Applications of Mathematics

Book Reviews

Applications of Mathematics, Vol. 50 (2005), No. 2, 173–176

Persistent URL: http://dml.cz/dmlcz/134599

BOOK REVIEWS

F. Colonius at al.: ADVANCES IN MATHEMATICAL SYSTEMS THEORY. A Volume in Honour of Diederich Hinrichsen. Birkhäuser-Verlag, Boston-Basel-Berlin, 2000. ISBN 0-8176-4162-9, 336 pages, price USD 119.–.

This volume contains lectures presented at the workshop "Advances in Mathematical Systems Theory" held on the island of Borkum, Germany, April 20–23, 1999. Many of the contributors are leading international researchers in the field. The main topics are recent advances in nonlinear systems theory, including parameterization problems and behaviour of the linear system, convolutional codes, complementary and hybrid systems. Controllability and stabilizability of infinite-dimensional systems are treated as well. Among the contributors are A. J. Pritchard, V. L. Kharitonov, A. D. B. Paice and F. R. Wirth, A. Ilchmann and I. Y. Mareels, F. Colonius and W. Kliemann, J. C. Willems, P. A. Fuhrmann and U. Helmke, H. Gluesing-Luerssen, J. Rosenthal and P. A. Weiner, M. Heymann, F. Lin and G. Meyer, U. Krause, H. Schumacher, B. Jacob and H. Zwart, R. F. Curtain and J. C. Oostveen, J. Logemann and A. D. Mawby.

Bohdan Maslowski

K. Sobczyk, D. J. Kirkner: STOCHASTIC MODELLING IN MICROSTRUCTURES. Birkhäuser-Verlag, Boston-Basel-Berlin, 2001. ISBN 0-8176-4233-1, 280 pages, price EUR 105.–.

It is the objective of this book to provide the basic principles and results of the theory of random fields (both continuous and discrete) with special emphasis on methods that are important for the modelling of real random material microstructures. The book is divided into six chapters. Chapter 1 summarizes some basic concepts of probability theory that are needed in the sequel. Chapter 2 contains a systematic presentation of the most important concepts and results of the theory of random fields. In the next chapter, fundamentals on discrete-type random patterns are given, the basic ingredient in the modelling of which is the Poisson-point random field. Gibbsian random fields and models for a random distribution of particles and a random division of space into polyhedra are also treated. In Chapter 4, the basic methodology of statistical inference for random spatial patterns is presented. Chapters 5 and 6 are devoted to specific issues of microstructural modelling (correlation structure, scales of random variations, and others) and to analysis of some selected applied problems (like water-saturated porous media and solid microheterogeneous elastic materials).

The book may be viewed as a comprehensive introduction to the field of stochastic modelling of material microstructures and will be useful for researchers and professionals in material modelling, engineering and in applied mathematics in general.

Bohdan Maslowski

J. H. Davis: FOUNDATIONS OF DETERMINISTIC AND STOCHASTIC CONTROL. Systems & Control: Foundations and Applications. Birkhäuser-Verlag, Boston-Basel-Berlin, 2002. ISBN 0-8176-4257-9, 440 pages, price EUR 99.81.

This is a textbook intended for use in courses on linear control and filtering and estimation on (advanced) levels. Its major purpose is an introduction to both deterministic and stochastic control and estimation. Topics are treated in both continuous and discrete time versions. In addition to the standard finite-dimensional linear regulator problems, the control of distributed parameter systems (i.e. systems governed by partial differential equations) based on the framework of linear-quadratic Gaussian optimization problems is treated as well. The methods utilize Wiener-Hopf integral equations, which provide direct derivation of the results and allow parallels between the finite- and infinite-dimensional versions of the problems. Among others, the book also contains chapters on Stability Theory, Kalman-Bucy Filters, Filters Without Riccati Equations, and chapters on numerical aspects of control problems. Each chapter involves problems and exercises, and the book is supplemented by appendices, where fundamentals on Hilbert and Banach spaces, operator theory and measure theoretic probability may be found.

