BOOK REVIEWS

HERBERT AMANN, JOACHIM ESCHER, *Analysis III*, Birkhäuser Verlag, Basel-Boston-Berlin, 2009, xii + 468 p., ISBN 3-7643-7479-2.

This book is the last volume, devoted to integration theory and to the fundamentals of global analysis, of a modern, clear and complete introduction to analysis.

The first chapter (Chapter IX) focuses on the general theory of the measure of lines, areas, volumes, and sets in higher dimensional spaces. The authors use the realm of general measure theory for characterizing measurable sets in the *n*-dimensional Euclidean space. Carathéodory's approach, involving the outer measures, is used for constructing the measures developed by Lebesgue, Hausdorff, and Stieltjies. The first one is studied in detail in the last part of the chapter.

The second chapter (Chapter X) is devoted to the theory of integration. In the first part, integrals over general measure spaces are studied. The second part focuses on the special case of the Lebesgue measure in the *n*-dimensional Euclidean space. In this context, the authors prove and discuss the convergence theorems of Fubini and Lebesgue, the transformation theorem and the fundamental approximation theorems. They also explain the convolution and the Fourier transform.

Chapters XI and XII deal with the theory of differential forms of higher degree and integrated over certain submanifolds of general manifolds, generalizing the theory of line integrals. Chapter XI is an introduction to differential geometry and differential topology, including properties of manifolds with boundary, orientability, basic facts of Riemannian geometry, and properties of several operators used in the integration theory: gradient, divergence, curl and Hodge star. Further on, in the last chapter, the authors explain how to extend the integration theory to manifolds. Using local charts, they construct the Riemann-Lebesgue measure on manifolds and, as this is a complete Radon measure, show how to integrate *m*-forms over *m*-dimensional manifolds. Many examples and several physical and geometric interpretations are provided. The last section is devoted to Stokes' theorem for manifolds with singularities and to its applications and consequences.

As the authors also emphasize, due to the ampleness of the material, the volume can be used in a course only if a more specific subject is chosen. Its completeness, as to the notions discussed and the proofs of the results as well, and the numerous openings into advanced topics of the integration theory and global analysis, make it a suitable support for self-study and a valuable background for more specialized courses.

Gabriela Lițcanu

TITU ANDREESCU, RĂZVAN GHELCA, *Mathematical Olympiad Challenges*, Second Edition, Birkhäuser, Boston, 2009, xvii+ 283 p., ISBN 978-0-8176-4528-1.

Mathematical Olympiad Challenges presents a different side of Mathematics. Researchers in Mathematics know that results in the field are achieved after a long experience and a deep familiarity with mathematical objects, progress is slowly and collectively made after periods of sustained effort. In contrast, the Olympiad environment demands a relatively brief period of intense concentration.

This book weaves together Olympiad problems with a common theme, so that insights become techniques, tricks become methods. The book is organized for learning. Each section treats a particular technique or topic. Introductory results or problems are provided with solutions, then related problems are presented, with solutions, in another section.

The problems presented are daunting at any level. True to its title, the book is a challenging one. There are no elementary problems – although there are elementary solutions. The content of the book begins just at the edge of the usual high school curriculum. The calculus is sometimes referred to, but rarely leaned on, for either solutions or motivation.

Ionuţ Munteanu

BARRY C. ARNOLD, N. BALAKRISHNAN, H.N. NAGARAYA, *A First Course in Order Statistics*, SIAM, 2008, xxiii+279 p., ISBN: 978-0-89871-648-1.

This book provides an introduction to the general theory of order statistics and their applications. Requiring no advanced background in mathematics or statistics, this undergraduate-level text can be read effectively as a course, but also as a self-study guide or professional reference. Several of the main themes in the order statistics literature are approached, making it a book of reference among students in statistics and mathematics, or for specialists using statistics in their work.

