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BOOK REVIEWS

CALIN, OVIDIU; DER-CHEN CHANG. – *Geometric Mechanics on Riemanniann Manifolds,* Applied and Numerical Harmonic Analysis, Birkhäuser Verlag, Boston, Basel, Berlin, 2004, xv+278 pp., ISBN 0-8176-4354-04.

This work is a text for a course or seminar directed at graduate and advanced undergraduate students interested in elliptic and parabolic equations, differential geometry, calculus of variations, quantum mechanics. Its main goal is to explore some connections between differential geometry and partial differential equations: that is, partial differential equations are linked with a geometric view of classical mechanics in both its Lagrangian and Hamiltonian formulations on Riemannian manifolds. When quantitative solutions cannot be obtained explicitly, the equations of motion are solved qualitatively using conservation laws provided by the geometry of the problem. The first chapter is introductory. Here there are presented several concepts and results from the mathematical analysis on differentiable manifolds (tangent vectors, differential of a map, Lie bracket, one forms, tensors) as well as some results from the Riemannian geometry and the theory of linear connections. Next, one studies the Laplace operator on Riemannian manifolds presenting, as applications, the uniqueness for solution of the Cauchy problem for the heat operator and the Hessian. Then the authors discuss some topics such as: Lagrangian formalism on Riemannian manifolds, harmonic maps from a Lagrangian point of view, conservation theorems, Hamiltonian formalism, Hamilton-Jacobi theory, minimal hypersurfaces, radially symmetric spaces. At the end they study the fundamental solutions for heat operators with potentials, fundamental solutions for elliptic operators and some mechanical curves such as: the astroid, the cycloid, and curves that minimize the potential.

V. Oproiu

MARSDEN, JEROLD E.; RATIU, TUDOR S. (eds.) – *The Breadth of Symplectic and Poisson Geometry, Festschrift in Honor of Alan Weinstein*, Progress in Mathematics, Volume 232, Birkhäuser Verlag, Boston, Basel, Berlin, 2005, xxiii+654 pp., ISBN 0-8176-3565-3.

This volume contains contributions of some of the best workers in the subjects of symplectic geometry and mechanics, geometric PDE, Schrödinger operator, geometric quantization, Poisson manifolds. The intended audience readers for this book include active researchers in the general area of symplectic geometry and mechanics, as well as aspiring graduate students who wish to learn where the subject is headed and what some of the current research topics are. After a short introduction in the scientific work of Alan Weinstein, the following contributions are included: Dirac structures, momentum maps, and quasi-Poisson manifolds, by H.Bursztyn and M. Crainic, Construction of Ricci type connections by reduction and induction, by M.Cahen, S.Gutt and L. Schwachöfer, A mathematical model for geomagnetic reversals, by J.J.Duistermaat, Nonholonomic systems via moving frames: Cartan equivalence and Chaplygin Hamitonization, by K.Ehlers, J.Koiller, R. Montgomery, and P.M.Rios, Thompson's conjecture for real semisimple Lie groups, by S.Evens and Jiang-Hua Lu, The Weinstein conjecture and theorems of nearby and almost existence, by V.L.Ginszburg, Simple singularities and integrable hierarchies, by A.B. Givental and T.E.Milanov, Momentum maps and measure-valued solutions for the EPDiff equation, by D.D.Holm and J.E.Marsden, Higher homotopies and Maurer-Cartan algebras: Quasi-Lie-Rienhart, Gerstenhaber, and Batalin-Vilkovisky algebras, by J. Huebschmann, Localization theorems by symplectic cuts, by L.Jeffrey and M.Kogan, Refinements of the Morse stratification of the normsquare of the moment map, by F. Kirwan, Quasi, twisted and all that ... in Poisson geometry and Lie algebroid theory, by Y.Kormann-Scwarzbach, Minimal coadjoint orbits and symplectic induction, by B.Kostant, Quantization of pre-quasi-symplectic grupoids and their Hamiltonian spaces, by C. Laurent-Gengoux and Ping Xu, Duality and triple structures, by K.C.H. Mackenzie, Star exponential functions as two-valued elements, by Y.Maeda, N.Miyazaki, H.Omori, and A. Yoshioka, From momentum maps and dual pairs to symplectic and Poisson grupoids, by C.M.Marle, Construction of spectral invariants of Hamiltonian paths on closed symplectic manifolds, by Yong-Geun Oh, The universal covering and covered spaces of a symplectic Lie algebra action, by J.-P. Ortega and T.S.Ratiu, Poissona homotopy algebra: An idiosyncratic survey of homotopy algebraic topics related to Alan's interests, by J.Stasheff, Dirac submanifolds of Jacobi manifolds, by I.Vaisman, and Quantum maps and automorphisms, by S. Zelditch.

V. Oproiu

ANKER, JEAN-PHILIPPE; ORSTED, BENT (eds.) – *Lie Theory: Unitary Representations and Compactifications of Symmetric Spaces*, Progress in Mathematics, Volume 229, Birkhäuser Verlag, Boston, Basel, Berlin, 2005, x+207 pp., ISBN 0-8176-3526-2.

This is the second volume in a three volume series *Lie Theory,* aiming at presenting the central role played by semisimple Lie groups in much of currently active mathematics. It is well suited for graduate students in semisimple Lie theory and neighboring fields, and also for researchers who wish to learn about some current core areas and applications of semisimple Lie theory. In the first lecture *Introduction to Symmetric Spaces and Their Compactifications* the author Lizhen Ji has updates his lectures given at the University of Hongkong in the summers of 1998 and 1999 and at the European School in Group Theory at CIRM, Marseille-Luminy, July 2001. He presents a self-contained introduction to symmetric spaces and studies their compactifications using the Poincaré disc and bidisc. First, he studies the example of the Poincaré disc and examines many different constructions of compactifications all of which coincide with the closed disc. The bidisc is one of the basic examples of higher rank symmetric spaces. The author points out the differences and difficulties which arise in carrying out some constructions in the higher rank case. Next, he presents an introduction to symmetric spaces, covering various geometric and group-theoretic aspects. The next lecture *Compactifications of Symmetric and Locally Symmetric Spaces,* by Armand Borel and Lizhen Ji, is based in part on the lectures given at the European School in Group Theory at CIRM, Marseille-Luminy, July 2001. The authors study the compactifications in which the Riemannian symmetric space is open dense, the compactifications of an arithmetic quotient in which the latter is open dense and smooth compactifications of Riemannian or semisimple symmetric spaces in which the space is open, not dense. The last lecture *Restrictions of Unitary Representations of real Reductive Groups* is writen by Toshiyuki Kobayashi. The author provides the necesary background for understanding a currently active area of representation theory for Lie groups, i.e. that of branching laws. We can find many concrete examples an important concepts from modern representation theory, such as Harish Chandra modules, associated varieties, micolocal analysis, derived functor modules, geometric quantization etc.

V. Oproiu

COLOMBO, F.; SABADINI, I.; SOMMEN, F.; STRUPPA, D.C. – *Analysis of Dirac Systems and Computational Algebra,* Progress in Mathematical Physics, 39, Birkhäuser Verlag A.G. Boston, Basel, Berlin, 2004, xiv+ 332pp., ISBN 0-8176-4255-2.

In this book the authors present a uniform treatment of several operators such as the Moisil-Teodorescu operator for the quaternions, the Imaeda operators for biquaternions, complexified Fueter-type operators, the Dirac equation involving the quantum mechanical operators, used in describing of several physical phenomena. The book is addressed to Ph.D. students and researchers interested in (hyper) complex analysis, Clifford analysis, systems of partial differential equations with constant coefficients, and mathematical physics. Its reading requires knowledge from different fields of mathematics: commutative algebra, Gröbner bases, sheaf theory, cohomology, topological vector spaces, generalized functions (distributions and hyperfunctions). The book is a pioneering attempt to apply computational and algebraic techniques to hypercomplex analysis. In the first chapter the authors present some background material about commutative algebra,Gröbner bases, sheaf theory, topological linear spaces, distributions, Fourier transform, hyperfunctions in one variable, cohomological properties of the sheaf of holomorphic functions, hyperfunctions of several variables, category theory. Next they study the computational algebraic analysis: the Ehrenpreis-Palamadov fundamental principle, the fundamental principle for hyperfunctions, and the using of computational algebra software. In the third chapter the authors study the Cauchy-Fueter system with its variations: regular functions of one quaternionic variable, quaternionic functions in one variable, algebraic and analytic approaches for several quaternionic variables, the Moisil-Teodorescu system. Next they study some special first order systems in Clifford analysis: Dirac operators, radial algebra, Fischer decomposition, the Dirac complex for two, three and four operators, generalized systems, systems using the Witt basis, combinatorial systems. At the end, the authors study some first order linear operators in physics (operators from the Maxwell and Proca fields, the Dirac equation and the linearization, octonionic Dirac equation) and open problems related to the Cauchy-Fueter system, the Dirac system etc.

V. Oproiu

KURDILA, A.J.; ZABARANKIN, M. – *Convex Functional Analysis*, Systems and Control: Foundations and Applications, Bikhäuser Verlag, Basel·Boston·Berlin, 2005, xiv+228pp., ISBN 3-7643-2198-9, CHF128/EUR78.

This volume is dedicated to the fundamentals of convex functional anal-

ysis. It presents those aspects of functional analysis that are extensively used in various applications to mechanics and control theory.

The purpose of the text is essential two-fold. On the one hand, a bare minimum of the theory required to understand the principles of functional, convex and set-valued analysis is presented. Numerous examples and diagrams provide as intuitive an explanation of the principles as possible. On the other hand, the volume is largely self-contained. Those with a background in graduate mathematics will find a concise summary of all main definitions and theorems.

The contents of this book is the following: *1. Classical Abstract Spaces in Functional Analysis*, *2. Linear Functionals and Linear Operators*, *3. Common Function Spaces in Applications, 4. Differential Calculus in Normed Vector Spaces, 5. Minimization of Functionals, 6. Convex Functionals, 7. Lower Semicontinuous Functionals.* Also, is given a detailed Index and a List of Figures.

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STROOCK, DANIEL, W. – *A Concise Introduction to the Theory of Integration*, (third edition), Bikhäuser, Boston·Basel·Berlin, 1999, xiv+253pp., ISBN 0-8176-4073-8, ISBN 3-7643-4073-8.

Lucrarea pe care o recenzăm reprezintă cea de a treia ediţie a unei cărţi interesante şi bine documentate privind teoria măsurii şi integrării în spaţii euclidiene cu unele elemente de teoria abstractă a măsurii.

Faţă de ediţia a doua, apărută în 1994 la aceeaşi editură, prezenta versiune conţine un capitol în plus, dedicat Analizei Fourier.

Expunerea acestui capitol se bazează pe funcţiile Hermite, care sunt utilizate, în particular, pentru a diagonaliza transformata Fourier şi a obţine apoi identitatea lui Parseval şi aplicaţii.

O altă noutate a acestei ediţii a lucrării o constituie prezentarea, la finele volumului, a soluţiilor tuturor problemelor propuse la sfârşitul fiecărui capitol, ultima parte apărând ca o mini-culegere de probleme.

Cartea se adresează unui public larg, fiind deosebit de utilă, în special, studenţilor din Institutele Economice sau Tehnice care au parcurs deja un curs clasic de Analiză matematică şi care doresc să aprofundeze anumite capitole din teoria integrării.

Modul de abordare a problematicii lucrării este diferit de cel al majorităţii cărţilor cu o asemenea tematică.

A.M. Precupanu

FREEDEN, WILLI; MICHEL, VOLKER – *Multiscale Potential Theory*, With Applications to Geoscience, Applied and numerical harmonic analysis, Birkäuser Boston, Boston-Basel-Berlin, 2004, xvi+509 pp., ISBN 0-8176-4105-X, ISBN 3-7643-4105-X.

The book *Multiscale Potential Theory* represents a self–contained work which can provide a basis for the scientists interested in the areas related to multiscale (geo) potential theory. The models and methods employed show how various large and small–scale processes may be addressed by a single scientific modelling framework for potential determination. The general purpose of this approach is to gain a much more precise and detailed description of the Earth's gravitational field from terrestrial, airborne and spaceborne data. The work comprises two main parts: Part I treats well–posed boundary–value problems of potential theory and elasticity; Part II examines ill–posed problems of satellite technology. This book presents a mathematical demonstration of how Runge–Walsh type solutions in potential theory can be formulated as multiscale representations that are both accurate and tractable in computation. Also, harmonic wavelets methods are used to solve the gravimetry problem.

