Book reviews

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BOOK REVIEWS

M. Kapovich: HYPERBOLIC MANIFOLDS AND DISCRETE GROUPS. Progress in Mathematics, vol. 183. Birkhäuser, Boston, 2000, ISBN 0-8176-3904-7, hardcover, 496 pages, CHF 138.–.

The main objective of the book is to give a reasonably complete and self-contained proof of Thurston's hyperbolization theorem. Though the theorem was announced back in the 70's, Thurston never published a complete proof, and various pieces of it thus had to wait to be gradually assembled in journal papers by numerous authors over the next two decades. In 1996, J.-P. Otal published a complete proof of the "exceptional" (or "fiber bundle", as opposed to "generic") case of the theorem (*Le théorème d'hyperbolisation pour les variétés fibrées de dimension 3,* Astérisque 235, Paris, 1996). The present book gives an outline of Otal's proof, a full proof of the "generic" case, and also provides a large collection of diverse background material to make the book (fairly) self-contained (basics of 3-dimensional topology, hyperbolic geometry and Kleinian groups, Teichmüller spaces, orbifolds, group actions on trees, etc.). Though there are also numerous exercises, examples, and a lot of illustrations, the book is still quite condensed and probably pretty demanding for a reader without a working knowledge of the field; however, those who persist and make it all the way through will, in the reviewer's opinion, be very well rewarded for their efforts.

Miroslav Engliš, Praha

K. P. Knudson: HOMOLOGY OF LINEAR GROUPS. Progress in Mathematics vol. 193, Birkhäuser 2000, ISBN 3-7643-6415-7, 208 pages, CHF 98.–.

The importance of the homology of matrix groups became evident after Quillen's definition of higher algebraic K-groups of a ring R as the homotopy of $BGL(R)^+$, the plus-construction (that is, a suitable modification) of the classifying space of the infinite general linear group of R. The monograph presents the current state of art in calculations of these groups.

The first chapter covers classical results, such as Quillen's description of the homology of $GL_n(\mathbb{F}_p)$ and Borel's calculation of the stable cohomology of some arithmetic groups. Also a conjecture about the structure of $H^*(GL_n(\Lambda), \mathbb{F}_q)$, where Λ is a $\mathbb{Z}[1/p]$-algebra, due to Quillen and Lichtenbaum, is formulated there.

Chapter 2 is focused to the stability of the homology of matrix groups. Stability may help to reduce calculations to low-dimensional cases which are then studied in Chapter 3. A special attention is paid there to $H_3(GL_1)$ and stunning connections of this group to the geometry of hyperbolic space.

Chapter 4 is devoted to rank one groups, namely to SL_2 and PGL_2. It turns out that the cohomology can be in some cases calculated using actions of these groups on trees. The generalizations to higher ranks is also discussed there.

The last chapter is devoted to the Friedlander-Milnor conjecture concerning the homology of an algebraic group made discrete. In the following three appendices the author recalls homology of discrete groups, classifying spaces, K-theory and étale cohomology.

Although the book certainly assumes rather broad preliminary knowledge of group homology, homological algebra and algebraic geometry, it might yet give, even to a non-specialist, some basic orientation in the area.

Martin Markl, Praha

S. I. Hayek: ADVANCED MATHEMATICAL METHODS IN SCIENCE AND ENGINEERING. Marcel Dekker, New York, 2001, 760 pages, USD 195.–.

The book presents a number of recipes how to use advanced mathematics for solving scientific and engineering problems.

The spectrum of mathematics used is apparent from the following list of topics as they appear in the respective chapters of the book: ordinary differential equations, series solutions of ODE's, special functions, boundary value problems and eigenvalue problems, functions of a complex variable, partial differential equations of mathematical physics, integral transforms, Green's functions and asypmptotic methods.

Concerning the topics listed above we have here a big compendium of mathematics with a description of the procedures to use and with a large amount of instructive examples. No mathematical proofs are presented, simply procedures for using without limitations and warnings. Nevertheless for educated scientists and engineers the book can serve as a handbook or encyclopedia of practical mathematics. As concerns the practical equations, e.g. the equations of mathematical physics or problems described by ODE's, their genesis is shortly described in many cases.

