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22nd International Workshop in Operator Theory and its Applications, Sevilla, July 2011

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edited by

BROOKLYN NATALEE

Function Spaces Springer Science & Business Media
Spectral Problems Associated with Corner Singularities of Solutions to Elliptic EquationsAmerican Mathematical Soc.
Nonlinear Elliptic and Parabolic Problems American Mathematical Soc.
This book considers dynamic boundary value problems in domains with singularities of two types. The first type consists of "edges" of various dimensions on the boundary; in particular, polygons, cones, lenses, polyhedra are domains of this type. Singularities of the second type are "singularly perturbed edges" such as smoothed corners and edges and small holes. A domain with singularities of such type depends on a small parameter, whereas the boundary of the limit domain (as the parameter tends to zero) has usual edges, i.e. singularities of the first type. In the transition from the limit domain to the perturbed one, the boundary near a conical point or an edge becomes smooth, isolated singular points become small cavities, and so on. In an "irregular" domain with such singularities, problems of elastodynamics, electrodynamics and some other dynamic problems are discussed. The purpose is to describe the asymptotics of solutions near singularities of the boundary. The presented results and methods have a wide range of applications in mathematical physics and engineering.

The book is addressed to specialists in mathematical physics, partial differential equations, and asymptotic methods. American Mathematical Soc.
Many phenomena in engineering and mathematical physics can be modeled by means of boundary value problems for a certain elliptic differential operator in a given domain. When the differential operator under discussion is of second order a variety of tools are available for dealing with such problems, including boundary integral methods, variational methods, harmonic measure techniques, and methods based on classical harmonic analysis. When the differential operator is of higher-order (as is the case, e.g., with anisotropic plate bending when one deals with a fourth order operator) only a few options could be successfully implemented. In the 1970s Alberto Calderón, one of the founders of the modern theory of Singular Integral Operators, advocated the use of layer potentials for the treatment of higher-order elliptic boundary value problems. The present monograph represents the first systematic treatment based on this approach. This research monograph lays, for the first time, the mathematical foundation aimed at solving boundary value problems for higher-order elliptic operators in non-smooth domains using the layer potential method and addresses a comprehensive range of topics, dealing with elliptic boundary value problems in non-smooth domains including layer potentials, jump relations, non-tangential maximal function estimates, multi-traces and

extensions, boundary value problems with data in Whitney–Lebesque spaces, Whitney–Besov spaces, Whitney–Sobolev- based Lebesgue spaces, Whitney–Triebel–Lizorkin spaces,Whitney–Sobolev-based Hardy spaces, Whitney–BMO and Whitney–VMO spaces.

Complex Analysis and Dynamical Systems V Springer Science & Business Media

Brownian dynamics serve as mathematical models for the diffusive motion of microscopic particles of various shapes in gaseous, liquid, or solid environments. The renewed interest in Brownian dynamics is due primarily to their key role in molecular and cellular biophysics: diffusion of ions and molecules is the driver of all life. Brownian dynamics simulations are the numerical realizations of stochastic differential equations that model the functions of biological micro devices such as protein ionic channels of biological membranes, cardiac myocytes, neuronal synapses, and many more. Stochastic differential equations are ubiquitous models in computational physics, chemistry, biophysics, computer science, communications theory, mathematical finance theory, and many other disciplines. Brownian dynamics simulations of the random motion of particles, be it molecules or stock prices, give rise to mathematical problems that neither the kinetic theory of Maxwell and Boltzmann, nor Einstein's and Langevin's theories of Brownian motion could predict. This book takes the readers on a

journey that starts with the rigorous definition of mathematical Brownian motion, and ends with the explicit solution of a series of complex problems that have immediate applications. It is aimed at applied mathematicians, physicists, theoretical chemists, and physiologists who are interested in modeling, analysis, and simulation of micro devices of microbiology. The book contains exercises and worked out examples throughout.

Recurrence Sequences Springer Handbook of Numerical Methods for Hyperbolic Problems explores the changes that have taken place in the past few decades regarding literature in the design, analysis and application of various numerical algorithms for solving hyperbolic equations. This volume provides concise summaries from experts in different types of algorithms, so that readers can find a variety of algorithms under different situations and readily understand their relative advantages and limitations.

Elliptic Equations in Polyhedral Domains

Spectral Problems Associated with Corner Singularities of Solutions to Elliptic Equations

Subriemannian geometries can be viewed as limits of Riemannian geometries. They arise naturally in many areas of pure (algebra, geometry, analysis) and applied (mechanics, control theory, mathematical physics) mathematics, as well as in applications (e.g., robotics). This book is devoted to

the study of subriemannian geometries, their geodesics, and their applications. It starts with the simplest nontrivial example of a subriemannian geometry: the two-dimensional isoperimetric problem reformulated as a problem of finding subriemannian geodesics. Among topics discussed in other chapters of the first part of the book are an elementary exposition of Gromov's idea to use subriemannian geometry for proving a theorem in discrete group theory and Cartan's method of equivalence applied to the problem of understanding invariants of distributions. The second part of the book is devoted to applications of subriemannian geometry. In particular, the author describes in detail Berry's phase in quantum mechanics, the problem of a falling cat righting herself, that of a microorganism swimming, and a phase problem arising in the N-body problem. He shows that all these problems can be studied using the same underlying type of subriemannian geometry. The reader is assumed to have an introductory knowledge of differential geometry. This book that also has a chapter devoted to open problems can serve as a good introduction to this new, exciting area of mathematics.

Computational Mechanics American Mathematical Soc.

This book collects many of the presented papers, as plenary presentations, mini-symposia invited presentations, or contributed talks, from the European Conference on Numerical Mathematics and Advanced Applications (ENUMATH)

2017. The conference was organized by the University of Bergen, Norway from September 25 to 29, 2017. Leading experts in the field presented the latest results and ideas in the designing, implementation, and analysis of numerical algorithms as well as their applications to relevant, societal problems. ENUMATH is a series of conferences held every two years to provide a forum for discussing basic aspects and new trends in numerical mathematics and scientific and industrial applications. These discussions are upheld at the highest level of international expertise. The first ENUMATH conference was held in Paris in 1995 with successive conferences being held at various locations across Europe, including Heidelberg (1997), Jyvaskyla (1999), Ischia Porto (2001), Prague (2003), Santiago de Compostela (2005), Graz (2007), Uppsala (2009), Leicester (2011), Lausanne (2013), and Ankara (2015).

Asymptotic Formulae in Spectral Geometry CRC Press

This book gives a state of the art approach to the study of polynomial identities satisfied by a given algebra by combining methods of ring theory, combinatorics, and representation theory of groups with analysis. The idea of applying analytical methods to the theory of polynomial identities appeared in the early 1970s and this approach has become one of the most powerful tools of the theory. A PI-algebra is any algebra satisfying at least one nontrivial polynomial identity.This includes the

polynomial rings in one or several variables, the Grassmann algebra, finite-dimensional algebras, and many other algebras occurring naturally in mathematics. The core of the book is the proof that the sequence of co dimensions of any PI-algebra has integral exponential growth - the PI-exponent of the algebra. Later chapters further apply these results to subjects such as a characterization of varieties of algebras having polynomial growth and a classification of varieties that are minimal for a given exponent. Results are extended to graded algebras and algebras with involution. The book concludes with a study of the numerical invariants and their asymptotics in the class of Lie algebras. Even in algebras that are close to being associative, the behavior of the sequences of co dimensions can be wild. The material is suitable for graduate students and research mathematicians interested in polynomial identity algebras.

Crack Theory and Edge Singularities

Springer

Around 1980, G. Mason announced the classification of a certain subclass of an important class of finite simple groups known as ``quasithin groups''. The classification of the finite simple groups depends upon a proof that there are no unexpected groups in this subclass. Unfortunately Mason neither completed nor published his work. In the Main Theorem of this two-part book (Volumes 111 and 112 of the AMS Mathematical Surveys and Monographs series) the authors provide a proof of a stronger

theorem classifying a larger class of groups, which is independent of Mason's arguments. In particular, this allows the authors to close this last remaining gap in the proof of the classification of all finite simple groups. An important corollary of the Main Theorem provides a bridge to the program of Gorenstein, Lyons, and Solomon (AMS Mathematical Surveys and Monographs, Volume 40) which seeks to give a new, simplified proof of the classification of the finite simple groups. Part II of the work (this volume) contains the proof of the Main Theorem, and the proof of the corollary classifying quasithin groups of even type. Part I (Volume 111) contains results which are used in the proof of the Main Theorem. Some of the results are known and fairly general, but their proofs are scattered throughout the literature; others are more specialized and are proved here for the first time.