The book is divided into nine chapters, each one (excepting the first) ending with an impressive list of exercises. Besides an extensive bibliography, there are also included author and subject indices. After introducing order statistics and applications in the first chapter, the authors cover basic continuous distribution theory in the second one, including joint distribution of two order statistics and the distribution of some associated characteristics. The third chapter is devoted to the discrete case of order statistics. In the next chapter, order statistics arising from well-known distributions are investigated; there are also indications on how to simulate order statistics on a computer.

In Chapter 5, the authors establish some identities and recurrence relations satisfied by the moments of order statistics from any arbitrary population; universal bounds for these moments are then derived. Chapter 6 deals with the question of how the knowledge of some properties of the distribution of order statistic determines parent distribution. Statistical inference with the help of order statistics in estimation, prediction and testing of hypothesis is described in Chapter 7. In the next chapter, attention is focused on the asymptotic behaviour of the distributions of order statistics, mainly by using weak convergence results. The study of standard record value processes associated with a sequence of independent identically distributed random variables is the subject of the last chapter.

Written in a simple and accessible style, this book can easily become a companion of choice for anyone concerned with mathematical statistics.

Adrian Zălinescu

RAINER BURKARD, MAURO DELL’AMICO, SILVANO MARTELLO, *Assignment Problems*, SIAM, Philadelphia, 2009, xx+ 382p., ISBN 978-0-898716-63-4.

This book exposes in detail the theory and algorithms related to assignment problems, completed by a wide range of practical applications and by software options.

The material is organized into ten self-contained chapters, so that the reader would be able to go to the specific issue he is interested in, without having to cover all the details of the previous chapters. Exercises, given as fully-developed numerical examples, may be used for self-study or as homework problems for students. The book also offers 669 titles of bibliography, along with an author index. The associated webpage contains links to efficient computer codes, as well as applets allowing step-by-step execution of some basic algorithms.

Chapter 1 gives an introductory overview of the various types of assignment problems.

Chapter 2 treats matchings. The first section is devoted to the marriage theorem and the existence of perfect matchings and the second, to the assignment polytope and its properties.

Chapter 3 studies bipartite matching algorithms. One finds here the Hopcroft-Karp algorithm and later improvements, matchings in convex bipartite graphs, and also applications of maximum bipartite matchings.

Chapters 4 and 5 deal with linear sum assignment problems. Primal-dual algorithms and the Hungarian algorithm, the Dinic-Kronrod algorithm, primal and dual non-simplex and simplex-based algorithms, as well as parallel algorithms are here presented. The features also include results on asymptotic analysis, variants and examples of real-life applications of linear sum assignment problems. Chapter 6 describes other types of linear assignment problems, such as bottleneck, algebraic, sum-k and balanced assignment problems.

Chapters 7 concerns quadratic assignment problems, the authors giving examples of combinatorial optimization problems representing special cases of quadratic assignment problems, then detailing different variants of formulation, linearization, and bounds. Chapter 8 presents exact and heuristic algorithms for quadratic assignment problems.

Chapter 9 is devoted to the quadratic bottleneck assignment problem, the asymptotic behaviour of quadratic assignment problems, cubic and quartic assignment problems and quadratic semi-assignment problem.

Finally, Chapter 10 treats multi-index assignment problems, namely the axial 3-index, planar 3-index and general multi-index assignment problems.

Besides its interest for both researchers and practitioners, this volume recommends itself as a valuable textbook for graduate students and for their teachers, being appropriate for advanced courses in discrete mathematics, integer programming, combinatorial optimization, and algorithmic computer science.

Adriana-Ioana Lefter

MARGARET CHENEY, BRETT BORDEN, *Fundamentals of Radar Imaging*, CBMS-NSF Regional Conference Series in Applied Mathematics, Vol. 79, SIAM, 2009, xxiv+140 p., ISBN: 978-0-898716-77-1.

Radar imaging is a subject of tremendous mathematical richness that involves partial differential equations, scattering theory, microlocal analysis, integral geometry, linear algebra, electromagnetic theory, harmonic analysis, approximation theory, group theory, and statistics. The topic is almost completely unknown in the mathematical community.

The focus here is on showing the connection between physics and mathematics, and on supplying an intuitive mathematical understanding of some basic ideas of the radar imaging technique.

The goal of this book is to provide mathematicians with the background they need to work in the field, building on the foundation of the underlying partial differential equations.

The two parts of this book, *Radar basics*, and *Radar imaging*, include: a description of how a radar system works, together with relevant mathematics; a theory that guides the choice of radar waveforms; the derivation of the fundamentals of scattering theory; derivation and discussion of the image formation process; a long list of current open problems. Most of these open problems are mathematical in nature.

Applied mathematicians will want this book because it explains the basics of radar imaging, provides a foundation for understanding literature, and gives references for many open problems.

This book is appropriate for graduate students and mathematicians interested in inverse problems, imaging, or electromagnetics. The material will also be of use to students and practitioners of electrical engineering and physics interested in radar applications.

Ion Crăciun

PAO-LIU CHOW, *Stochastic Partial Differential Equations*, Chapman & Hall/CRC, 2007, ix+ 281p., ISBN 1-58488-443-6.

This book offers an introduction to the analytical and computational techniques of stochastic partial differential equations of Itô type. The author has grouped the content into two parts: the first five chapters deal with prototypes of concrete equations, while the last four chapters are concerned with a unified theory of stochastic evolution equations.

After giving several examples of stochastic partial differential equations arising from applied sciences, the introductive chapter briefly presents some notions about Brownian motions, martingales, stochastic integrals, and stochastic differential equations, to be applied in the book.

Chapter 2 treats linear and quasilinear first-order stochastic equations, having finite-dimensional, spatially dependent white noises as coefficients.

Chapters 3 and 4 analyze, by Fourier methods, stochastic parabolic equations, such as the heat equation driven by a spatially dependent white noise, or linear parabolic equations with additive white noise; existence, uniqueness, regularity and positivity questions for linear and semilinear stochastic parabolic equations, in a bounded domain or over the whole space, are studied. A stochastic Feynman-Kac formula for a linear parabolic equation with a multiplicative noise is also given.

Chapter 5 discusses linear and semilinear stochastic wave equations in bounded or unbounded domains.

Chapter 6 studies stochastic evolution equations in Hilbert spaces. Hilbert space-valued martingales, stochastic integrals on Hilbert spaces and the corresponding Itô's formula are introduced, then existence and uniqueness theorems for mild and strong solutions are given.

Chapter 7 is concerned with the asymptotic behavior of solutions. Among the issues discussed are the boundedness of solutions, the stability of null solution, the existence of invariant measures for the solutions, and also small random perturbation problems.

Chapter 8 applies the theorems of Chapters 6 and 7 to examples of models in turbulence theory, such as stochastic Burgers' equations, Schrödinger equation, the equations describing the vibration of a nonlinear elastic beam excited by the turbulent wind, or forced Navier-Stokes equations.

The final chapter analyzes the connection between the stochastic partial differential equations and diffusion equations in infinite dimensions. The Kolmogorov and Hopf equations are treated.

The reader is assumed to be familiar with basic probability theory and ordinary Itô's differential equations, but not necessarily with partial differential equations.

Adriana-Ioana Lefter

GERMUND DAHLQUIST, ǺKE BJÖRK, *Numerical Methods in Scientific Computing,* Vol. I, SIAM, Philadelphia, 2008, xxvii+ 717 p., ISBN 978-0-898716-44-3.

This is the first volume of a new edition, thoroughly revised and updated, of the extremely successful book, *Numerical Methods*, released in 1974 by the same authors. It is a textbook on the methods of numerical analysis, starting from an elementary level up to more sophisticated notions; the authors have intended to make the content as self-contained as possible.

The volume is divided into 6 chapters. Each section ends with review questions and a set of problems and computer exercises; moreover, a section of Notes and References is inserted in each chapter. A list of figures, a list of tables, a list of conventions, an index, and a 389 titles reference list are also provided.

Chapter 1 is an overview of some basic methods applied in numerical analysis, approaching subjects such as matrix computations, the linear least squares problem, numerical solutions of differential equations, and an introduction to the Monte Carlo methods.

Chapter 2 is concerned with propagation, estimation and control of errors, while Chapter 3 treats different types of series (power series, Laurent and Fourier series), difference operators and operator expansions, methods for convergence acceleration of series and, finally, algebraic and analytic continued fractions and Padé approximants.

Chapter 4 studies various interpolation formulas and algorithms, as well as approximation problems and the related function spaces. The last two sections are devoted to the Fourier methods and to the Fast Fourier Transform.

Chapter 5 deals with numerical integration. The features include interpolatory quadrature rules, integration by extrapolation, quadrature rules with free and prescribed nodes, multidimensional integration, and a discussion of the Monte-Carlo and quasi Monte-Carlo methods.

The subject of Chapter 6 is devoted to solving scalar nonlinear equations. Methods based on interpolation or utilization of derivatives are described. Algebraic equations are widely treated in the final section.

From the Web page of the book one can also access three online appendices. Appendix A is devoted to matrix computations, Appendix B presents the MATLAB Mulprec Multiple Precision Package and Appendix C offers a guide to the literature in the domain, including books, journals and software.

This volume may be used both as a valuable reference in a graduate introductory course in numerical analysis or as a reference for researchers in applied sciences involved in scientific computing.

Adriana-Ioana Lefter

TOBIN A. DRISCOLL, *Learning MATLAB,* Society of Industrial and Applied Mathematics, Philadelphia, 2009, xiv + 98 p., ISBN 978-0-898716-83-2.

MATLAB (abbreviation of "matrix laboratory") is a software package used in education and research across the academic world and in the industry, for computation in engineering, science and applied mathematics. Developed by The MathWorks, Inc., MATLAB allows matrix manipulation, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs in other languages.

Driscoll's *Learning MATLAB* presents an introduction to the programming language for new and old users and provides a focused approach to the software for both students and professional researchers, by the numerous examples and exercises involving software's most useful and sophisticated features, and by an overview of the most common scientific computing tasks for which it can be applied.

The book is subdivided into seven chapters: *Introduction, Arrays and Matrices, Scripts and Functions, More on Functions, Graphics, Advanced Techniques* and *Scientific Computing*. Each chapter contains examples and exercises for better understanding the most useful and sophisticated features of the MATLAB programming language and for a better consolidation of the studied information.

After a short description of the software and of its basic options (Chapter 1), the constructions of arrays, vectors and matrices, their commands and operations are summarized (Chapter 2). The next methods describe how to write and call scripts (to execute a series of statements) and functions (to accept input arguments and produce output), and how to pass different types of data in a function call (Chapters 3 and 4). Following these four introductory chapters, advanced topics, such as a set of tools needed for graphics editing and plotting (Chapter 5), more advanced methods for matrix, vectors and functions calculation (Chapter 6) and diverse methods for MATLAB usage in various mathematics domains (Chapter 7) are described in varying degrees of detail.

The present handbook is dedicated for beginners. It can be used by students, PhD students and other people interested in MATLAB study. The chapters 1–4 contain the basic steps, while the chapters 5–7 provide more advanced concepts, so that the volume can be used by more advanced users as a guide book. Each chapter contains subchapters and exercises. The book is easy for read and it has a good structure.

The Tobin A. Driscoll's book is well-written, offering many examples and exercises; therefore, it can be used as the primary text for a short course, as a companion textbook for a numerical computing course, or for self-study.

Comments: the first chapter is written in a simple form but, for a better understanding, it would be recommended to attach pictures for the basic steps. Also, in the 5th chapter, more pictures and graphics are recommended.

Victor Cojocaru

SABER N. ELAYDI, *Discrete Chaos. With Applications in Science and Engineering*, Chapman & Hall/CRC – Taylor & Francis Group, 2008, xx + 420 p., ISBN: 1-58488-592-0.