Each part of the book is followed by a problem section with answers presented at the end of the book. Four useful appendices are presented on infinite series, special functions, orthogonal coordinate systems and the basic properties of the Dirac delta function from the viewpoint of an engineer.

For teaching pure mathematics the teacher can use the book as a good source of examples.

Štefan Schwabik, Praha

M. R. Grossinho et al. (eds.): NONLINEAR ANALYSIS AND ITS APPLICATIONS TO DIFFERENTIAL EQUATIONS. Birkhäuser, Basel, 2001, 400 pages, hardcover, ISBN 0-8176-4188-2, CHF 158.–.

The book is the outgrowth of the autumn school on nonlinear analysis and differential equations held at the University of Lisbon in September–October 1998. The school was devoted to the recent developments in nonlinear analysis and differential equations (both partial and ordinary). The book is divided into two parts:

The first part consists of 6 survey expository papers of larger extent which are written by personalities leading in the respective fields: C. De Coster and P. Habets (the method of lower and upper functions for ODEs), E. Feireisl (long-time properties of solutions to Navier-Stokes equations), J. Mawhin (periodic solutions of p-Laplacian systems), W. M. Oliwa (mechanics on Riemannian manifolds), R. Ortega (a geometric approach to dynamical systems in the plane via twist theorem) and K. Schmitt (bifurcations in variational inequalities).

The second part of the book contains 21 research papers which reflect the recent research of the participants of the seminar. They include a wide range of topics, like e.g. asymmetric nonlinear oscillators, spectral theory for equations with one-dimensional p-Laplacian, time maps in nonlinear boundary value problems, various boundary value problems for ordinary, impulsive and discontinuous equations, applications of the Nielsen number for multiplicity results, boundedness of solutions, symmetries of positive solutions and spectral theory for PDEs with n-dimensional p-Laplacian, Galerkin-averaging method in infinite-dimensional spaces, topological degree on Banach manifolds, various questions related to the calculus of variation and optimal control of systems governed by ODEs or PDEs, etc.

The proceedings are edited in a very good manner, the statements are mostly proved in detail. The book will be useful to everybody interested in nonlinear analysis and, in particular, to mathematicians and graduate students in the ODE and PDE community.

Milan Tvrdý, Praha

Claus Hillermeier: NONLINEAR MULTIOBJECTIVE OPTIMIZATION. A GENERALIZED HOMOTOPY APPROACH. Birkhäuser, Basel, 2001, 144 pages, hardcover, ISBN 3-7643-6498-X, CHF 78.–.

In multiobjective optimization problems we search for values of variables for which certain objective quantities take on minimum/maximum. If these quantities do not depend on a single objective, classical methods of optimization cannot be applied. We want to find good compromise values of parameters to obtain a set of efficient solutions (no objective can be improved without impairing at least one other objective).

The object of the book introduced in Chapter 1 is the following problem. Let a state be characterized by a vector $x = (x_1, \ldots, x_n) \in R \subset \mathbb{R}^n$ (R is a feasible set). Let a quantitative criterion for the assessment of a variable x be a (sufficiently smooth) function $f = (f_1, \ldots, f_k) \colon \mathbb{R}^n \to \mathbb{R}^k$. The problem is to minimize all f_i, $i = 1, \ldots, k$ at the same time.

Chapter 3 contains a survey of methods which reduce our problem to a scalar-valued optimization problem and which look for efficient points y^* (there is no other $y \neq y^*$, $y \in f(R)$ with $y \leqslant y^*$; $\leqslant$ is a certain order relation on $\mathbb{R}^k$) and their preimages x^* ($y^* = f(x^*)$), the so called (local) Pareto optimal points—they are candidates for being optimal solutions of the original vector optimization problem. The author generalizes a homotopy method of finding Pareto optimal points which Rakowska introduced in 1991 for the bicriterial case to the case $k > 2$.