Multiscale Potential Theory can be used as a reference book by graduate students and researchers in the fields of geomathematics, applied mathematics and geophysics.

M. Bîrsan

ISRAEL, GIORGIO; GASCA, ANA MILLÁN – *The Biology of Numbers*, The correspondence of Vito Volterra on Mathematical Biology, Birkhäuser Verlag, Basel-Boston-Berlin, 2002, x+405 pp., ISBN 3-7643-6514-5.

The Italian Mathematician Vito Volterra played a decisive role in the development of mathematical biology Volterra's interest in the application of mathematics in biology dates back to the turn of the century and was expressed in his inaugural address at the University of Rome for the academic year 1900/1901. However, it was only the mid-twenties that Volterra started to work in this field, at the instigation of his son in law, Umberto D'Ancona. From that time on, until his death in 1940, Volterra produced a large number of papers devoted to this subject.

Volterra's approach consists on transferring the model and the concepts of classical mechanics to biology.

The present book provides an exhaustive collection of the correspondence between Volterra and many other scientists on the topic of mathematical biology. The correspondence is based on Vito-Volterra Archive conserved at the Academia Nazionale dei Lincei. The correspondence involves important researcher, such as R.N. Chapman, U. D'Ancona, V.A. Kostitzin, A.J. Lotka, D.W. Thompson. The letters allow an accurate reconstruction to be made of the genesis of Volterra's work.

This material is very useful to biologists, biomathematicians, as well for science historians.

S. Aniţa

OMRI, RAND; VLADIMIR, ROVENSKI - *Analytical Methods in Anisotropic Elasticity: with Symbolic Computational Tools*, Birkhäuser, Boston 2005, vii+451pp+CD-ROM, ISBN 0–8176–4272–2.

This book brings together and refreshes the fundamentals of anisotropic elasticity and reviews various mathematical tools and analytical solution trails that are encountered in this area. It presents a collection of classical and advanced problems in anisotropic elasticity that encompasses various two–dimensional problems and different types of three–dimensional beam models. It is well recognized that analytical solutions should be applied to relatively simple problems, while numerical techniques may handle more complex cases. However, it is also agreed that analytical solutions provide better insight and improved understanding of the involved physical phenomena and enable a clear representation of the role taken by each of the problem parameters. Nowdays, the analytical and numerical methods are considered as complementary. While the analytical methods provide the required understanding, the numerical solutions provide accuracy and the capability to deal with cases where the geometry and other characteristics impose relatively complex solutions. In this connection, the present book includes models of various mathematical complexity and physical accuracy levels, and provides the theoretical background for composite material analysis. All classic and modern analytic solutions are derived using symbolic computational techniques.

The book contain eleven chapters, an index and a bibliography with many references to the anisotropic problems and a CD–ROM. The first three chapters address fundamental issues of anisotropic elasticity and analytical methodologies, the mathematical representation of general anisotropic materials (including the special cases of monoclinic, orthotropic, tetragonal, transversely isotropic, cubic and isotropic materials) and the two–dimensional deformation problems. Chapter 4 presents various solution

methodologies for the boundary value problems of plane deformations. The next three chapters are concerned with the basic aspects and general definitions of anisotropic beam analysis, including the classical Lekhnitskii formulation and a closed–form formulation for uncoupled monoclinic homogeneous beams. Chapter 8 is focused on problems in various non–homogeneous domains, while chapter 9 discusses coupled solid monoclinic beams and presents an exact, level–based solution scheme for coupled beam behaviour. Finally, the chapter 10 handles coupled thin–wall monoclinic beams with either multiply connected domain or simply connected domain cross–sections. The chapter 11 present instructions for the symbolic and illustrative programs included in this book.

The book is aimed at graduate and senior undergraduate students, professors, engineers, applied mathematicians, numerical analysis experts, mechanics researchers and composite materials scientists.

S. Chiriţă