ANALELE ŞTIINŢIFICE ALE UNIVERSITĂŢII "AL.I.CUZA" IAŞI
Tomul XLVI, s.I a, Matematică, 2000, f.1.

*BOOK REVIEWS*

SUNDER, V.S. – *Functional Analysis Spectral Theory,* Birkhäuser Advanced Texts, Birkhäuser Verlag, Basel, Boston, Berlin, 1998, 241+13p.

This book consists in five chapters and a rather voluminous Appendix and grew out of a course of lectures on functional analysis given by the author at the Institute of Mathematical Sciences, Madras, during the winter semester of 1996. The first couple of chapters are devoted to what may be usually seen in a first course on functional analysis: normed vector spaces and Hilbert spaces. The third chapter is concerning to the spectral theorem as a statement about the representations of $C^*$–algebras both commutative and non–commutative. In particular, the final section of this chapter is devoted to the classification of separable representations of $C^*$–algebras in the sense of Hahn–Hellinger. The fourth chapter is devoted to more standard "operator theory" in Hilbert spaces (the traditional theorem for normal operator obtained from Chapter 3 and the spectral analysis of compact operators). The final chapter is a brief introduction to unbounded operators on Hilbert spaces. The intended objective of the Appendix was to fill in the possible gaps in the background of the prospective Master's level reader (the course was initially intended for somewhat mature students in the Ph.D. programme). The book is punctuated with a lot of exercices having in as purpose not only to learn functional analysis but to do it. We consider the book valuable not only to Ph.D. programme but also to Master's level programme.

Şt. Frunză

BRAY, W.O. and STANOJEVIĆ, Č.V. (Eds.) – *Analysis of Divergence; Control and Management of Divergent Processes,* Birkhäuser, Boston, Basel, Berlin, 1999, 567–14p.

This book contains papers delivered at the 7*th* International Workshop in Analysis and Its Applications held at the University of Maine, June, 1997.

The theme of the workshop gave the title of this volume.

Divergent processes occur whenever a limit procedure is present. Here you have several examples: infinite series, Fourier analysis, singular integrals, variational or optimal problems involving singularities, applications of summability ideas to sampling theory.

The book is divided into four parts: I. *Convergence and Summability*; contains 8 chapters. II. *Singular Integrals and Multipliers*; contains 7 chapters. III. *Integral Operators and Functional Analysis*; contains 7 chapters. IV. *Asymptotics and Applications*; contains 7 chapters. Let us give several titles: "Tauberian theorems for generalized Abelian summability methods", by Č.V. Stanojević, J. Canak and V.B. Stanojević; "Convolution Calderoń–Zygmund singular integral operators with rough kernels" by L. Grafakos and A. Stefanov; "Hardy type inequalities for a new class of integral operators" by G. Sinnamon; "Optimal control of divergent control systems" by D.A. Carlson.

The volume addresses a wide mathematical audience: to specialists, graduate students and researchers in related fields.

Ovidiu Carjă

KRANTZ, S.G. – *Handbook of Complex Variables*, Birkhäuser Verlag AG Basel, Berlin, Boston, 1999. 320 p. sFr. 128.-/ DM 148.-/ öS 1081. ISBN 3-7643-4011-8.

The book contains all the material related to the theory of functions of one complex variable, exposed in a logical order and essentially without proofs. It is worth mentioning the presence of a paragraph entitled "A pictorial catalog of conformal maps"; of a whole chapter devoted to "Computer packages for studying complex variables" and an exhaustive "Glossary of terms from complex variable theory analysis".

"Handbook of Complex Variables" is a comprehensive reference work for scientists and engineers who need to know and use essential information and methods involving complex variables and analysis. Its focus is on basic concepts and informational tools for mathematical "practice": solving problems in applied mathematics, science and engineering.

The information is self–contained and accessible to a broad readership. All the indispensable ideas are presented, as well as applications topics and a brief survey of available computer software. The material has been carefully organized for quick, convenient reference by specialists and non–specialists alike.

This handbook is an essential reference and authoritative resource for all professionals, practitioners and researchers in mathematics, physical sciences and engineering. Specialists and non–specialists will find its practical, problem–solving style both accessible and useful for their work.

E. Popa

GLAZ, J. & BALAKRISHNAN, N. (Eds.) – *Scan Statistics and Applications.* Birkhauser Verlag, Boston, Basel, Berlin, 1999, Statistics for Industry and Technology, xxi + 323 pages, ISBN 3-7643-4041-x, 0-8176-4041-x.