In Chapter 4 he reduces a vector optimization problem to a scalar one with a function $g_\alpha \colon \mathbb{R}^n \to \mathbb{R}$, $g_\alpha(x) = \sum\limits_{i=1}^{n} \alpha_i f_i(x)$, by introducing an additional weight parameter $\alpha \in \mathbb{R}^k$, and uses the Karush-Kuhn-Tucker condition for Pareto optimality. Subsequently, by using a local curvature of the border ∂M of the image set $f(R)$ he divides the Pareto optimal points to minimizers and saddle points of g_α.

In Chapter 5 the feasible set R is supposed to be defined by m equality constraints $h_i(x) = 0$, $i = 1, \ldots, m$. Our problem is transformed to $F(x, \lambda, \alpha) = 0$, solutions of which are candidates for Pareto optimal points ($\lambda \in \mathbb{R}^m$ is the Lagrange multiplier). The null-set M of F is under certain conditions a $(k-1)$-dimensional differentiable manifold. Theorem 5.6 gives conditions for parametrizability of M by $k-1$ arbitrarily chosen components of α in a neighbourhood of a given point $(x^*, \lambda^*, \alpha^*)$ in M.

In Chapter 6 the author develops a method for generating neighbouring points on the manifold M, starting from a given point to obtain, step by step, the set of candidates for Pareto optimal points by using local charts φ_j. First, by variation of the chart parameter he chooses a direction on M. Second, the function value of the chart (actually the desired neighbouring point) is determined by a Newton method.

In Chapter 7 the author applies the results to an academic example and two examples from industry described in Chapter 2.

Jan Eisner, Praha

L. Schwartz: A MATHEMATICIAN GRAPPLING WITH HIS CENTURY. Birkhäuser, Basel, 2001, viii+490 pages, CHF 58.–.

The book is an autobiography of Laurent Schwartz, without any doubt one of the most remarkable mathematicians of the last century. It is a translation by Leila Schneps of the French version "Un mathématicien aux prises avec le siècle" from 1997 (Editions Odile Jacob).

Laurent Schwartz presents his mathematical discoveries, especially we have to mention his invention of distributions which has become one of the essential treasures of contemporary mathematics. He confesses how deeply his life is connected with mathematics and teaching since his very childhood.

On the other hand, the book also gives an account of the world in the 20th century from the point of view of a logically thinking man with pronounced social feelings. He describes his way from a hard trotskyist to a general fighter against wrong things in the world (the war against the Jews, Algeria, Vietnam, Afghanistan, the totalitarism and human rights in Eastern Europe, etc.).

The spirit of a great mathematician and his twentieth century is presented in this fascinating autobiography.

The book is an informative and instructive reading for everybody, not only for a mathematician.

Štefan Schwabik, Praha

Ansgar Jüngel: QUASI-HYDRODYNAMIC SEMICONDUCTOR EQUATIONS. Birkhäuser, Basel, 2001, 304 pages, CHF 148.–.

In this book the author presents a hierarchy of macroscopic models for semiconductors. After a short summary of physics of homogeneous and inhomogeneous semiconductors, three models are studied in detail: the isentropic drift diffusion model, the energy transport model and the quantum hydrodynamic model.

For each of these models, the author starts with the physical background and the derivation of the model. Then he presents the current existence theory. In this part, existence of weak solutions is discussed and other interesting qualitative properties as uniqueness, regularity, positivity, vacuum solutions, long time behaviour and steady state solutions are investigated. Modern analytical techniques have been used and further developed as positive solution methods and local energy and entropy methods. Modern tools of the theory of degenerate parabolic equations have been applied.

For each model, the theoretical study is supplement by numerical approximations based on discretization via mixed finite element methods. Interesting examples of numerical simulations are also presented.

Antonín Novotný, Praha

John Cagnol, Michael P. Polis, Jean-Paul Zolésio (eds.): SHAPE OPTIMIZATION AND OPTIMAL DESIGN. Lecture notes in pure and applied mathematics, volume 216. Marcel Dekker, New York, 2001, 450 pages, softcover, ISBN 0-8247-0556-4, USD 185.–.

