

International Mathematical Series

NONLINEAR PROBLEMS IN MATHEMATICAL PHYSICS AND RELATED TOPICS II

In Honor of Professor O. A. Ladyzhenskaya



Edited by

Michael Sh. Birman, Stefan Hildebrandt,
Vsevolod A. Solonnikov, and Nina N. Uraltseva

Nonlinear Problems In Mathematical Physics And Related Topics

Vladimir Maz'ya



Nonlinear Problems In Mathematical Physics And Related Topics:

Nonlinear Problems in Mathematical Physics and Related Topics I Michael Sh. Birman, Stefan Hildebrandt, Vsevolod A. Solonnikov, Nina N. Uraltseva, 2012-12-06 The new series International Mathematical Series founded by Kluwer Plenum Publishers and the Russian publisher Tamara Rozhkovskaya is published simultaneously in English and in Russian and starts with two volumes dedicated to the famous Russian mathematician Professor Olga Aleksandrovna Ladyzhenskaya on the occasion of her 80th birthday O A Ladyzhenskaya graduated from the Moscow State University But throughout her career she has been closely connected with St Petersburg where she works at the V A Steklov Mathematical Institute of the Russian Academy of Sciences Many generations of mathematicians have become familiar with the nonlinear theory of partial differential equations reading the books on quasilinear elliptic and parabolic equations written by O A Ladyzhenskaya with V A Solonnikov and N N Uraltseva Her results and methods on the Navier Stokes equations and other mathematical problems in the theory of viscous fluids nonlinear partial differential equations and systems the regularity theory some directions of computational analysis are well known So it is no surprise that these two volumes attracted leading specialists in partial differential equations and mathematical physics from more than 15 countries who present their new results in the various fields of mathematics in which the results methods and ideas of O A Ladyzhenskaya played a fundamental role Nonlinear Problems in Mathematical Physics and Related Topics I presents new results from distinguished specialists in the theory of partial differential equations and analysis A large part of the material is devoted to the Navier Stokes equations which play an important role in the theory of viscous fluids In particular the existence of a local strong solution in the sense of Ladyzhenskaya to the problem describing some special motion in a Navier Stokes fluid is established Ladyzhenskaya's results on axially symmetric solutions to the Navier Stokes fluid are generalized and solutions with fast decay of nonstationary Navier Stokes equations in the half space are stated Application of the Fourier analysis to the study of the Stokes wave problem and some interesting properties of the Stokes problem are presented The nonstationary Stokes problem is also investigated in nonconvex domains and some L_p estimates for the first order derivatives of solutions are obtained New results in the theory of fully nonlinear equations are presented Some asymptotics are derived for elliptic operators with strongly degenerated symbols New results are also presented for variational problems connected with phase transitions of means in controllable dynamical systems nonlocal problems for quasilinear parabolic equations elliptic variational problems with nonstandard growth and some sufficient conditions for the regularity of lateral boundary Additionally new results are presented on area formulas estimates for eigenvalues in the case of the weighted Laplacian on Metric graph application of the direct Lyapunov method in continuum mechanics singular perturbation property of capillary surfaces partially free boundary problem for parametric double integrals

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Ladyzhenskaya obtained her most influential results One of the main topics considered is the set of Navier Stokes equations and their solutions