This new volume in the series *Statistics for Industry and Technology* edited by Birkhauser Verlag brings together 14 contrbutions on a subfield of Statistics, the *Scan Statistics.* They are due to experts working in this area of research and they review some of the developments that have taken place over the years, and they also present new orginal works and point out some open problems. The study of scan statistics and their applications to many various scientific and engineering problems have received considerable attention in the recent literature. Besides its intrinsic theoretical interest, this area of scan statistics has also found interesting applications in diverse disciplines such as archaeology, astronomy, epidemiology, geography, material science, molecular biology, reliability and quality control, sociology and telecommunications. Such applications are approached in the contributions included in this volume.

Chapter 1 – *Introduction to Scan Statistics* – is written by the editors Joseph Glaz & N.Balakrishnan. It starts with a short introduction, followed by such topics as order statistics, discrete and continuous scan statistics in one- and multi-dimensional cases, and closes with a rich list of 96 references. We cannot enter here into many technical details, but let us mention that the scan statistics are connected with the order statistics and – in general – a scan statistic is associated to a sequence of random variables $X_1, X_2, ..., X_n$ by means of a max operator applied to partial sums of the variables in the sequence. Thus, a scan statistic is a numerical characteristic assigned to a sequence of random variables (that may be either of discrete type or of continuous type). Ch. 2 – *Approximations for the Distribution and the Moments of Discrete Scan Statistics*, by Jie Chen & Joseph Glaz – presents approximations to scan statistics for i.i.d. (independent and identically distributed) discrete RVs (random variables) of product type, of Poisson type and others. 3 – *Ratchet Scan and Disjoint Statistics*, by Joachim Krauth – firstly defines disjoint statistics, continues with linear and circular ratchet

scan statistics (SS); a ratchet SS is the maximum number of $X_j$'s observed in $m$ consecutive cells. There are also presented exact bounds for the upper tail probabilities of the statistic $M(m)$. In 4 – *Scanning Multiple Sequences* – Joseph Naus generalizes the discrete scan statistics to multiple sequences. This extension is also applicable to the problem of matching in multiple random letter sequences, and to that of common words in multiple sequences. 5 – *Approximations of the Distributions of Scan Statistics of Poisson Processes*, by Sven Erick Alm – presentes methods of approximation in one dimension, two dimensions and higher dimensions; it also includes a couple of comments on simulations. 6 – *An Approach to Computations Involving Spacings With Applications to Scan Statistics*, by Fred Huffer & Chien–Tai Lin – presents a general method for computing probabilities involving differences of the order statistics or linear combinations between the order statistics, uniformly distributed on the interval $(0, 1]$. This method is applicable to compute the distribution of $S_w-$ the (continuous conditional) scan statistic with window length $w$. 7 – *Using Moments to Approximate the Distribution of the Scan Statistic,* by Fred Huffer & Chien–Tai Lin – deals with the use of moments to obtain bounds and approximations for the distribution $S_w$. Upper and lower bounds are derived by means of four moments; in some situations these bounds improve considerably previously available bound. 8 – *Applying Ballot Problem Results to Compute Probabilities Required for a Generalization of the Scan Statistics*, by Sylvan Wallenstein – defines the exact distribution of a statistic with critical values changing on each interval of length $w$, and then gives a method for finding the probability for the step function with $2L$ steps. The results are extended to arbitrarily fine step functions (which are constant over intervals of length $w/r$, with $r$ an integer). 9 – *Scan Statistics and Multiple Scan Statistics,* by Chien-Tai Lin – presents methods of evaluating the tail probabilities of the distribution $S_w$, the moments and the probabilities of $C_w$, the multiple scan statistic, as well as approximations for $P(C_w \geq 2)$. 10 – *On Poisson Approximation for Continuous Multiple Scan Statistics in Two Dimensions*, by Marianne Mănsson – defines the multiple scan statistic in $d$ dimensions on the scanning set that can be any convex set. The errors involved in the approximation are studied both by simulations and by giving bounds on the total variation distances by means of the Stein-Chen method. A compound Poisson approximation is also presented.

Part IV of the volume includes four applications of scan statistics. The first of them is 11 – *A Start-Up Demonstration Test Using a Simple Scan-Based Statistic*, by Markos Koutras & N. Balakrishnan. A start-up demonstration test (as first discussed by Hahn & Gage in 1985) involves

successive attempted start-ups of an equipment with each attempt resulting in either a success or a failure, and accepts the equipment if a prescribed number ($c$) of consecutive successful start-ups occur on or before a prespecified number of attempts. In this contribution, the authors propose a start-up demonstration test using a simple scan statistic that would facilitate an early rejection of a potentially bad equipment.

12 – *Applications of the Scan Statistic in DNA Sequence Analysis*, by Ming–Ying Leung & Traci Yamashita. The mathematical methods play an increasingly important role in the analysis of long DNA sequences and in interpreting rapidly accumulating DNA data. The authors discuss a specific example of identifying nonrandom clusters of palindromes in a family of herpesvirus genomes using the $r$-scan statistic. After a comparison of three Poisson-type approximations, the $r$-scan distributiuon is computed by a coumpound Poisson approximation proposed by Glaz (1994). 13 – *On the Probability of Pattern Matching in Nonaligned DNA Sequences: A Finite Markov Chain Imbedding Approach*, by James Fu, W.Y. Wendy Lou, and S.C. Chen. Pattern matching probabilities are crucial for statistically rigorous comparisons of DNA (and other) sequences, and various bounds and approximations of such probabilities have recently been developed. In this contributuoion, the authors present a simple and efficient method based on the finite Markov chain imbedding technique to obtain the exact probability of pperfect matching for i.i.d. four-state trials with either equal or unequal state probabilities. 14 – *Spatial Scan Statistics: Models, Calculations, and Applications*, by Martin Kulldorff – approaches a common problem in spatial statistics: Whether a set of points are randomly disributed or if they show signs of clusters or clustering. Different spatial scan statistics have been proposed, and they are discussed and presented in a general framework that incorporates two-dimensional scan statistics on the plane or on the sphere, as well 3D scan statistics in space or in space–time. Computational issues are then looked at, presenting efficient algorithms that can be used for different scan statistics in connection with Monte-Carlo based hypothesis testing. The scan statistic has to be chosen as depending on the application at hand, and this issue is discussed for past and possible future applications in areas such as epidemiology, medical imaging, astronomy, archaeology, urban and regional planning, and reconnaissance.

To conclude, the monograph we are reviewing clearly outlines the high interest and the broad applicability of the *scan statistics* as a tool to analyse the occurrence of observed clusters of events in time and space. "Scan Statistics and Applications" is a comprehensive and fine edited survey that brings together the results due to leading authorities in this new area of statistical research and its applications. Each chapter is closed by a rich

reference list, what allows the interested reader to go deeper in one topic or another. The technical presentation of the volume is of a high level – a well–established feature of the books edited by Birkhauser Verlag in the SIT Series.

Alexandru Cărăuşu

SCHINAZI, R.B. – *Classical and Spatial Stochastic Processes.* Birkhauser Verlag, Boston, Basel, Berlin, 1999, Statistics for Industry and Technology, X + 178 pages, ISBN 0-8176-4081-9, 3-7643-4081-9.

This book due to Prof. Rinaldo Schinazi - University of Colorado is intended as a textbook for a first course in stochastic processes at the upper undergraduate or graduate levels. In guiding the student from the simplest classical models to some of the spatial models, currently the object of considerable research, the text is aimed at a broad audience of students and researchers in biology, engineering, mathematics and physics.

The first two chapters deal with *discrete Markov chains.* The first chapter includes such issues as the classification of states, finite Markov chains, birth-and-death chains, time to get ruined (by a gambler), absorbtion probabilities for martingales, and the simple symmetric 2D random walk. The Bienaymé-Galton-Watson branching pocess, initially formulated to model the survival of family names, is restated in terms of particles in successive generations. Examples are given including – for instance – an application to a queue problem. Several problem sets are proposed, and the proofs of three important theorems close this 1st chapter. Chapter 2 deals with the *Stationary Distributions of Markov Chains.* The main problem consists in finding conditions in order for a Markov chain $X_n$ on a countable space $\mathcal{S}$ to have an equilibrium. Reversible measures are examined in the second section; a characterization for a birth-and-death chain to have a reversible distribution is given. The proof of other theorems close this chapter.

Chapter 3 – *Continuous Time Birth and Death Markov Chains* – deals with B&D chains in which the change of states occurs after a random time and not at integer times; still, the chains have countably many states. It is shown that the memoryless property of the exponential distribution makes it compatible with the Markov property (§ III.1), then B&D continuous time chains are defined and constructed (§ III.2), and it is shown that the transition probabilities always converge for continuous time B&D chains ; a necessary and sufficient condition is also given for the existence of stationary

distributions for such chains (§ III.3). Next, the recurrence, transience and positive recurrence are defined, and it is also shown that the behavior of a continuous time chain is closely related to a discrete time chain called the embedded chain (§ III.4). The Poisson process is characterized by two theorems (§ III.5), the expected time for a B&D chain to go from state $i$ to state $i+1$ is computed (§ III.6), and chains without the Markov property are also discussed (§ III.7). Theorem proofs are given in the last three sections. The spatial model of *Percolation* is approached in Chapter 4. The percolation in more dimensions is considered on a $d$-dimensional lattice $Z^d$, with open / closed edges of probabilities $p$ / $1-p$, respectively. The percolation process is introduced on a *binary tree* for which explicit computations can be easily done; two *critical exponents* are thus computed, namely $E|C|$ = the expected number of elements (open clusters) at 0, and $\gamma$ = another critical exponent; both of them are believed to be the same for large classes of models, what is analogous to the universality principle in mathematical physics. A *Cellular Automaton* is considered in Chapter V ; an initial configuration on $Z^2$ is defined, and the rules of evolution for the cellular automaton (CA) are formulated. The construction of the model shows that the CA and the renormalized system are coupled in such a way that if the origin is empty for the CA at time $n$ then the renormalized origin is also empty at the corresponding rescaled time $\tau$. The *Continuous Time Branching Random Walk* is the subject matter of Chapter VI. This type of random process is applicable to systems of particles that can give birth to other particles and then die. A continuous time BGW branching process (earlier presented in § I.9) is defined in § VI.1, and a characterization for the existence of two phase transitions is given in § VI.2. It is then shown that the global survival probability is continuous at $\lambda_1$ (§ VI.3), while the local survival probability is not continuous at $\lambda_2$ if $\lambda_1 < \lambda_2$ (§ VI.4). The proof of a theorem stated in § VI.2 is given in the last § VI.5 of this chapter. *The Contact Process on a Homogeneous Tree* – Chapter VII – is similar to a branching Markov chain but there is at most one particle per site for the contact process while there is no bound in the number of particles per site for the branching Markov chains; thus, the two types of processes may be thought as two extreme points in tyhe same class of models. Bounds for the critical values are computed in Theorem VII.1.1 (§ VII.1), which show that there are two phase transitions for the contact process on a homogeneous tree with degree $d \geq 7$. The main result in § VII.2 states that there is global survival $\Longleftrightarrow$ the expected total number of particles grows exponentially fast with time, what also allows to prove that the first phase transition is continuous (§ VII.2). The contact process is constructed using Harris' graphical construction (§ VII.3), and the additive property of the contact process is obtained as a consequence

of this construction. The proofs of the results in the previous § VII.2 are given in § VII.4, and three open problems concerning the contact processes are listed in § VII.5.

An *Appendix* discusses *Some Facts Abount Probabilities on Countable Spaces*: Probability space, Independence, and Discrete random variables; this last section includes two applications of the Borel-Cantelli Lemma on sequences of events.

Let us outline the clearly structured contents of this excellent textbook, what makes it easy to be read and understood. Each chapter starts with a brief description of the sections it consists of. Every section includes well chosen examples and problem sets, what challenges the reader to go deeper into the subject. The proofs of the theorems are grouped at the end of each section, followed by Notes and references. A rich reference list closes the volume. Graphical illustrations are also included. This is not a criticism, but we suppose that a Subject Index would have been necessary.

To conclude, this textbook by Rinaldo B. Schinazi brings a clear and very well structured presentation of some important types of classical and spatial stochastic processes. The latter ones are very useful for modeling many problems in engineering, biology, physics of particles. The reader is assumed to have knowledge of Calculus and elementary Probability Theory. Although many types of stochastic processes emerged from modeling needs in various fields, their mathematical properties present an intrinsic interest for mathematicians, too.

Alexandru Cărăuşu

HOLZ, M., STEFFENS, K., WEITZ, E. – *Introduction to Cardinal Arithmetic*, Birkhäuser Verlag, 1999, 312 p, ISBN 3-7643-6124-7.

This book is an introduction into modern cardinal arithmetic in the frame of the axioms of Zermelo–Fraenkel set theory together with the axiom of choice. A fist part describes the classical theory developed by Bernstein, Cantor, Hausdorff, König and Tarski between 1870 and 1930. Next, the development in the seventies led by Galvin, Hajnal and Silver is characterized. The third part presents the fundamental investigations in pcf theory which have been worked out by Shelah to answer the questions left open in the seventies.

This text is the first self–contained introduction to cardinal arithmetic which also includes pcf theory. It is aimed at undergraduates, and also at postgraduate students and researchers who want to broaden their know-

ledge of cardinal arithmetic. It gives a relatively complete survey of results provable in ZFC.

This unique book is the first to give a complete overview of the field, including classical results and recent pcf theory. It is selfcontained and requires only a modest background.