The editors selected nineteen papers from the 19th conference System Modeling and Optimization (Cambridge, England). The papers present some advanced topics and latest developments in optimal shape design and control theory for systems governed by partial differential equations. Though one can hardly find a unique criterion to group or sort the papers, a few families with similar features can be distinguished.

A large group is formed by contributions closely related to the French-Polish school of shape optimization established by J.-P. Zolésio and J. Sokolowski. Titles of these are listed and briefly commented in the next paragraph.

The shape differentiability of the velocity, the pressure, and a particular class of shape functionals is studied in *Boundary variations in the Navier-Stokes equations and Lagrangian functionals* (S. Boisgérault, J.-P. Zolésio). Equations for material and shape derivatives of both electric and magnetic fields are derived in *Shape sensitivity analysis in Maxwell's equations* (J. Cagnol, J.-P. Marmorat, J.-P. Zolésio). A calculus for the computation of first and second derivatives of shape functions is presented in *Tangential calculus and shape derivatives* (M. C. Delfour, J.-P. Zolésio). Functionals associated with evolution problems defined in time-dependent domains are treated in *Eulerian derivative for non-cylindrical functionals* (R. Dziri, J.-P. Zolésio). Cracks are subjects of both *Shape derivative on a fractured manifold* (J. Ferchichi, J.-P. Zolésio) and *Shape sensitivity analysis of problems with singularities* (G. Fremiot, J. Sokolowski). The latter paper also covers a control problem with the state equation in the form of a Dirichlet-Neumann boundary value problem. Incompressible Euler flow and energy cost functionals are in the focus of attention of *Weak set evolution and variational applications* (J.-P. Zolésio). In *Existence of free-boundary for a two non-Newtonian fluids problem* (N. Gomez, J.-P. Zolésio), shape analysis techniques are used to show the existence of a solution. Similarly, *Mapping method in optimal shape design problems governed by hemivariational inequalities* (L. Gasiński) aims at existence theorems for optimal shapes.

Three papers professing optimal control theory form the next group. Though not numerous, it occupies slightly more than one third of the book. This group comprises *Feedback laws for the optimal control of parabolic variational inequalities* (C. Popa), *Nonlinear boundary feedback stabilization of dynamic elasticity with thermal effects* (I. Lasiecka), and *Simultaneous exact/approximate boundary controllability of thermo-elastic plates with variable transmission coefficient* (M. Eller, I. Lasiecka, R. Triggiani). The last paper is the most extensive in the whole collection (122 pages) and gives a deep and detailed treatment of the subject.

The above mentioned papers concentrate on theoretical analysis and do not deal with numerical methods or numerical examples. On the contrary, the third family consists of papers containing a sort of numerics (with the only exception of a paper on asymptotic analysis). Various problems are considered. A few of them stray from the subject of shape optimization or optimal control.

Slope stability and shape optimization: Numerical aspects (J. Deteix) presents a method for solving a soil mechanics problem. In *Parallel solution of contact problems* (Z. Dostál, F. A. M. Gomes, S. A. Santos), a non-overlapping domain decomposition algorithm is suggested and numerically tested. *Domain optimization for unilateral problems by an embedding domain method* (A. Myśliński) also deals with contact problems but focuses on a shape optimization problem solved by a fictitious domain based approach. The paper *Some new problems occurring in modeling of oxygen sensors* (J.-P. Yvon, J. Henry, A. Viel) analyzes a system of two ordinary differential equations and the asymptotic behavior of its solution. Based on a reduced control problem, a quasi-optimal control method for the Navier-Stokes equations is presented in *Adaptive control of a wake flow using proper orthogonal decomposition* (K. Afanasiev, M. Hinze). A numerical method solving inverse problems for the Poisson equation and scattered data is designed in *Application of special smoothing procedure to numerical solutions of inverse problems for real 2-D systems* (E. Rydygier, Z. Trzaska). The subject of *Asymptotic analysis of aircraft wing model in subsonic airflow* (M. A. Shubov) is a theoretical asymptotic and spectral analysis of an operator related to a system of two coupled integro-differential equations and a two parameter family of boundary conditions.

