Inverse Problems And Inverse Scattering Of Plane Waves Roy Dilip N Ghosh Couchman L S

Inverse Problems and Inverse Scattering of Plane WavesAn Introduction to Inverse Scattering and Inverse Spectral ProblemsTheory of SolitonsInverse Scattering Problems in OpticsInverse Problems in Scattering and ImagingInverse Problems in Quantum Scattering TheoryInverse Scattering Theory and Transmission EigenvaluesInverse Scattering PapersThe Inverse Scattering Transformation and The Theory of SolitonsConference on Inverse Scattering--Theory and ApplicationInverse Scattering Problems and Their Application to Nonlinear Integrable EquationsSolitons and the Inverse Scattering TransformInverse Scattering and ApplicationsThe Inverse Scattering ProblemThe Legacy of the Inverse Scattering Transform in Applied MathematicsPoint Sources and Multipoles in Inverse Scattering TheoryAn Introduction to Electromagnetic Inverse ScatteringDirect and Inverse Scattering for the Matrix Schr□ dinger EquationInverse Spectral and Scattering TheoryTheory of Solitons: the Inverse Scattering Method D.N. Roy Khosrow Chadan S. Novikov H.P. Baltes Bertero K. Chadan Fioralba Cakoni Irvin W. Kay W. Eckhaus J. Bee Bednar Pham Loi Vu Mark J. Ablowitz David H. Sattinger Irvin W. Kay J. L. