Ricardo Weder

Spectral and Scattering Theory for Wave Propagation in Perturbed Stratified Media

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Gregoire Allaire

Spectral And Scattering Theory For Wave Propagation In Perturbed Stratified Media:

   Spectral and Scattering Theory for Wave Propagation in Perturbed Stratified Media Ricardo Weder,1990-12-14 The propagation of acoustic and electromagnetic waves in stratified media is a subject that has profound implications in many areas of applied physics and in engineering just to mention a few in ocean acoustics integrated optics and wave guides See for example Tolstoy and Clay 1966 Marcuse 1974 and Brekhovskikh 1980 As is well known stratified media that is to say media whose physical properties depend on a single coordinate can produce guided waves that propagate in directions orthogonal to that of stratification in addition to the free waves that propagate as in homogeneous media When the stratified media are perturbed that is to say when locally the physical properties of the media depend upon all of the coordinates the free and guided waves are no longer solutions to the appropriate wave equations and this leads to a rich pattern of wave propagation that involves the scattering of the free and guided waves among each other and with the perturbation These phenomena have many implications in applied physics and engineering such as in the transmission and reflexion of guided waves by the perturbation interference between guided waves and energy losses in open wave guides due to radiation The subject matter of this monograph is the study of these phenomena   Spectral and Scattering Theory for Wave Propagation in Perturbed Stratified Media Anne Boutet de Monvel-Berthier,Dragos Manda,1993   Mathematical Scattering Theory Dmitri_ Rauel_evich I_Afaev,2010-03-10 The main subject of this book is applications of methods of scattering theory to differential operators primarily the Schrodinger operator There are two different trends in scattering theory for differential operators The first one relies on the abstract scattering theory The second one is almost independent of it In this approach the abstract theory is replaced by a concrete investigation of the corresponding differential equation In this book both of these trends are presented The first half of this book begins with the summary of the main results of the general scattering theory of the previous book by the author Mathematical Scattering Theory General Theory American Mathematical Society 1992 The next three chapters illustrate basic theorems of abstract scattering theory presenting in particular their applications to scattering theory of perturbations of differential operators with constant coefficients and to the analysis of the trace class method In the second half of the book direct methods of scattering theory for differential operators are presented After considering the one dimensional case the author returns to the multi dimensional problem and discusses various analytical methods and tools appropriate for the analysis of differential operators including among others high and low energy asymptotics of the Green function the scattering matrix ray and eikonal expansions The book is based on graduate courses taught by the author at Saint Petersburg Russia and Rennes France Universities and is oriented towards a reader interested in studying deep aspects of scattering theory for example a graduate student in mathematical physics
   Acoustic and Electromagnetic Equations Jean-Claude Nedelec,2013-06-29 This book is devoted to the study of the acoustic wave equation and of the Maxwell system the two most common wave equations encountered in physics or in

engineering The main goal is to present a detailed analysis of their mathematical and physical properties Wave equations are time dependent However use of the Fourier trans form reduces their study to that of harmonic systems the harmonic Helmholtz equation in the case of the acoustic equation or the har monic Maxwell system This book concentrates on the study of these harmonic problems which are a first step toward the study of more general time dependent problems In each case we give a mathematical setting that allows us to prove existence and uniqueness theorems We have systematically chosen the use of variational formulations related to considerations of physical energy We study the integral representations of the solutions These representa tions yield several integral equations We analyze their essential properties We introduce variational formulations for these integral equations which are the basis of most numerical approximations Different parts of this book were taught for at least ten years by the author at the post graduate level at Ecole Poly technique and the University of Paris 6 to students in applied mathematics The actual presentation has been tested on them I wish to thank them for their active and constructive participation which has been extremely useful and I apologize for forcing them to learn some geometry of surfaces **Analysis and Simulation of Chaotic Systems** Frank C. Hoppensteadt,2013-03-09 Analysis and Simulation of Chaotic Systems is a text designed to be used at the graduate level in applied mathematics for students from mathematics engineering physics chemistry and biology The book can be used as a stand alone text for a full year course or it can be heavily supplemented with material of more mathematical more engineering or more scientific nature Computations and computer simulations are used throughout this text to illustrate phenomena discussed and to supply readers with probes to use on new problems **Piecewise-smooth Dynamical Systems** Mario Bernardo,Chris Budd,Alan Richard Champneys,Piotr Kowalczyk,2008-01-01 This book presents a coherent framework for understanding the dynamics of piecewise smooth and hybrid systems An informal introduction expounds the ubiquity of such models via numerous The results are presented in an informal style and illustrated with many examples The book is aimed at a wide audience of applied mathematicians engineers and scientists at the beginning postgraduate level Almost no mathematical background is assumed other than basic calculus and algebra **Direct Methods in the Calculus of Variations** Bernard Dacorogna,2007-11-21 This book is developed for the study of vectorial problems in the calculus of variations The subject is a very active one and almost half of the book consists of new material This is a new edition of the earlier book published in 1989 and it is suitable for graduate students The book has been updated with some new material and examples added Applications are included *Averaging Methods in Nonlinear Dynamical Systems* Jan A. Sanders,Ferdinand Verhulst,James Murdock,2007-08-18 Perturbation theory and in particular normal form theory has shown strong growth during the last decades So it is not surprising that the authors have presented an extensive revision of the first edition of the Averaging Methods in Nonlinear Dynamical Systems book There are many changes corrections and updates in chapters on Basic Material and Asymptotics Averaging and Attraction Chapters on Periodic Averaging and Hyperbolicity Classical first level