The book is devoted to the study of discrete dynamical systems and difference equations. The main aspects approached are the stability theory for one and two dimensional maps and the corresponding bifurcation theory and chaos.

The book is structured into seven chapters. The first chapter studies one-dimensional maps, criteria for stability of hyperbolic and nonhyperbolic fixed points, as well as the period doubling scenario for chaos. Chapter 2 is devoted to the bifurcation theory, the main result here obtained being the Sharkovski theorem. In the next chapter, the author gives a mathematical description of the chaos for one-dimensional dynamical systems. Symbolic dynamics is also studied and this is important because it describes the chaotic behaviour of the dynamics produced by differential systems possessing hyperbolic homoclinic orbits. Chapter 4 studies in detail the stability of two-dimensional maps through linearization techniques or by the method of Liapunov, second-order difference equations, Hartman-Grobman theorem, while Chapter 5 addresses the bifurcation theory for two dimensional maps, the hyperbolic toral automorphisms, symbolic dynamics and horseshoe map of Smale. The last two chapters are devoted to fractal sets. All chapters are completed with examples and applications, as well as with sets of exercises. Moreover, the book is completed with a CD containing PHASER, a software designed to simulate both discrete and continuous dynamical systems, very useful for experimenting the examples provided in the book, as well as other, new ones.

In conclusion, the text may be very useful to scientists and students interested in the study of asymptotic behaviour of discrete dynamical systems.

Cătălin Lefter

ANDREAS GRIEWANK, ANDREA WALTHER, *Evaluating Derivatives. Principles and Techniques of Algorithmic Differentiation*, 2nd edition, SIAM, 2008, xxi+ 438 p., ISBN 978-0-898716-59-7.

This is the second edition of a book presenting techniques and methods of algorithmic (also known as automatic, or computational) differentiation (AD). It has been updated and expanded to cover recent developments in applications and theory; also, its readability has been improved. The aim of AD is to provide fast and accurate numerical derivative values, which are useful in many domains, such as the resolution of algebraic and differential equations, curve fitting, sensitivity analysis, inverse problems, design optimization.

The volume is structured into an introduction and 14 Chapters, grouped in three parts. Each chapter concludes with examples and exercises. Lists of figures and tables, an index of assumptions and definitions, and an index of propositions, corollaries and lemmas are also provided. Moreover, the authors emphasize along the presentation a set of 26 rules in algorithmic differentiation. The book ends with a reference list including more than 200 titles.

Part I, "Tangents and Gradients", consists of Chapters 2–6. Chapter 2 discusses the authors' model of computer-evaluated functions. Chapter 3 presents the fundamentals of forward and reverse modes for computing dense derivative vectors of first order. Chapters 4 studies memory issues and complexity bounds, while Chapter 5 concerns extensions of the reverse mode and adjoints of adjoints. Chapter 6 details the implementation of algorithmic differentiation software.

Part II, "Jacobians and Hessians", groups Chapters 7–11. Chapters 7 and 8 treat dynamically sparse approaches and the exploitation of sparsity by compression. Chapter 9 introduces generalizations of the forward and reverse modes. Chapter 10 discusses Jacobian and Hessian accumulation. Chapter 11 contains observations on the results obtained previously and provides some general advice to users about problem preparation.

Part III, "Advances and Reversals", namely the last four chapters, treats more advanced issues, useful for specialists. Chapter 12 studies reversal schedules and checkpointing. Chapter 13 explains methods for evaluating higher derivatives. Chapters 14 and 15 concern the differentiation of codes with nondifferentiabilities, of implicit functions and of iterative processes.

The book is intended not only to scientists interested in algorithmic differentiation, but also to designers of algorithms and software for nonlinear computational problems, and, not the least, to users of current numerical software, needing to choose from the existing algorithmic differentiation software tools the most appropriate ones for their purposes.

Adriana-Ioana Lefter

ILSE C.F. IPSEN, *Numerical Matrix Analysis. Linear Systems and Least Squares,* SIAM, Philadelphia, 2009, xiii+ 128 p., ISBN 978-0-898716-76-4.