Each paper comprises a bibliography section and the whole collection is supplemented by a two page subject index.

The volume under review will certainly satisfy readers interested in the theoretical background of shape optimization and sensitivity analysis (including advanced topics) as well as readers dealing with boundary control problems, notably those coupled with thermoelasticity. Also readers concerned with flow problems augmented by optimal design or control will find a mine of inspiration there. The book, however, offers much more as it treats other widely applicable subjects, too.

Jan Chleboun, Praha

Alexander A. Samarskii: THE THEORY OF DIFFERENCE SCHEMES. Marcel Decker, New York, 2001, xviii+761 pages, ISBN 0-8247-0468-1, USD 225.–.

The author of this extensive book is one of the leading persons of the Moscow school of numerical analysis and gives in it a systematic exposition to the foundations of the theory of difference schemes and to applications of this theory to the solution of simple typical problems of mathematical physics. The book consists of 10 chapters. The first has introductory character and linear difference equations and some variants of the elimination method are investigated in it. Chapter 2 treats besides relevant elements of functional analysis also the basic concepts of the theory of difference schemes: approximation, stability, and convergence. The theory of homogeneous conservative schemes for ordinary linear selfadjoint differential equations of the second order is given in Chapter 3. Chapter 4 is devoted to various difference approximations of second-order elliptic equations. Mainly the Poisson equation is investigated. In Chapter 5 difference schemes for the simplest time-dependent equations are studied. The heat conduction equation in one and several space variables, one (space) dimensional Schrödinger, transport and wave equations are included. In Chapter 6 the two-layer and three-layer difference schemes are treated as operator difference schemes in a Hilbert space and their stability with respect to initial data and right-hand side is studied. The results of the preceding chapters are applied in Chapter 7 to homogeneous difference schemes for parabolic and hyperbolic second-order differential equations with variable coefficients. Special attention is paid here to space one-dimensional problems. Chapter 8 is the only chapter dealing with nonlinear problems. The difference schemes for the quasilinear heat conduction equation and for some non stationary equations of gas dynamics are constructed here. Also iterative methods for solving nonlinear difference equations are treated. Chapter 9 contains the theory of economical difference schemes for multidimensional problems of mathematical physics. The general stability theory lies in the foundations of this theory. The final chapter, Chapter 10, deals with the solution of linear elliptic difference equations. The main attention is paid here to iterative methods.

The positive feature of this book is that it is well written and that it contains very large amount of material. On the other hand, there are also very serious objections against it. Actually, the book is the translation of the old book: Samarskij, A. A.: Teoriya raznostnykh skhem (The theory of difference schemes), izd. vtoroe (second edition), Moskva, Nauka, 1983, and this fact is not indicated in the title of it. Moreover, the Russian original is even not mentioned in any way throughout the book reviewed as if it did not ever exist. The same is also true for an older book by Samarskij with a very similar contents: Vvedeniye v teoriyu raznostnykh skhem (Introduction to the theory of difference schemes), Moskva, Nauka, 1971. This circumstance is, in my opinion, very serious since it means at least (even if we ignore that it is very strange to translate a book without indicating it) that the book is not updated, and that it is, in fact, more than 20 years old. Maybe this fact causes that such an important method for solving linear systems of equations arising in solving elliptic differential equations as the conjugate gradient method is not at all mentioned in the book. Also the quality of the translation (we have to speak about translation because this is the correct characterization of the book) is not too high. One example for all: On page 741 one paragraph is named **Gibrid** ... and this word is a perhaps ad hoc formed word from the Russian word „Gibridnye“ ... (see page 589 of the above mentioned Russian original) whereas the English word „Hybrid“ would be quite acceptable.