The book will be very useful for students but also for a variety of specialists interested in deterministic and stochastic control and filtering.

Bohdan Maslowski

P. Koch Medina, S. Merino: MATHEMATICAL FINANCE AND PROBABILITY. Birkhäuser-Verlag, Basel-Boston-Berlin, 2003. ISBN 3-7643-6921-3, x + 328 pages, price EUR 45.–.

The book presents the part of mathematical finance devoted to the pricing of derivative instruments; its basic theme is the study of prices in securities markets in an uncertain environment. In one half of its 18 chapters and also in the appendices, more or less pure mathematics prevails as can be seen from their titles: Positive Linear Functionals, Finite Probability Spaces, Random Variables, Information and Randomness, Independence, Conditioning and Martingales, The Central Limit Theorem, Optimal Stopping. In two appendices, the basic notions concerning Euclidean spaces and linear algebra are summarized and the theorem of de Moivre-Laplace is proved. The basic knowledge of linear algebra and calculus (corresponding to the first three semesters at standard universities) is necessary, however, the probability in the framework of finite sample spaces is developed from the very beginning. Consequently, the book can also be considered as an introduction to the modern probability theory with applications in the financial branch.

Seven chapters covering financial topics are entitled as follows: A Short Primer on Finance, General One-Period and Multi-Period Models (in two separate chapters), The Fundamental Theorems of Asset Pricing, The Cox-Ross-Rubinstein Model, The Block-Scholes Formula and American Claims. As the objective of the book is to provide a sound understanding of important issues of modern approaches to mathematical finance, several mathematical models are developed and examined in detail. The focus is on finite-time models and the highest level of generality is frequently sacrificed for the sake of a greater insight into the underlying economic ideas. Even when the problems are approached from the mathematical point of view and almost all results are strictly proved, the financial interpretation is always stressed.

The style of presentation is aimed at students of financial economics, mathematics and physics and at mathematicians, physicists and economists working in financial industry.

Ivan Saxl

D. Lupo, C. D. Pagani, B. Ruf, eds.: NONLINEAR EQUATIONS: METHODS, MODELS AND APPLICATIONS. Progress in Nonlinear Differential Equations and Their Applications 54. Birkhäuser-Verlag, Basel-Boston-Berlin, 2003. ISBN 3-7643-0398-0, 276 pages, price EUR 98.–.

This volume contains 20 selected articles from the "Workshop on Nonlinear Analysis and Applications" which took place in Bergamo on July 9 to 13, 2001. This workshop was organized by Daniela E. Lupo and Carlo D. Pagani as the third edition of a meeting (1996 and 1998, both held in Campinas). The topics of contributions are calculus of variations, variational inequalities, critical point theory, elliptic differential equations, equations of Hamilton-Jacobi, Schrödinger and Navier-Stokes, as well as free boundary problems.

After a brief preface, the contributions follow: M. O. Ahmedou (A Riemann mapping type theorem in higher dimensions), V. Benci and G. Menconi (Computable information content and a simple application to the study of DNA), L. Boccardo and B. Pellacci (Bounded positive critical points of some multiple integrals of the calculus of variations), M. Calanchi and R. Musina (S^2-type parametric surfaces with prescribed mean curvature and minimal energy), I. C. Dolcetta (Representations of solutions of Hamilton-Jacobi equations), G. Caristi (Nonexistence of global solutions of higher order evolution inequalities in $\mathbb{R}^N$), S. Cingolani and G. Vannella (Morse index computations for a class of functionals defined in Banach spaces), M. Clapp (A global compactness result for elliptic problems with critical nonlinearity on symmetric domains), M. Degiovanni (Variational methods for functionals with lack of strict convexity), V. Benci and D. Fortunato (Some remarks on the semilinear wave equation), R. J. Iorio, Jr. (Unique continuation principles for some equations of Benjamin-Ono type), H. A. Biagioni and F. Linares (Well-posedness results for the modified Zakharov-Kuznetsov equation), O. Lopes (A class of isoinertial one parameter families of selfadjoint operators), J. Horák and P. J. McKenna (Traveling waves in nonlinearly supported beams and plates), A. M. Micheletti and D. Visetti (Solitary waves solutions of a nonlinear Schrödinger equation), C. O. Alves, P. C. Carrião and O. H. Miyagaki (Nontrivial solutions of a class of quasilinear eliptic problems involving critical exponents), F. Pacella and P. N. Srikanth (Solutions of semilinear problems in symmetrical planar domains—ODE behaviour and uniqueness of branches), P. H. Rabinowitz and E. Stredulinsky (Solutions of an Allen-Cahn model equation), G. Talenti (Some equations of non-geometrical optics).