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Birman,Stefan Hildebrandt,Vsevolod A. Solonnikov,Nina N. Uraltseva,2014-01-14 The main topics reflect the fields of mathematics in which Professor O A Ladyzhenskaya obtained her most influential results One of the main topics considered in the volume is the Navier Stokes equations This subject is investigated in many different directions In particular the existence and uniqueness results are obtained for the Navier Stokes equations in spaces of low regularity A sufficient condition for the regularity of solutions to the evolution Navier Stokes equations in the three dimensional case is derived and the stabilization of a solution to the Navier Stokes equations to the steady state solution and the realization of stabilization by a feedback boundary control are discussed in detail Connections between the regularity problem for the Navier Stokes equations and a backward uniqueness problem for the heat operator are also clarified Generalizations and modified Navier Stokes equations modeling various physical phenomena such as the mixture of fluids and isotropic turbulence are also considered Numerical results for the Navier Stokes equations as well as for the porous medium equation and the heat equation obtained by the diffusion velocity method are illustrated by computer graphs Some other models describing various processes in continuum mechanics are studied from the mathematical point of view In particular a structure theorem for divergence free vector fields in the plane for a problem arising in a micromagnetics model is proved The absolute continuity of the spectrum of the elasticity operator appearing in a problem for an isotropic periodic elastic medium with constant shear modulus the Hill body is established Time discretization problems for generalized Newtonian fluids are discussed the unique solvability of the initial value problem for the inelastic homogeneous Boltzmann equation for hard spheres with a diffusive term representing a random background acceleration is proved and some qualitative properties of the solution are studied An approach to mathematical statements based on the Maxwell model and illustrated by the Lavrent ev problem on the wave formation caused by explosion welding is presented The global existence and uniqueness of a solution to the initial boundary value problem for the equations arising in the modelling of the tension driven Marangoni convection and the existence of a minimal global attractor are established The existence results regularity properties and pointwise estimates for solutions to the Cauchy problem for linear and nonlinear Kolmogorov type operators arising in diffusion theory probability and finance are proved The existence of minimizers for the energy functional in the Skyrme model for the low energy interaction of pions which describes elementary particles as spatially localized solutions of nonlinear partial differential equations is also proved Several papers are devoted to the study of nonlinear elliptic and parabolic operators Versions of the mean value theorems and Harnack inequalities are studied for the heat equation and connections with the so called growth theorems for more general second order elliptic and parabolic equations in the divergence or nondivergence form are investigated Additionally

qualitative properties of viscosity solutions of fully nonlinear partial differential inequalities of elliptic and degenerate elliptic type are clarified Some uniqueness results for identification of quasilinear elliptic and parabolic equations are presented and the existence of smooth solutions of a class of Hessian equations on a compact Riemannian manifold without imposing any curvature restrictions on the manifold is established

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Arnold's Problems Vladimir I. Arnold, 2004-06-24 Vladimir Arnold is one of the most outstanding mathematicians of our

time Many of these problems are at the front line of current research **Rectifiability** Pertti Mattila,2023-01-12 Rectifiable sets measures currents and varifolds are foundational concepts in geometric measure theory The last four decades have seen the emergence of a wealth of connections between rectifiability and other areas of analysis and geometry including deep links with the calculus of variations and complex and harmonic analysis This short book provides an easily digestible overview of this wide and active field including discussions of historical background the basic theory in Euclidean and non Euclidean settings and the appearance of rectifiability in analysis and geometry The author avoids complicated technical arguments and long proofs instead giving the reader a flavour of each of the topics in turn while providing full references to the wider literature in an extensive bibliography It is a perfect introduction to the area for researchers and graduate students who will find much inspiration for their own research inside

Analysis and Numerics of Partial Differential Equations Franco Brezzi,Piero Colli Franzone,Ugo Pietro Gianazza,Gianni Gilardi,2012-12-22 This volume is a selection of contributions offered by friends collaborators past students in memory of Enrico Magenes The first part gives a wide historical perspective of Magenes work in his 50 year mathematical career the second part contains original research papers and shows how ideas methods and techniques introduced by Magenes and his collaborators still have an impact on the current research in

Mathematics Mathematics of Complexity and Dynamical Systems Robert A. Meyers,2011-10-05 Mathematics of Complexity and Dynamical Systems is an authoritative reference to the basic tools and concepts of complexity systems theory and dynamical systems from the perspective of pure and applied mathematics Complex systems are systems that comprise many interacting parts with the ability to generate a new quality of collective behavior through self organization e g the spontaneous formation of temporal spatial or functional structures These systems are often characterized by extreme sensitivity to initial conditions as well as emergent behavior that are not readily predictable or even completely deterministic The more than 100 entries in this wide ranging single source work provide a comprehensive explication of the theory and applications of mathematical complexity covering ergodic theory fractals and multifractals dynamical systems perturbation theory solitons systems and control theory and related topics Mathematics of Complexity and Dynamical Systems is an essential reference for all those interested in mathematical complexity from undergraduate and graduate students up through professional researchers **Convex Variational Problems with Linear, Nearly Linear And/or Anisotropic**