Normal Form Theory Nilpotent classical Normal Form and Higher Level Normal Form Theory are entirely new and represent new insights in averaging in particular its relation with dynamical systems and the theory of normal forms Also new are surveys on invariant manifolds in Appendix C and averaging for PDEs in Appendix E Since the first edition the book has expanded in length and the third author James Murdock has been added Review of First Edition One of the most striking features of the book is the nice collection of examples which range from the very simple to some that are elaborate realistic and of considerable practical importance Most of them are presented in careful detail and are illustrated with profuse illuminating diagrams Mathematical Reviews **Inverse Problems for Partial Differential Equations** Victor Isakov,2013-06-29 This book describes the contemporary state of the theory and some numerical aspects of inverse problems in partial differential equations The topic is of sub stantial and growing interest for many scientists and engineers and accordingly to graduate students in these areas Mathematically these problems are relatively new and quite challenging due to the lack of conventional stability and to nonlinearity and nonconvexity Applications include recovery of inclusions from anomalies of their gravitational fields reconstruction of the interior of the human body from exterior electrical ultrasonic and magnetic measurements recovery of interior structural parameters of detail of machines and of the underground from similar data non destructive evaluation and locating flying or navigated objects from their acoustic or electromagnetic fields Currently there are hundreds of publica tions containing new and interesting results A purpose of the book is to collect and present many of them in a readable and informative form Rigorous proofs are presented whenever they are relatively short and can be demonstrated by quite general mathematical techniques Also we prefer to present results that from our point of view contain fresh and promising ideas In some cases there is no com plete mathematical theory so we give only available results We do not assume that a reader possesses an enormous mathematical technique In fact a moderate knowledge of partial differential equations of the Fourier transform and of basic functional analysis will suffice **Mathematical Problems in Image Processing** Gilles Aubert,Pierre Kornprobst,2006-11-30 Partial differential equations PDEs and variational methods were introduced into image processing about fifteen years ago Since then intensive research has been carried out The goals of this book are to present a variety of image analysis applications the precise mathematics involved and how to discretize them Thus this book is intended for two audiences The first is the mathematical community by showing the contribution of mathematics to this domain It is also the occasion to highlight some unsolved theoretical questions The second is the computer vision community by presenting a clear self contained and global overview of the mathematics involved in image procesing problems This work will serve as a useful source of reference and inspiration for fellow researchers in Applied Mathematics and Computer Vision as well as being a basis for advanced courses within these fields During the four years since the publication of the first edition there has been substantial progress in the range of image processing applications covered by the PDE framework The main goals of the second edition are to update the first edition by