The book is closed by a complete list of speakers.

Jan Eisner

W. Bangerth, R. Rannacher: ADAPTIVE FINITE ELEMENT METHODS FOR DIFFERENTIAL EQUATIONS. Birkhäuser-Verlag, Basel-Boston-Berlin, 2003. ISBN 3-7643-7009-2, 216 pages, price EUR 22.–.

This volume of the series *Lectures in Mathematics* of ETH Zürich treats a timely topic in Numerical Analysis, namely that of nonlinear approximation and of adaptivity in particular. It is organized as follows. In the introductory first chapter, the flavour of the topic is given. Furthermore, basic concepts are outlined in a finite dimensional context, the most important one being duality-based error estimation.

The following four chapters (2–5) form the heart of the book. In easy terms and using examples well-known in Numerical Analysis, the process of adaptive approximation using finite elements is described; first in a Discontinuous Galerkin setting applied to an initial value problem, and afterwards in a standard finite element setting using an elliptic boundary value problem as a model. Practical aspects are covered, and limitations of the theory are not only admitted, but also discussed in detail. Therefore, this part of the book represents a fair overview of the current status of adaptivity. As such, it could easily serve as teaching

material for an advanced course in Numerical Analysis, especially since each chapter is concluded with both theoretical and programming exercises, for which detailed answers are provided at the end of the book. Moreover, programs can be downloaded from a website.

Chapters 6–9 treat adaptivity in the nonlinear setting (with the eigenvalue problem as a special case), in optimization, and in (possibly nonlinear) evolution equations. These three topics are mostly independent of each other, although they do require the first six chapters as prerequisites. Chapters 10 and 11 cover specific applications in structural and fluid mechanics, and the book is concluded with a chapter on historical remarks, current developments, and open problems.

All in all, the book is a pleasant mixture of theory, applications, and exercises, with quite a few numerical examples to illustrate the respective topics under consideration.

Jan Brandts

D. Haroske, T. Runst, H.-J. Schmeiser, eds.: FUNCTION SPACES, DIFFERENTIAL OPERATORS AND NONLINEAR ANALYSIS. The Hans Triebel anniversary volume. Birkhäuser-Verlag, Basel, 2003. ISBN 3-7643-6935-3, 12+474 pages, price EUR 88.–.

The book represents a collection of papers based on lectures delivered at the International Conference "Function Spaces, Differetial Operators and Nonlinear Analysis" held in Teistungen, Thuringia/Germany, from June 28 to July 4, 2001, in honour of Hans Treibel's 65th birthday. The conference was the fifth one in series of meetings organized under the same name alternately in Finland, Germany, and the Czech Republic.

This collection of papers is a tribute to Hans Triebel's distinguished work with an extraordinary impact on mathematical analysis. The book is desired into three parts.

Part I contains two lectures (delivered by O. V. Besov and D E. Edmunds) having a survey character and honouring Hans Triebel's contributions.

Part II consists of seven papers reflecting recent developments in the theory of function spaces and linear and nonlinear partial differential equations (presented by D. G. de Figueiredo, G. Bourdaud, V. Maz'ya, A. Miyachi, S. Pohozaev, M. Solomyak, and G. Uhlmann).

Part III contains twenty four communications related to the topics of the conference.

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