The volume entitled *Numerical Matrix Analysis. Linear Systems and Least Squares* is a self-contained textbook on numerical matrix analysis. The material is presented at a basic level, still mathematically rigorous. The author uses many examples and the steps of the algorithms are clearly detailed.

The content is divided into 6 chapters. Each section of the chapters ends with simple exercises, for use in the classroom, or more challenging exercises, for student practice. Chapter 1 reviews matrices, operations with matrices and some special classes of matrices. Chapter 2 deals with sensitivity, absolute and relative errors, vector and matrix norms and conditioning. Chapter 3 analyses algorithms for solving linear systems; it presents the resolution of triangular systems and the LU, Cholesky and QR factorization of matrices. Chapter 4 treats the singular value decomposition, while Chapter 5 concerns least squares problems. The final chapter covers the properties of column, row, and null spaces of matrices, the relations among these subspaces, the operations that can be defined on them and their computational representation.

This book differs from other numerical linear algebra textbooks by offering a systematic development of numerical conditioning, a simplified concept of numerical stability in exact arithmetic, simple derivations, a high-level view of algorithms and results for complex matrices.

Although written for graduate students in applied and pure mathematics, computational science, or engineering, this volume may also be a valuable resource for self-study.

Adriana-Ioana Lefter

CHANDRIKA KAMATH, *Scientific Data Mining: A Practical Perspective*, SIAM, 2009, xxxviii + 286 p., ISBN: 978-0-898716-75-7.

This book offers a large perspective about data mining, with them applications and techniques used in solving a variety of problems in the analysis of data from various scientific domains.

The book has fourteen chapters, organized in five main "areas", which include data mining in scientific applications (Chapters 1 and 2), data mining process (Chapters 3 and 4), tasks in the data mining process (Chapters 5 through 12), data mining systems (Chapter 13) and lessons learned, challenges and opportunities (Chapter 14).

The first "area" presents an introduction to data mining and to them applications in astronomy, biological science, security and surveillance, computer simulations, experimental physics and others. Data mining techniques allow scientists and engineers to analyze, preprocess, search for patterns, visualize and validate the results of massive, complex data sets.

In the second "area", the author describes the data mining process, which includes common themes used in the applications, the existing scientific data types and the steps which should be followed to extract useful information from the raw data. We can also find information about the characteristics of scientific data and scientific data analysis, which are common across several different application domains.

The operations which can be applied to the scientific data, making them easier to be analyzed are presented in the third "area". This refers to reducing the size of data, fusing different data modalities, enhancing image data, finding objects in the data, extracting features describing the objects, reducing dimensions of the data, finding patterns in the data, visualizing the data and validating the results.

In the next "area", we can find software architectures for scientific data mining, including three examples which show the possibility of building a software infrastructure to support the different needs of analysis problems in science and engineering domains.

An interesting feature of the book is the presentation of lessons for initiating analysis of a data set. This increases the challenges and the opportunities for scientists and engineers who want to analyze data from new domains, with new characteristics, and new algorithm requirements.

The book is useful to scientists and engineers working with large data bases and their goal is to preprocess, analyze data from scientific simulations, experiments and observations. The data mining process help them to develop their researches and discover the insides of the scientific collected data. All information in the book are given in detail, making them easier to understand.

Alina Untu
Monica Feraru

ADAM B. LEVY, *The Basics of Practical Optimization,* SIAM, 2009, xvii+149 p., ISBN 978-0-898716-79-5.

The goals of this book are to help readers understand how optimization is actually done in practice, and to expand their appreciation on the richness of the theory behind the practice. The only prerequisite knowledge for getting the most out of this text is a basic understanding of multivariable calculus. The volume is structured into 9 Chapters, in which the author presents step-by-step solutions for five prototypical examples which fit the general optimization model, instruction on using numerical methods to solve models and making informed use of the results, information on how to optimize while adjusting the method.

To accommodate various practical concerns, three fundamentally different approaches for optimizating functions under constraints and ways to handle the special case when the variables are integers are discussed. Also, the author provides four types of learn-by-doing activities throughout the book, exercise for in-class work, problems for in-class work or homework, computational problems for homework or computer lab session and implementations usable as collaborative activities in computer lab over an extended period of time.

This book is appropriate for undergraduate students who have taken a multivariate calculus course.

Cristina Stamate

RAMON E. MOORE, R. BAKER KEARFOTT, MICHAEL J. CLOUD, *Introduction to Interval Analysis*, SIAM, 2009, xi+223 p., ISBN 978-0-898716-69-6.

Introduction to Interval Analysis is a useful book for those not yet familiar with the methods for computing with intervals, but eager to find out how this type of methods may be approached.

The objective of the book is to illustrate the great difference between considering an approximate solution of an equation (*e.g.* an algebric equation) instead of its upper and lower bounds.

Methods of computational error control, based on order estimates for the approximation errors are not rigorous, nor do they take into account rounding error accumulation. Linear sensitivity analysis is not a rigorous way to determine the effects of uncertainty in the initial parameters. In contrast, interval algorithms are designed to automatically provide rigorous bounds on the accumulated rounding errors, approximation errors, and propagated uncertainties in the initial data during computation.

Lots of applications, such as the Newton method, interval matrices, interval functions, and more, are presented, and lots of computer algorithms in INTLAB, associated to the discussed problems, are provided.

Ionuț Munteanu

BÉATRICE RIVIÈRE, *Discontinuous Galerkin Methods for Solving Elliptic and Parabolic Equations Theory and Implementation*, Frontiers in Applied Mathematics 35*,* SIAM, 2008, xxii+190 p., ISBN 978-0-898716-56-6.

Galerkin methods are among the most popular numerical tools for solving partial differential equations. This book focuses on three variants of a class of primal discontinuous Galerkin methods (DG), namely interior penalty methods: the symmetric interior penalty Galerkin, incomplete interior penalty Galerkin and nonsymmetric interior penalty Galerkin methods. Both theoretical and computational aspects are discussed, including stability and convergence of the method, error analysis, coding issues, and algorithms. The author uses model problems for discussing these issues.

The book is divided into three parts: the first one discusses applications of DG to second order elliptic problems, in one dimension and higher dimensions. In Part II, DG methods are applied to time-dependent parabolic problems, with or without convection. The last part focuses on important applications to solid mechanics (linear elasticity), to fluid dynamics (Stokes and Navier-Stokes problems), and to porous media flow (two-phase and miscible displacement). Appendices include a MATLAB® implementation for a one-dimensional problem and C routines for the higher dimensional one. Each chapter ends with bibliographical remarks and exercises.

The book is intended for applied mathematicians, computer scientists and engineers willing to apply numerical methods to differential equations and their applications in solid mechanics or fluid dynamics. It also provides a good support for graduate courses in numerical analysis and, more specifically, numerical and finite element methods in partial differential equations.

Gabriela Lițcanu

ETIENNE SANDIER, SYLVIA SERFATY, *Vortices in the Magnetic Ginzburg-Landau Model,* Birkhäuser, Boston, 2007, xii + 322 p., ISBN: 0-8176-4316-8.

The Ginzburg-Landau equation with magnetic field, to which this book is devoted, is modelling superconductivity in type II superconductors. The model is important in physics because it is explaining the quantization effects and the formation of vortices. It is also important from a mathematical point of view, if considering the methods and techniques developed for it since the issuing in 1994 of the book of F. Bethuel, H. Brezis and F. Hélein, *Ginzburg-Landau Vortices*. These tools have proved to be useful for other models, such as the Gross-Pitaevskii model in superfluidity and the Bose-Einstein condensates.

The main problem addressed in the book is the asymptotic behaviour of the Ginzburg-Landau energy with magnetic field, in space dimension two, when a small parameter, related to certain physical characteristics of the material, tends to 0. The goal is to characterize the vortices and their distribution, in the limit regime. This is done through appropriate estimates of the energy in terms of vortices, when dealing with minimum energy solutions; when studying the general solutions of the Ginzburg-Landau equation, necessary stationarity conditions are obtained for a given measure, as a possible limit of vorticity measures of the general solutions corresponding to the small parameter.

