticated level by mammals. The complexity of this system calls for its encapsulation by mathematical models, and this book aims at the associated

description and analysis. In the process, it introduces tools that should be in the armory of any current or aspiring applied mathematician, in the context of, arguably, the most effective system nature has devised to protect an organism from its manifold invisible enemies.

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## **DECOMPOSITION METHODS FOR DIFFERENTIAL EQUATIONS**

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### **THEORY AND APPLICATIONS**

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CRC Press Decomposition Methods for Differential Equations: Theory and Applications describes the analysis of numerical methods for evolution equations based on temporal and spatial decomposition methods. It covers real-life problems, the underlying decomposition and discretization, the stability and consistency analysis of the decomposition methods, and numerical results. The book focuses on the modeling of selected multi-physics problems, before introducing decomposition analysis. It presents time and space discretization, temporal decomposition, and the combination of time and spatial decomposition methods for parabolic and hyperbolic equations. The author then applies these methods to numerical problems, including test examples and real-world problems in physical and engineering applications. For the computational results, he uses various software tools, such as MATLAB®, R3T, WIAS-HiTNIHS, and OPERA-SPLITT. Exploring iterative operator-splitting methods, this book shows how to use higher-order discretization methods to solve differential equations. It discusses decomposition methods and their effectiveness, combination possibility with discretization methods, multi-scaling possibilities, and stability to initial and boundary values problems.

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## **LECTURES ON FIELD THEORY AND TOPOLOGY**

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American Mathematical Soc. These lectures recount an application of stable homotopy theory to a concrete problem in low energy physics: the classification of special phases of matter. While the joint work of the author and Michael Hopkins is a focal point, a general geometric frame of reference on quantum field theory is emphasized. Early lectures describe the geometric axiom systems introduced by Graeme Segal and Michael Atiyah in the late 1980s, as well as subsequent extensions. This material provides an entry point for mathematicians to delve into quantum field theory. Classification theorems in low dimensions are proved to illustrate the framework. The later lectures turn to more specialized topics in field theory, including the relationship between invertible field theories and stable homotopy theory, extended unitarity, anomalies, and relativistic free fermion systems. The accompanying mathematical

explanations touch upon (higher) category theory, duals to the sphere spectrum, equivariant spectra, differential cohomology, and Dirac operators. The outcome of computations made using the Adams spectral sequence is presented and compared to results in the condensed matter literature obtained by very different means. The general perspectives and specific applications fuse into a compelling story at the interface of contemporary mathematics and theoretical physics.

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## **NUMERICAL METHODS FOR CONSERVATION LAWS**

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**Birkhauser** These notes developed from a course on the numerical solution of conservation laws first taught at the University of Washington in the fall of 1988 and then at ETH during the following spring. The overall emphasis is on studying the mathematical tools that are essential in developing, analyzing, and successfully using numerical methods for nonlinear systems of conservation laws, particularly for problems involving shock waves. A reasonable understanding of the mathematical structure of these equations and their solutions is first required, and Part I of these notes deals with this theory. Part II deals more directly with numerical methods, again with the emphasis on general tools that are of broad use. I have stressed the underlying ideas used in various classes of methods rather than presenting the most sophisticated methods in great detail. My aim was to provide a sufficient background that students could then approach the current research literature with the necessary tools and understanding. Without the wonders of TeX and LaTeX, these notes would never have been put together. The professional-looking results perhaps obscure the fact that these are indeed lecture notes. Some sections have been reworked several times by now, but others are still preliminary. I can only hope that the errors are not too blatant. Moreover, the breadth and depth of coverage was limited by the length of these courses, and some parts are rather sketchy."

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## **MATHEMATICAL ASPECTS OF QUANTUM FIELD THEORIES**

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**Springer** Despite its long history and stunning experimental successes, the mathematical foundation of perturbative quantum field theory is still a subject of ongoing research. This book aims at presenting some of the most recent advances in the field, and at reflecting the diversity of approaches and tools invented and currently employed. Both leading experts and comparative newcomers to the field present their latest findings, helping readers to gain a better understanding of not only quantum but also classical field theories. Though the book offers a valuable resource for mathematicians and physicists alike, the focus is more on mathematical developments. This volume consists of four

parts: The first Part covers local aspects of perturbative quantum field theory, with an emphasis on the axiomatization of the algebra behind the operator product expansion. The second Part highlights Chern-Simons gauge theories, while the third examines (semi-)classical field theories. In closing, Part 4 addresses factorization homology and factorization algebras.

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## **APPLIED LINEAR ALGEBRA**

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**Springer** This textbook develops the essential tools of linear algebra, with the goal of imparting technique alongside contextual understanding. Applications go hand-in-hand with theory, each reinforcing and explaining the other. This approach encourages students to develop not only the technical proficiency needed to go on to further study, but an appreciation for when, why, and how the tools of linear algebra can be used across modern applied mathematics. Providing an extensive treatment of essential topics such as Gaussian elimination, inner products and norms, and eigenvalues and singular values, this text can be used for an in-depth first course, or an application-driven second course in linear algebra. In this second edition, applications have been updated and expanded to include numerical methods, dynamical systems, data analysis, and signal processing, while the pedagogical flow of the core material has been improved. Throughout, the text emphasizes the conceptual connections between each application and the underlying linear algebraic techniques, thereby enabling students not only to learn how to apply the mathematical tools in routine contexts, but also to understand what is required to adapt to unusual or emerging problems. No previous knowledge of linear algebra is needed to approach this text, with single-variable calculus as the only formal prerequisite. However, the reader will need to draw upon some mathematical maturity to engage in the increasing abstraction inherent to the subject. Once equipped with the main tools and concepts from this book, students will be prepared for further study in differential equations, numerical analysis, data science and statistics, and a broad range of applications. The first author's text, *Introduction to Partial Differential Equations*, is an ideal companion volume, forming a natural extension of the linear mathematical methods developed here.