HELGASON, S. – *The Radon Transform*, Second revised and extended edition, Birkhäuser Verlag, 1999, 208 p., ISBN 3-7643-4109-2.

The Radon Transform is an important topic in integral geometry which deals with the problem of expressing a function on a manifold in terms of its integrals over certain submanifolds. Solutions to such problems have a wide range of applications, namely to partial differential equations, group representations, $X$-ray technology, nuclear magnetic resonance scanning, and tomography.

This significantly expanded and updated second edition presents new material taking into account some of the progress made in the field since 1980. The first chapter introduces the Radon transform and presents new material on the $d$-plane transform and applications to the wave equation. The second chapter places the Radon transform in a general framework of integral geometry known as double fibration of a homogeneous space. Several significant examples are developed in detail. The two subsequent chapters treat some specific examples of generalized Radon transforms, for example, antipodal manifolds in 2-point homogeneous spaces, and orbital integrals in isotropic Lorentzian manifolds. A final chapter deals with Fourier transforms and distributions, developing all the tools needed in the work.

Review of the First Edition: "... until now the subject has lacked anything approaching a systematic exposition aimed at beginners. Publication of the present volume... by one of the chief contributors to the modern theory of Radon transform, is thus a timely and welcome event... Helgason's notes provide the most agreable introduction to the Radon transform currently available." SIAM REVIEW

FLUCHER, M. – *Variational Problems with Concentration*, Birkhäuser Verlag, 1999, 176 p., ISBN 3-7643-6136-0.

The subject of this research monograph is semilinear Dirichlet problems and similar equations involving the $p$-Laplacian. Solutions are constructed by a constraint variational method. The major new contribution is a detailed analysis of low–energy solutions. In PDE terms the low–energy

limit corresponds to the well–known vanishing viscosity limit.

First it is shown tht in the low–energy limit the Dirichlet energy concentrates at a single point in the domain. This behaviour is typical of a large class of nonlinearities known as zero mass case. Moreover, the concentration point can be identified in geometrical terms. This fact is essential for flux minimization problems. Finally, the asymptotic behaviour of low–energy solutions in the vicinity of the concentration point is analysed on a microscopic scale.

The sound analysis of the zero mass case is novel and complementary to the majority of research articles dealing with the positive mass case. It illustrates the power of a purely variational approach where PDE methods run into technical difficulties. To the reader's benefit, the presentation is self–contained and new techniques are explained in detail.

Bernoulli's free–boundary problem and the plasma problem are the principal applications to which the theory is applied. The author derives several numerical methods approximating the concentration point and the free boundary. These methods have been implemented and tested by a co–worker. The corresponding plots are highlights of this book.

TRUESDELL, C.A., RAJAGOPAL, K.R. – *An Introduction to the Mechanics of Fluids, Modeling and Simulation in Science, Engineering and Technology,* Birkhäuser, Boston, Basel, Berlin, 2000, XIV, 282 p, ISBN 0-8176-4014-2.

The authors "... have endeavored to provide a compact and moderately general foundation of the mechanics of continua, turning aside now and then to particular applications that rise to hand as illustrations of some general principles. Here, we proffer some applications special to fluids, first of rather general kinds and then for the classical fluids named after Euler, Navier, and Stokes."

*Contents:* Preface – General references. 1. Bodies, configurations, and motions, 2. Kinematics and basic laws, 3. Constitutive equations, reduced constitutive equations, and internal constraints, 4. Simple fluids, 5. Flows of incompressible fluids in general, 6. Some flows of particular nonlinear fluids, 7. Some flows of fluids of grade 2, 8. Navier–Stokes fluids, 9. Incompressible Euler fluids, 10. Compressible Euler fluids, 11. Singular surfaces and waves – Some elementary results from Real Analysis – Solutions to Exercices – Index.

The main concepts of continuum mechanics necessary for the definition of the central concept of the book, viz. *simple fluid*, are briefly reviewed in