Concrete Operators, Spectral Theory, Operators in Harmonic Analysis and Approximation

American Mathematical Society(RI)
This textbook focuses on the abstract aspects of topological dynamics and ergodic theory, and presents several examples of the joining technique. The author covers dynamical systems on Lebesgue spaces, the Koopman representation, isometric and weakly mixing extensions, the Furstenberg-Zimmer structure theorem, and the entropy theory for Z-systems. Annotation (c)2003 Book News, Inc., Portland, OR (booknews.com).

The Classification of Quasithin Groups Springer Nature
This book contains a collection of research articles and surveys on recent developments on operator theory as well as its applications covered in the IWOTA 2011 conference held at Sevilla University in the summer of 2011. The topics include spectral theory, differential operators, integral operators, composition operators, Toeplitz operators, and more. The book also presents a large number of techniques in operator theory.
Finite Element Error Analysis for PDE-constrained Optimal Control Problems Springer Science & Business Media
Mixed, transmission, or crack problems belong to the analysis of boundary value problems on manifolds with singularities. The Zaremba problem with a jump between Dirichlet and Neumann conditions along an interface on the boundary is a classical example. The central theme of this book is to study mixed problems in standard Sobolev spaces as well as in weighted edge spaces where the interfaces are interpreted as edges. Parametrices and regularity of solutions are obtained within a systematic calculus of boundary value problems on manifolds with conical or edge singularities. This calculus allows singularities on the interface and homotopies between mixed and crack problems. Additional edge conditions are computed in terms of relative index results. In a detailed final chapter, the intuitive ideas of the approach are illustrated, and there is a

discussion of future challenges. A special feature of the text is the inclusion of many worked-out examples which help the reader to appreciate the scope of the theory and to treat new cases of practical interest. This book is addressed to mathematicians and physicists interested in models with singularities, associated boundary value problems, and their solvability strategies based on pseudo-differential operators. The material is also useful for students in higher semesters and young researchers, as well as for experienced specialists working in analysis on manifolds with geometric singularities, the applications of index theory and spectral theory, operator algebras with symbolic structures, quantisation, and asymptotic analysis.

Sturm-Liouville Theory American Mathematical Soc.

This book provides a representative selection of the most relevant, innovative, and useful mathematical methods and models applied to the analysis and characterization of composites and their behaviour on micro-, meso-, and macroscale. It establishes the fundamentals for meaningful and accurate theoretical and computer modelling of these materials in the future. Although the book is primarily concerned with fibre-reinforced composites, which have ever-increasing applications in fields such as aerospace, many of the results presented can be applied to other kinds of composites. The topics covered include: scaling and homogenization procedures in composite

structures, thin plate and wave solutions in anisotropic materials, laminated structures, instabilities, fracture and damage analysis of composites, and highly efficient methods for simulation of composites manufacturing. The results presented are useful in the design, fabrication, testing, and industrial applications of composite components and structures. The book is written by well-known experts in different areas of applied mathematics, physics, and composite engineering and is an essential source of reference for graduate and doctoral students, as well as researchers. It is also suitable for non-experts in composites who wish to have an overview of both the mathematical methods and models used in this area and the related open problems requiring further research.

With Applications in Modeling and Numerical Approximations Springer Science & Business Media

This text focuses on the analysis of eigenvalues and eigenfunctions that describe singularities of solutions to elliptic boundary value problems in domains with corners and edges. The authors treat both classical problems of mathematical physics and general elliptic boundary value problems. The volume is divided into two parts: The first is devoted to the power-logarithmic singularities of solutions to classical boundary value problems of mathematical physics. The second deals with similar singularities for higher order elliptic equations and systems. Chapter 1 collects basic facts concerning

operator pencils acting in a pair of Hilbert spaces. Related properties of ordinary differential equations with constant operator coefficients are discussed and connections with the theory of general elliptic boundary value problems in domains with conic vertices are outlined. New results are presented. Chapter 2 treats the Laplace operator as a starting point and a model for the subsequent study of angular and conic singularities of solutions. Chapter 3 considers the Dirichlet boundary condition beginning with the plane case and turning to the space problems.
Special Volume American Mathematical Soc.
From the series that publishes some of the AMS's most distingushed titles, this book stands alone in its class. The authors present a good, detailed introduction to a topic that serves as a standard tool in algebraic topology. It works well as an independent study resource for both students and researchers. A must for bookstores.