The book provides a quite complete description of the main ideas, methods and techniques applied in this field, gathering already classical and very recent results. It also provides a collection of open problems and connections with other research directions in the field. The book may be thus very useful to graduate students and researchers and will find its well-definite place in the specialized literature.

Cătălin Lefter

TAI SHIMA, STEVEN RASMUSSEN (Editors), *UAV Cooperative Decision and Control. Challenges and Practical Approaches*, SIAM, 2009, xxii+164 p., ISBN 978-0-898716-64-1.

UAV Cooperative Decision and Control, Challenges and Practical Approaches is a book approaching problems which appear in the use of unmanned aerial vehicles (UAVs) for various military missions. These problems are solved by mathematical methods and algorithm approaches.

This book provides an authoritative reference on the U.S. Air Force relevant cooperative decision and control problems, and on the means available to solve them. The book is aimed at helping practitioners, academicians and students alike to better understand what cooperative decision and control is, along with its applications and methods for implementing algorithms that make cooperative UAV operations possible.

To help researchers new to the field, and those already in the field, a thorough description of the problem and of its challenges is presented. Solution algorithms that have been recently developed are also presented using various approaches.

Ionuț Munteanu

JASON L. SPEYER, WALTER H. CHUNG, *Stochastic Processes, Estimation, and Control*, SIAM, 2008, xiv + 383 p., ISBN: 978-0-898716-55-9.

This textbook provides a comprehensive treatment of stochastic systems, beginning with the foundations of probability and ending with stochastic optimal control. The book is divided into ten chapters, following three interrelated topics. First, the concepts of probability theory, random variables and stochastic processes are presented, which leads easily to expectation, conditional expectation, and discrete time estimation and the Kalman filter. Against this background, stochastic calculus and continuous-time estimation are introduced. Finally, dynamic programming for both discrete-time and continuous-time systems leads to the solution of optimal stochastic control problems, resulting in controllers with significant practical applications. The book is written in a very accessible style, the material here presented being both practical and rich in research opportunities.

In the first two chapters, the main concepts of the probability theory are introduced; a key role is played by the notion of random variable and its probabilistic characterization. Very important is its extension to the random variable indexed by another variable, leading to concepts of stochastic sequence or stochastic process.

In Chapter 3, the authors apply the concepts of conditional probability and expectation, already introduced in the previous chapters, to dynamic filtering. The discrete-time conditional mean estimator, called the "Kalman filter", is derived and illustrated. In Chapter 4, this estimator is shown to be related with the classical least squares method through the orthogonal projection lemma.

The fifth chapter acquaints the reader with the calculus for stochastic processes. More precisely, the Itô integral with respect to the Brownian motion is introduced, along with the Itô chain rule. This allows to deal with stochastic differential equations and exponential.

By the mathematical foundation laid out in chapter 5, the next chapter deals with the continuous-time versions of the Gauss-Markov theory. The continuous-time Kalman filter is also derived, along with the introduction of concepts of stationarity, ergodicity and power spectral density, which are useful concepts in engineering applications. The chapter culminates with a foundational result in the estimation theory: the Wiener filter.

In Chapter 7, the problem of estimating the solution for a nonlinear system leads to the introduction of the extended Kalman filter. A selection of results from the estimation theory is given in Chapter 8.

The last chapters of the book are devoted to stochastic control. In Chapter 9, the stochastic problem is formulated for both the discrete and continuous-time problems with full information of the state and with noisy partial measurement information structure. The solution is obtained by a dynamic programming approach. The dynamic programming algorithms are implemented on the so-called "linear quadratic Gaussian control problem". This problem is extended to the "linear exponential Gaussian control problem" in Chapter 10.

This book will be valuable to first-year graduate students studying systems and control, as well as to professionals in this field.

Adrian Zălinescu