the first three chapters. *Fundamental Theorem on Fluid, Noll's Fundamental Theorem on Monotonous Motions*, and the *Reduction of Constitutive Relation for a Simple Material* in a *Monotonous Motion* are presented in Ch.4. C.A. Truesdell's "*A First Course in Rational Continuum Mechanics*" (New York, Academic Press, 1991) is a prerequisite for a better understanding of the first four chapters. In Ch.5 the authors analyze the following items: The most general stress compatible with the constitutive equation of an incompressible fluid undergoing a viscometric flow, normal–stress effects in steady viscometric flows, the analysis of the classical theory of viscometry, the dynamics of the main viscometric flows, and a critical discussion of impossibility of steady rectilinear flows in pipes. A circumstantial analysis of *Rivlin–Ericksen fluids* of complexity $n$ and of fluids of grade $n$, a penetrating discussion of the boundary conditions and of perturbations procedures, a study of the secondary steady flow of simple fluids down a straight pipe, and a coherent making evident of some universal flows of fluids of grade 1,2 and 3 are the matters studied in Ch.6. A thorough investigation is made, in Ch.7 of some particular flows of fluids of grade 2, viz. unsteady linear flow, steady and unsteady plane flows, and steady flows between rotating parallel plates. Stability and instability results are obtained for some flows of a fluid of grade 2 in a closed vessel. Ch.8, the vaster of the book, is devoted to some specific problems of incompressible and homogeneous Navier–Stokes fluids. We mention only few of the topics here broached: Condition of compatibility, Bernoullian theorems, the study of some steady and unsteady flows that can be undergone by incompressible Navier–Stokes fluids, problems regarding hydrodynamic stability, instability, uniqueness and continuous dependence on data of solutions of the Navier–Stokes equations. Indeed, as the authors say, from this chapter "Students will learn that the Navier–Stokes equations, spiny though they are, do have some explicit, precise solutions of interest and value: will taste and feel some of the most famous of these and also some of the most recent; and will encounter some of the qualitative theorems that can be proved with a beginner's mathematical tools." A deep analysis is made in Ch.9 of some characteristics properties of Euler incompressible fluids. The following subjects are dealt with: Compatibility condition and general solution of Euler's dynamical equations, accelerationless flows, general aspects of irrottional flows and reactions on submerged obstacles and cavities, rotational flows and Bernoullian theorems for rotational flows, Stokes' conjecture for the height of irrottional waves, the problem of axiality symmetric ring vortices, and the theorem of V. Bjerknes on baroclinic flow. A short examination is incepted in Ch.10 of some, carefully and several selected, topics of the mechanics of compressible fluids: Irrotational flow, Munk–Prim substitution principle, Graffi's investigation on the

uniqueness of the flow of compressible fluids, linear waves, steady flow in an axiality symmetric tube, one dimensional flows,+ and the equilibrium of gaseous mass under self–gravitation and under constant body–force field. Ch.11, the shortest of the book, is a general brief survey of the kinematics of singular surfaces and their classification. Over 130 integrated chapter exercises enhance the understanding and usefulness of this book.

No doubt, this is quite exceptionally book, lovely, profound, and an approachable treatment, in a masterly style, of an important field of continuum mechanics, namely fluid mechanics. The book is an up-to-date account in fluid mechanics and addresses to graduate students, scientists and professionals in applied mathematics, mechanics and mechanical engineering.

Gh.Gr. Ciobanu

WALTER, G.G., CONTRERAS, M. – *Compartmental modeling with networks*, Birkhäuser, Boston, Basel, Berlin, 1999, 250+XVIII p, ISBN 0-8176-4019-3, 3-7643-4019-3.

This book presents the flow model or compartmental model theory and some of their applications. In order to construct such a model, the analysed system is divided into homogeneous compartments and the possible connections between them are identified. These connections can be flows of materials or information between a compartment with another and can be schematically presented as digraphs; in their turn, these digraphs can be converted into Markov chains. In case when the flow rates are known the model leads to a system of differential or difference equations. These systems can be sometimes solved by the well–known means; if is not possible to solve them, the properties of the solutions can be frequently inferred.

The architecture of the book respects this research scheme. Part I, entitled *Structure of Models: Directed Graphs*, is devoted to the theory of digraphs. It is an elementary, selfcontained and attractive introduction to digraph theory. The important results for applications are presented almost exclusively. In Part II, entitled *Digraphs and Probabilities: Markov Chains,* certain elements of the theory of Markov chains which are useful in the study of compartmental models, via digraph theory, are presented. The third part, *Compartmental Models: Applications*, deals with a plenty of applications of digraphs and Markov chains in modeling of real situations from ecology, biophysics, biomedicine. Here are presented some models for the spread of epidemics, ecosystem models, competition models, fisheries models, drug kinetics. The last part, *Compartmental Models Theory*, presents a theory

of compartmental models. The connections between the structure of such a model and the dynamical properties of its solution are emphasized.

The book presents the essential topics and methods that are useful for the construction of a compartmental model. Many key applications and examples are given. Every section is ended with end–section problems.

With its accessible style and concrete examples, the book is an essential resource for the use of digraphs, Markov chains and differential equations in constructions of compartmental models.