Emil Vitásek, Praha

D. Alpay, V. Vinnikov (eds.): OPERATOR THEORY, SYSTEMS THEORY AND RELATED TOPICS. Operator Theory, Advances and Applications, vol. 123, Birkhäuser, Basel, 2001, 584 pages, CHF 228.–.

The volume presents the refereed proceedings of the Conference in Operator Theory in Honour of Moshe Livšic's 80th Birthday, held at the Ben-Gurion University of Negev (Beer-Sheva, Israel) in June/July 1997.

The papers included in this selection cover many areas of operator theory and its applications that are, directly or indirectly, connected with important results and ideas of M. Livšic.

The volume contains more than 20 papers containing recent achievements in interpolation theory, direct and inverse problems for the string equation and nonselfadjoint differential operators, moment problems, operator models, function theory, system theory and theoretical physics.

The ideas presented in the volume can be useful and interesting for a wide audience in pure and applied mathematics, theoretical physics and engineering sciences.

Vladimír Müller, Praha

E. Scholz (ed.): HERMANN WEYL'S RAUM-ZEIT-MATERIE AND A GENERAL INTRODUCTION TO HIS SCIENTIFIC WORK. Birkhäuser, Basel, 2001, vii+402 pages, CHF 68.–.

The book consists of two parts. The first part "Historical Aspects of Weyl's *Raum-Zeit-Materie*" contains the contributions of Skúli Sigurdsson (Journeys in spacetime), Erhard Scholz (Weyls Infinitesimalgeometrie, 1917–1925, in German), Hubert Goenner (Weyl's contributions to cosmology) and Norbert Straumann (Ursprünge der Eichtheorien (Origins of the calibration theories)).

The second part "Hermann Weyl: Mathematician, Physicist, Philosopher" is written by Robert Coleman and Herbert Korté.

The first part deals with Weyl's involvement in the theory of relativity, cosmology and matter on the basis of his book *Raum-Zeit-Materie (Space-Time-Matter)* published in 1918. Weyl's struggle with the classical determinism in the theory of nature is demonstrated very carefully.

In the second part an account of the whole work of H. Weyl is given.

The book is a good contribution to the description of the complicated interplay between mathematics, physics and philosophy in the first half of the 20th century.

Štefan Schwabik, Praha

R. Narasimhan, Y. Nievergelt: COMPLEX ANALYSIS IN ONE VARIABLE. Second edition. Birkhäuser, Boston, 2001, ISBN 0-8176-4164-5, hardcover, 400 pages, CHF 118.–.

The first part of this book, authored by Raghavan Narasimhan, presents complex analysis in one variable in the context of modern mathematics, with clear connections to several complex variables, de Rham theory, real analysis, and other branches of mathematics. In Chapter 1 the classical theory of holomorphic functions is developed. Chapter 2 is devoted to the monodromy theorem. In Chapter 3 the residue theorem is proved. Chapter 4 contains a proof of Picard's theorem. In Chapter 5 the inhomogeneous Cauchy-Riemann equation is studied. The Runge approximation theorem is proved. Chapter 6 is devoted to various theorems which can be proved using Runge's theorem: the existence of functions with prescribed zeros or poles, a "cohomological" version of Cauchy's theorem, and related theorems. Chapter 7 deals with the Riemann mapping theorem and simply connected plane domains. In Chapter 8 functions of several complex variables are studied. Chapter 9 serves as an introduction to Riemann surfaces. Chapter 10 presents a proof of the corona theorem. In Chapter 11 the author introduces and studies subharmonic functions and uses them to solve the Dirichlet problem for harmonic functions. The second part of the book, authored by Yves Nievergelt, consists of exercises and relevant references.

Dagmar Medková, Praha

H. Bart, I. Gohberg, A. C. M. Ran (eds.): OPERATOR THEORY AND ANALYSIS. Birkhäuser, Basel, 2001. ISBN 3-7643-6499-8, hardcover, 480 pages.