Brownian Dynamics at Boundaries and Interfaces

American Mathematical Soc.
Subject of this work is the analysis of numerical methods for the solution of optimal control problems governed by elliptic partial differential equations. Such problems arise, if one does not only want to simulate technical or physical processes but also wants to optimize them with the help of one or more influence variables. In many practical applications these influence variables, so

called controls, cannot be chosen arbitrarily, but have to fulfill certain inequality constraints. The numerical treatment of such control constrained optimal control problems requires a discretization of the underlying infinite dimensional function spaces. To guarantee the quality of the numerical solution one has to estimate and to quantify the resulting approximation errors. In this thesis a priori error estimates for finite element discretizations are proved in case of corners or edges in the underlying domain and nonsmooth coefficients in the partial differential equation. These facts influence the regularity properties of the solution and require adapted meshes to get optimal convergence rates. Isotropic and anisotropic refinement strategies are given and error estimates in polygonal and prismatic domains are proved. The theoretical results are confirmed by numerical tests.

A Special Tribute to the Work of Herbert Amann Springer Science & Business Media

The questions that have been at the center of invariant theory since the 19th century have revolved around the following themes: finiteness, computation, and special classes of invariants. This book begins with a survey of many concrete examples chosen from these themes in the algebraic, homological, and combinatorial context. In further chapters, the authors pick one or the other of these questions as a departure

point and present the known answers, open problems, and methods andtools needed to obtain these answers. Chapter 2 deals with algebraic finiteness. Chapter 3 deals with combinatorial finiteness. Chapter 4 presents Noetherian finiteness. Chapter 5 addresses homological finiteness. Chapter 6 presents special classes of invariants, which deal with modular invarianttheory and its particular problems and features. Chapter 7 collects results for special classes of invariants and coinvariants such as (pseudo) reflection groups and representations of low degree. If the ground field is finite, ad The book contains numerous examples to illustrate the theory, often of more than passing interest, and an appendix on commutative graded algebra, which provides some of the required basic background. There is an extensive reference list to provide the reader withorientation to the vast literature.

Arithmetic Differential Equations

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This book gives a self-contained and up-to-date account of mathematical results in the linear theory of water waves. The study of waves has many applications, including the prediction of behavior of floating bodies (ships, submarines, tension-leg platforms etc.), the calculation of wave-making resistance in naval architecture, and the description of wave patterns over bottom topography in geophysical

hydrodynamics. The first section deals with time-harmonic waves. Three linear boundary value problems serve as the approximate mathematical models for these types of water waves. The next section uses a plethora of mathematical techniques in the investigation of these three problems. The techniques used in the book include integral equations based on Green's functions, various inequalities between the kinetic and potential energy and integral identities which are indispensable for proving the uniqueness theorems. The so-called inverse procedure is applied to constructing examples of non-uniqueness, usually referred to as 'trapped nodes.'

Spectral Problems Associated with Corner Singularities of Solutions to Elliptic Equations American Mathematical Soc.

This research monograph develops an arithmetic analogue of the theory of ordinary differential equations: functions are replaced here by integer numbers, the derivative operator is replaced by a ``Fermat quotient operator'', and differential equations (viewed as functions on jet spaces) are replaced by ``arithmetic differential equations''. The main application of this theory concerns the construction and study of quotients of algebraic curves by correspondences with infinite orbits. Any such quotient reduces to a point in usual algebraic geometry. But many quotients as above cease to be trivial (and become quite interesting) if one enlarges algebraic geometry by using arithmetic differential

equations in place of algebraic equations. The book partly follows a series of papers written by the author; however, a substantial part of the material presented here has never been published before. For most of the book the only prerequisites are the basic facts of algebraic geometry and number theory.

22nd International Workshop in Operator Theory and its Applications, Sevilla, July 2011 American Mathematical Soc.

The authors study the relationship between foliation theory and differential geometry and analysis on Cauchy-Riemann (CR) manifolds. The main objects of study are transversally and tangentially CR foliations, Levi foliations of CR manifolds, solutions of the Yang-Mills equations, tangentially Monge-Ampere foliations, the transverse Beltrami equations, and CR orbifolds. The novelty of the authors' approach consists in the overall use of the methods of foliation theory and choice of specific applications. Examples of such applications are Rea's holomorphic extension of Levi foliations, Stanton's holomorphic degeneracy, Boas and Straube's approximately commuting vector fields method for the study of global regularity of Neumann operators and Bergman projections in multi-dimensional complex analysis in several complex variables, as well as various applications to differential geometry. Many open problems proposed in the monograph may attract the mathematical community and lead to further applications of

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