Useful for a graduate course, or as a reference for practitioners' use, this book is accessible to students at the master's degree level in engineering, biology, mathematics and other related areas. It is set up in such a way that it can be used fast and easily by researchers from experimental sciences in order to construct new models.

Ilie Burdujan

CORDUNEANU. C., SANDVERG, I.W. (Eds.) – *Volterra Equations and Applications*, Gordon and Breach Science Publlishers, Australia, Canada, Germany, India, Japan, Luxemburg, Malaysia, The Netherlands, Russia, Singapore, Switzerland, 2000, XVI+496p, ISBN 90-5699-171-X, 1023-6155.

This volume contains 52 contributions presented at the Volterra Centennial Symposium, held from May 23-25, 1996 on the campus of the University of Texas at Arlington. The first nine papers represent the invited lectures given at the meeting, while the remaining 43 constitute the contributed presentations.

These 52 contributions can be grouped in following main research directions: history, stability theory, stochastic processes, classical Volterra equations, numerical problems, periodic solutions, control theory, infinite-dimensional systems, integro-differential equations, approximation methods, abstract Volterra operators and equations, problems in physics and engineering, varia. There exist two papers of a *historical nature*. The paper by M. Schetzen emphasizes the great impact of Volterra's ideas on the development of nonlinear system theory. In his paper, R.K. Miller describes the contribution of the Wisconsin school to the theory of integral equations, mainly of Volterra type. There are four papers dealing with the *stability theory*. Their contributions are on: the stability and related asymptotic behavior for linear and non–linear (quasi-linear) differential equations involving Volterra operators, the concept of $D$–stability (due to N. Azbelev) and its applications to classical equations, the current status of the uniform asymp-

totic stability theory for delay equations, the problem of the exponential decay for integro–differential equations involved in continuum mechanics, the attractivitity in case of discrete dynamical systems. The four papers on the *stochastic processes* are concerned with the existence problems for stochastic equations (integral, integro–differential or differential) and with the stability conditions. The six papers on *classical Volterra equations* deal with a variety of problems involving special types of equations and establish connections with the dynamical systems. The generalization of the known discretization methods as well as of the finite element method for integral or integro–differential equations are discussed in the four papers on "*numerical problems*". Three studies concern the existence and the stability of *periodic solutions* of various types of equations. The *control theory* is represented by four papers. Optimal control problems are investigated for processes described both by Volterra equations and by ordinary differentialequations; the theory of nonselfadjoint spectral operators is applied to control theory. The direction *infinite–dimensional systems* is addressed by five papers which treat a large number of problems on integral equations, integral inclusions, integro–differential equations and partial differential equations using methods drawn mainly from Functional Analysis. There exists seven papers concerning the applications of *integrodifferential equations* in the field of applied science. The *approximation methods* concern the (not necessarily causal) maps arising in the applications to the equalization or nonlinear communication channels and to image processing. Many problems in Physics and Engineering are solved using the Volterra's ideas or by tools coming from Functional Analysis.

The volume is closed by a subject index and an author index. This book is of great interest to researchers in Mathematics, Physics and Engineering.

Ilie Burdujan

PATERNAIN, G. P. – *Geodesic Flows*, Progress in Mathematics, Vol. 180, Birkhäser Boston–Basel–Berlin, 1999.

The monograph under review is concerned with a systematic presentation of one of the most interesting class of conservative dynamical systems, i.e. geodesic flows of a complete RIEMANNIAN manifold.

After a concise introduction to the topic, the author focuses his attention on the symplectic properties of geodesic flows and continues with some remarkable applications as the nonexistence of continuous invariant

LAGRANGIAN subbundles for manifolds with conjugate points. The relationship between the exponential growth rate of the average number of geodesic arcs between two points in the manifold and the topological entropy of the geodesic flow, i.e. MANÉ's formula, is subsequently presented and proved in detail. Finally, the author explores the relationship between the topological entropy of the geodesic flow and the homology of the loop space of the corresponding manifold. The book is self-contained and clearly written. It is of interest for graduate students and researchers in dynamical systems and differential geometry.

Ioan I. Vrabie

DRĂGAN, V., HALANAY, A. – *Stabilization of Linear Systems*, Systems & Control: Foundations & Applications, Birkhäser Boston–Basel–Berlin, 1999.

The monograph under review is concerned with a systematic presentation of the existing theory and methods used for the stabilization of linear dinamical systems in continuous time, a special attention being paid to those arising in control applications under incomplete information.