Growth Conditions Michael Bildhauer,2003-06-20 The author emphasizes a non uniform ellipticity condition as the main approach to regularity theory for solutions of convex variational problems with different types of non standard growth conditions This volume first focuses on elliptic variational problems with linear growth conditions Here the notion of a solution is not obvious and the point of view has to be changed several times in order to get some deeper insight Then the smoothness properties of solutions to convex anisotropic variational problems with superlinear growth are studied In spite of the fundamental differences a non uniform ellipticity condition serves as the main tool towards a unified view of the

regularity theory for both kinds of problems **Hormander Operators** Marco Bramanti, Luca Brandolini, 2022-10-21 Hormander operators are a class of linear second order partial differential operators with nonnegative characteristic form and smooth coefficients which are usually degenerate elliptic parabolic but nevertheless hypoelliptic that is highly regularizing The study of these operators began with the 1967 fundamental paper by Lars Hormander and is intimately connected to the geometry of vector fields Motivations for the study of Hormander operators come for instance from Kolmogorov Fokker Planck equations arising from modeling physical systems governed by stochastic equations and the geometric theory of several complex variables The aim of this book is to give a systematic exposition of a relevant part of the theory of Hormander operators and vector fields together with the necessary background and prerequisites The book is intended for self study or as a reference book and can be useful to both younger and senior researchers already working in this area or aiming to approach it **Lectures on Navier-Stokes Equations** Tai-Peng Tsai, 2018-08-09 This book is a graduate text on the incompressible Navier Stokes system which is of fundamental importance in mathematical fluid mechanics as well as in engineering applications The goal is to give a rapid exposition on the existence uniqueness and regularity of its solutions with a focus on the regularity problem To fit into a one year course for students who have already mastered the basics of PDE theory many auxiliary results have been described with references but without proofs and several topics were omitted Most chapters end with a selection of problems for the reader After an introduction and a careful study of weak strong and mild solutions the reader is introduced to partial regularity The coverage of boundary value problems self similar solutions the uniform L^3 class including the celebrated Escauriaza Seregin ver k Theorem and axisymmetric flows in later chapters are unique features of this book that are less explored in other texts The book can serve as a textbook for a course as a self study source for people who already know some PDE theory and wish to learn more about Navier Stokes equations or as a reference for some of the important recent developments in the area *Spectral Theory of Differential Operators* T. Suslina, 2008-01-01 Translations of articles on mathematics appearing in various Russian mathematical serials *Sobolev Spaces in Mathematics II* Vladimir Maz'ya, 2008-11-26 Sobolev spaces become the established and universal language of partial differential equations and mathematical analysis Among a huge variety of problems where Sobolev spaces are used the following important topics are the focus of this volume boundary value problems in domains with singularities higher order partial differential equations local polynomial approximations inequalities in Sobolev Lorentz spaces function spaces in cellular domains the spectrum of a Schrodinger operator with negative potential and other spectral problems criteria for the complete integration of systems of differential equations with applications to differential geometry some aspects of differential forms on Riemannian manifolds related to Sobolev inequalities Brownian motion on a Cartan Hadamard manifold etc Two short biographical articles on the works of Sobolev in the 1930s and the foundation of Akademgorodok in Siberia supplied with unique archive photos of S Sobolev are included **Mathematical Results In Quantum Mechanics -**

Proceedings Of The Qmath10 Conference Radu Purice, Ingrid Beltita, Gheorghe Nenciu, 2008-08-11 The 10th Quantum Mathematics International Conference Qmath10 gave an opportunity to bring together specialists interested in that part of mathematical physics which is in close connection with various aspects of quantum theory It was also meant to introduce young scientists and new tendencies in the field This collection of carefully selected papers aims to reflect recent techniques and results on Schrödinger operators with magnetic fields random Schrödinger operators condensed matter and open systems pseudo differential operators and semiclassical analysis quantum field theory and relativistic quantum mechanics quantum information and much more The book serves as a concise and well documented tool for the more experienced scientists as well as a research guide for postgraduate students

Instability in Models Connected with Fluid Flows II Claude Bardos, Andrei V. Fursikov, 2007-12-20 This is a unique collection of papers all written by leading specialists that presents the most recent results and advances in stability theory as it relates to fluid flows The stability property is of great interest for researchers in many fields including mathematical analysis theory of partial differential equations optimal control numerical analysis and fluid mechanics This text will be essential reading for many researchers working in these fields

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