giving a coherent account of some of the recent challenging applications and to update the existing material In addition this book provides the reader with the opportunity to make his own simulations with a minimal effort To this end programming tools are made available which will allow the reader to implement and test easily some classical approaches **Dynamics of Evolutionary Equations** George R. Sell,Yuncheng You,2002-01-02 The theory and applications of infinite dimensional dynamical systems have attracted the attention of scientists for quite some time Dynamical issues arise in equations that attempt to model phenomena that change with time The infi nite dimensional aspects occur when forces that describe the motion depend on spatial variables or on the history of the motion In the case of spatially depen dent problems the model equations are generally partial differential equations and problems that depend on the past give rise to differential delay equations Because the nonlinearities occurring in thse equations need not be small one needs good dynamical theories to understand the longtime behavior of solutions Our basic objective in writing this book is to prepare an entree for scholars who are beginning their journey into the world of dynamical systems especially in infinite dimensional spaces In order to accomplish this we start with the key concepts of a semiflow and a flow As is well known the basic elements of dynamical systems such as the theory of attractors and other invariant sets have their origins here Variational Methods for Structural Optimization Andrej Cherkaev,2012-12-06 In recent decades it has become possible to turn the design process into computer algorithms By applying different computer oriented methods the topology and shape of structures can be optimized and thus designs systematically improved These possibilities have stimulated an interest in the mathematical foundations of structural optimization The challenge of this book is to bridge a gap between a rigorous mathematical approach to variational problems and the practical use of algorithms of structural optimization in engineering applications The foundations of structural optimization are presented in a sufficiently simple form to make them available for practical use and to allow their critical appraisal for improving and adapting these results to specific models Special attention is to pay to the description of optimal structures of composites to deal with this problem novel mathematical methods of nonconvex calculus of variation are developed The exposition is accompanied by examples **Topology, Geometry, and Gauge Fields** Gregory L. Naber,2013-03-14 This volume is intended to carryon the program initiated in Topology Geometry and Gauge Fields Foundations henceforth N4 It is written in much the same spirit and with precisely the same philosophical motivation Mathematics and physics have gone their separate ways for nearly a century now and it is time for this to end Neither can any longer afford to ignore the problems and insights of the other Why are Dirac magnetic monopoles in one to one correspondence with the principal U l bundles over S^2 Why do Higgs fields fall into topological types What led Donaldson in 1980 to seek in the Yang Mills equations of physics for the key that unlocks the mysteries of smooth 4 manifolds and what phys ical insights into quantum field theory led Witten fourteen years later to propose the vastly simpler but apparently equivalent Seiberg Witten equations as an alternative We do not presume to answer these questions here but only to promote

an atmosphere in which both mathematicians and physicists recognize the need for answers More succinctly we shall endeavor to provide an exposition of elementary topology and geometry that keeps one eye on the physics in which our concepts either arose in dependently or have been found to lead to a deeper understanding of the phenomena Chapter 1 provides a synopsis of the geometrical background we assume of our readers manifolds Lie groups bundles connections etc

Vortex Dominated Flows Lu Ting,Rupert Klein,Omar M Knio,2007-07-05 This monograph provides in depth analyses of vortex dominated flows via matched and multiscale asymptotics and demonstrates how insight gained through these analyses can be exploited in the construction of robust efficient and accurate numerical techniques The book explores the dynamics of slender vortex filaments in detail including fundamental derivations compressible core structure weakly non linear limit regimes and associated numerical methods Similarly the volume covers asymptotic analysis and computational techniques for weakly compressible flows involving vortex generated sound and thermoacoustics The book is addressed to both graduate students and researchers **Weakly Connected Neural Networks** Frank C. Hoppensteadt,Eugene M. Izhikevich,2012-12-06 This book is devoted to an analysis of general weakly connected neural networks WCNNs that can be written in the form 0 1 m Here each Xi E IR is a vector that summarizes all physiological attributes of the ith neuron n is the number of neurons Ii describes the dynam ics of the ith neuron and gi describes the interactions between neurons The small parameter indicates the strength of connections between the neurons Weakly connected systems have attracted much attention since the sec ond half of seventeenth century when Christian Huygens noticed that a pair of pendulum clocks synchronize when they are attached to a light weight beam instead of a wall The pair of clocks is among the first weakly connected systems to have been studied Systems of the form 0 1 arise in formal perturbation theories developed by Poincare Liapunov and Malkin and in averaging theories developed by Bogoliubov and Mitropolsky *Determinants and Their Applications in Mathematical Physics* Robert Vein,Paul Dale,2006-05-07 The last treatise on the theory of determinants by T Muir revised and enlarged by W H Metzler was published by Dover Publications Inc in 1960 It is an unabridged and corrected republication of the edition ori nally published by Longman Green and Co in 1933 and contains a preface by Metzler dated 1928 The Table of Contents of this treatise is given in Appendix 13 A small number of other books devoted entirely to determinants have been published in English but they contain little if anything of importance that was not known to Muir and Metzler A few have appeared in German and Japanese In contrast the shelves of every mathematics library groan under the weight of books on linear algebra some of which contain short chapters on determinants but usually only on those aspects of the subject which are applicable to the chapters on matrices There appears to be tacit agreement among authorities on linear algebra that determinant theory is important only as a branch of matrix theory In sections devoted entirely to the establishment of a determinantal relation many authors de ne a determinant by rst de ning a matrixM and then adding the words Let detM be the determinant of the matrix M as though determinants have no separate existence This