The main topics covered are: stabilization of linear systems, stabilization of linear systems with two time scales, high-gain feedback stabilization of linear systems, adaptive stabilization and adaptation and discrete implementation of stabilization procedures. It should be mentioned that several quite interesting results due to the authors are also included.

The book is self-contained and very well written. It is of interest for graduate students and researchers in applied mathematics, control engineering, aerospace engineering as well as to all those interested in stabilization problems in both systems and control.

Ioan I. Vrabie

DACOROGNA, B., MARCELLINI, P. – *Implicit Partial Differential Equations*, Progress in Nonlinear Differential Equations and Applications, Vol.37, Birkhäser Boston–Basel–Berlin, 1999.

The book under review is concerned with a systematic study of a broad class of implicit nonlinear partial differential equations and systems. Using a new and quite interesting method based on the BAIRE category theorem, the authors develop a very general and elegant existence theory concerning

almost everywhere solutions. Moreover, they compare their method with that of viscosity solutions as well as with that of convex integration. Some important applications to the calculus of variations, geometry, nonlinear elasticity and optimal design are discussed in detail.

The book consists of four parts, the first two ones being devoted to first and second order partial differential equations and respectively systems. The third part contains several applications, while the fourth one presents some nonclassical VITALI type covering theorems and some approximation results of SOBOLEV functions by piecewise affine, or polynomial functions.

The book is almost self-contained and very well written. It is of interest for advanced graduate students and researchers in nonlinear partial differential equations and systems.

Ioan I. Vrabie

W.H. SCHMIDT, K. HEIER, L. BITTNER, R. BULIRSCH (Eds.) – *Variational Calculus, Optimal Control and Applications*, Proceeding of the International Conference in honour of L. Bittner and R. Klötzer, Trassenheide, Germany. Sept. 23–27, 1996, Birkhäuser Verlag, Basel, 1998. ISBN 3–7643–5906–4.

The paper published in these proceedings reflect the trend to practical problems. The starting points are often problems in flight dynamics.

The first chapter concerns the existence theory and optimality conditions. Relaxed problems are considered from various standpoints. Suboptimality conditions are obtained by using the Ekeland variational principle. An overview on the theory of extremal problems closes this chapter.

A modern interpretation of a solution of the Hamilton–Jacobi–Bellman equation is given in the second chapter. This is connected to the question of feedback control. Controlling under uncertainty, problems of sensitivity and observability are investigated.

Recent results in the field of numerical methods and their application to flight path optimization and fluid dynamics are presented in the third chapter. We remark the results concerning the nonlinear programming methods, accelerated multiple shooting and homotopy methods.

The fourth chapter deals with problems from mechanical and aerospace systems. It is mainly devoted to the applications. One can find solutions for some problems concerning the mobil robot controlling, geometrical extremal problems, fluid transport, fluid waves and human sciences.

S. Aniţa

W. DESCH, F. KAPPEL, K. KUNISCH (Eds.) – *Control and Estimation of Distributed Parameter Systems*, Proceeding of the International Conference in Vorau (Austria), July 14–20, 1996, Birkhäuser Verlag, Basel, 1998, ISBN 3–7643–5835–1

This volume contains some new results concerning the control and estimation of distributed parameter systems. A special attention is paid to the models with profound physical significance. We mention the model for nonlinear elastomers, the Chaboche model, the damped wave equation, the generalized Boussinesq equation. More theoretical papers are devoted to an optimal control problem governed by semilinear elliptic equations, to some control problems for parabolic equations with state constraints, to the optimal control of coupled linear systems and to the algebraic Riccati equation in discrete and continuous time. All contributions are important both from theoretical and numerical point of view.

S. Aniţa

T.M. ATANACKOVIC, A. GURAN – *Theory of Elasticity for Scientists and Engineers*, Birkhäuser, Boston, Basel, Berlin, 1999, 392 pages, DM 148, ISBN 3–8176–4072–x.

This book treats classical elasticity theory and it is intended as a general introduction to the various branches of elasticity theory and its applications in science and engineering. It is written at a level for undergraduate and beginning graduate engineering students in mechanical, civil or aerospace engineering. The book contains the following chapters: 1. Analysis of Stress; 2. Analysis of Strain; 3. Hooke's Law; 4. Boundary Value Problems of Elasticity Theory; 5. Solutions for Some Problems of Elasticity Theory; 6. Plane State of Strain and Plane State of Stress; 7. Energy Method in Elasticity Theory; 8. Elementary Theory of Plates; 9. Pressure Between Two Bodies in Contact; 10. Elastic Stability. The approach is oriented toward the formulation and solution of problems. At the end of each chapter a selected number of problems are given.

M. Bîrsan