This book contains the proceedings from the workshop on operator theory at the Vrije Universiteit dedicated to M. A. Kaashoek on the occasion of his sixtieth birthday. It consists of 16 mathematical papers and three additional (short) papers with biography of M. A. Kaashoek and his list of publications. The mathematical papers are of good quality (i.e. with all proofs included, etc.) and cover a variety of topics ranging from factorization of matrix-valued functions, interpolation and commutant lifting, Toeplitz and Bezout matrices and spectral theory to monodromy of differential systems and stability and control of differential equations with time delays. In the reviewer's opinion, this book is a worthy resource for anyone interested in this area of operator theory or its applications in systems theory and optimal control.

Miroslav Engliš, Praha

L. Polterovich: THE GEOMETRY OF THE GROUP OF SYMPLECTIC DIFFEOMORPHISMS. Lectures in Mathematics, ETH Zürich, Birkhäuser, 2001, ISBN 3-7643-6432-7, 152 pages, CHF 34.–.

It is a classical fact that the kinematics of most systems of classical mechanics can be described in terms of a symplectic manifold M called the 'phase space' of the system. The evolution is then determined by a choice of a smooth 'energy' function F on M called the Hamiltonian. More precisely, the skew-symmetric gradient of F generates a flow, that is, a one-parametric family of symplectic diffeomorphisms of M, and the evolution is given by the action of this flow.

The central object of the book is the group $\mathrm{Ham}(M,\Omega)$ of Hamiltonian diffeomorphisms of M which are, by definition, diffeomorphisms induced by Hamiltonian flows. The geometry of this group is reflected by a metrics, introduced by H. Hofer in 1990, which measures the minimal amount of energy necessary to generate a given motion of the system.

The first four chapters of the book are devoted to basic properties of $\mathrm{Ham}(M,\Omega)$ and Hofer's metric. The rest of the book is then dedicated to various problems of symplectic geometry, dynamics and ergodic theory viewed from the geometric perspective provided by Hofer's metric.

Among other things, it is proved that the diameter of the group $\mathrm{Ham}(M,\Omega)$ is infinite when M is a closed surface. The length spectrum of the fundamental group of $\mathrm{Ham}(M,\Omega)$ with applications to ergodic theory is also studied. There are two chapters devoted to geodesics on $\mathrm{Ham}(M,\Omega)$ and, in the last chapter of the book, the flux conjecture which states that the group $\mathrm{Ham}(M,\Omega)$ is C^∞-closed in the group of all symplectic diffeomorphisms is formulated. The proofs use a broad variety of methods, so the reader may get acquainted also with other parts of modern mathematics, as Gromov's theory of pseudo-holomorphic curves, symplectic connections and Floer homology.

The book is addressed to students and researchers interested in Hamiltonian mechanics and symplectic geometry. Reading of the book requires only a basic familiarity with differential geometry and topology.

Martin Markl, Praha

John J. Benedetto, Paulo J. S. G. Ferreira (eds.): MODERN SAMPLING THEORY. Mathematics and Applications. Birkhäuser, Boston, 2001, xvi+417 pages, ISBN 0-8176-4023-1, CHF 168.–.

The idea to edit this modern and authoritative guide to sampling theory took its origin at the international workshop SampTA'97 on sampling theory and applications held in 1997 in Aveiro, Portugal. Chapter 1 written by the editors contains a mathematical history and the perspectives of sampling theory, as well as an outline of the volume and an overview of each chapter. The contents of Chapter 2 is formed by the English translation from Russian of Kotel'nikov's classical sampling paper, *On the transmission capacity of the "ether" and wire in electrocommunications*. The rest of the book is divided into three parts reflecting, respectively, the role of the wavelet theory in sampling, a broad range of other modern mathematical methods used in sampling theory, and some current and important tools and applications.

Part I, Sampling, Wavelets, and the Uncertainty Principle, contains the following chapters: Wavelets and sampling by Gilbert G. Walter (Chap. 3), Embeddings and uncertainty principles for generalized modulation spaces by J. A. Hogan and J. D. Lakey (Chap. 4), Sampling theory for certain Hilbert spaces of bandlimited functions by Jean-Pierre Gabardo (Chap. 5), and Shannon-type wavelets and the convergence of their associated wavelet series by Ahmed I. Zayed (Chap. 6).