belief has no basis in history **Shape Optimization by the Homogenization Method** Gregoire Allaire,2012-12-06 The topic of this book is homogenization theory and its applications to optimal design in the conductivity and elasticity settings Its purpose is to give a self contained account of homogenization theory and explain how it applies to solving optimal design problems from both a theoretical and a numerical point of view The application of greatest practical interest tar geted by this book is shape and topology optimization in structural design where this approach is known as the homogenization method Shape optimization amounts to finding the optimal shape of a domain that for example would be of maximal conductivity or rigidity under some specified loading conditions possibly with a volume or weight constraint Such a criterion is embodied by an objective function and is computed through the solution of astate equation that is a partial differential equa tion modeling the conductivity or the elasticity of the structure Apart from those areas where the loads are applied the shape boundary is al ways assumed to support Neumann boundary conditions i e isolating or traction free conditions In such a setting shape optimization has a long history and has been studied by many different methods There is therefore a vast literat ure in this field and we refer the reader to the following short list of books and references therein 39 42 130 135 149 203 220 225 237 245 258 The N-Vortex Problem Paul K. Newton,2013-03-09 This text is an introduction to current research on the N vortex problem of fluid mechanics It describes the Hamiltonian aspects of vortex dynamics as an entry point into the rather large literature on the topic with exercises at the end of each chapter **Homogenization of Reticulated Structures** Doina Cioranescu,Jeannine Saint Jean Paulin,2012-12-06 This book presents recent works on lattice type structure Some of the results discussed here have already been published in mathematical journals but we give here a comprehensive and unified presentation We have also added some new topics such as those contained in Chapter 4 treating elastic problems for gridworks The aim of this book is to give continuous simple models for thin reticulated structures which may have a very complex pattern This means that we have to treat partial differential equations depending on several small parameters and give the asymptotic behavior with respect to these parameters which can be the period the thickness of the material or the thickness of a plate or of a beam This book is written from the point of view of the applied mathematician atten tion being paid to the mathematical rigor convergence results and error estimates It consists of six chapters and more than a hundred figures The basic ideas are presented in the first two chapters while the four last ones study some particular models using the ideas of Chapters 1 and 2 Chapter 1 is an introduction to homogenization methods in perforated domains Here the parameter to be taken into consideration is the period After describing the multiple scale method which consists in asymptotic expansions we focus our attention on the variational method introduced by Tartar whose main idea is the construction of rapidly oscillating test functions **Chaos, Fractals, and Noise** Andrzej Lasota,Michael C. Mackey,2013-11-27 The first edition of this book was originally published in 1985 under the ti tle Probabilistic Properties of Deterministic Systems In the intervening years interest in so called chaotic systems has continued unabated but with a more

thoughtful and sober eye toward applications as befits a ma turing field This interest in the serious usage of the concepts and techniques of nonlinear dynamics by applied scientists has probably been spurred more by the availability of inexpensive computers than by any other factor Thus computer experiments have been prominent suggesting the wealth of phe nomena that may be resident in nonlinear systems In particular they allow one to observe the interdependence between the deterministic and probabilistic properties of these systems such as the existence of invariant measures and densities statistical stability and periodicity the influence of stochastic perturbations the formation of attractors and many others The aim of the book and especially of this second edition is to present recent theoretical methods which allow one to study these effects We have taken the opportunity in this second edition to not only correct the errors of the first edition but also to add substantially new material in five sections and a new chapter

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