In Part II, Sampling Topics from Mathematical Analysis, one finds: Non-uniform sampling in higher dimensions: From trigonometric polynomials to bandlimited functions by Karlheinz Gröchenig (Chap. 7), The analysis of oscillatory behavior in signals through their samples by Rodolfo H. Torres (Chap. 8), Residue and sampling techniques in deconvolution by Stephen Casey and David Walnut (Chap. 9), Sampling theorems from the iteration of low order differential operators by J. R. Higgins (Chap. 10), and Approximation of continuous functions by Rogosinski-type sampling series by Andi Kivinukk (Chap. 11).

Finally, Part III, Sampling Tools and Applications, is formed by: Fast Fourier transforms for nonequispaced data: A tutorial by Daniel Potts, Gabriele Steidl, and Manfred Tasche (Chap. 12), Efficient minimum rate sampling of signals with frequency support over non-commesurable sets by Cormac Herley and Ping Wah Wong (Chap. 13), Finite- and infinite-dimensional models for oversampled filter banks by Thomas Strohmer (Chap. 14), Statistical aspects of sampling for noisy and grouped data by M. Pawlak and U. Stadtmüller (Chap. 15), Reconstruction of MRI images from non-uniform sampling and its application to intrascan motion correction in functional MRI by Marc Burgeois, Frank T. A. Wajer, Dirk van Ormondt, and Danielle Graveron-Demilly (Chap. 16), and Efficient sampling of the rotation invariant Radon transform by Laurent Desbat and Catherine Mennessier (Chap. 17).

The book does a good turn to engineers and mathematicians working in wavelets, signal processing and harmonic analysis, as well as to scientists and engineers working in applications as varied as medical imaging and synthetic aperture radar.

Emil Vitásek, Praha

J. Gil, D. Grieser, M. Lesch (eds.): APPROACHES TO SINGULAR ANALYSIS. Operator Theory, Advances and Applications, vol. 125. Birkhäuser, Basel, 2001, vi+256 pages, CHF 128.–.

The book is based on the workshop "Approaches to Singular Analysis" held in Berlin in 1999. It contains eight papers of the participants and invited authors. Some of them have a very detailed list of references.

The publication presents different approaches to problems arising in the context of singular situations in partial differential equations. These approaches stand here next to each other. It offers e.g. introductions to various pseudodifferential calculi and relations between them. From the other topics let us mention at least: the cone algebra, basics of b-calculus, Boutet de Monvel calculus, pseudodifferential analysis on manifolds with boundary, operator algebras on manifolds with singularities, singular asymptotics lemma and push-forward theorem.

For a well prepared specialist in the field, the book will be very usefull.

Milan Práger, Praha

S. F. Singer: SYMMETRY IN MECHANICS. A gentle modern introduction. Birkhäuser, Boston, 2001, ISBN 0-8176-4145-9, ISBN 3-7643-4145-9, CHF 58.–.

This is a remarkable book. It is designed for undergraduate students of physics in order to motivate them to study and use more modern mathematical methods. On the other hand, it can be equally well useful for undergraduate students of mathematics. The latter are no doubt familiar with these more modern methods, but quite often are not aware of their various nice applications in physics. The more modern mathematical methods are concentrated around the symplectic geometry and the hamiltonian approach to classical mechanics. The author first treats simpler examples like particles on the line and magnetism in the three space, and only then proceeds to the main example, namely the two body problem. It is obvious that the author has much experience in teaching these subjects. The book is perfectly written and serves very well its purpose. The text should be accessible already to students of physics in the third year of their studies. The reader is made familiar in a very acceptable way with basic notions of modern differential geometry and with Lie groups in their matrix form. Symmetries are considered as Lie group actions, and infinitesimal symmetries as Lie algebras. There are many exercises included, and at the end of the book the reader will find solutions for majority of them. The text ends with a recommendation of a wide variety of books for further reading.

Jiří Vanžura, Brno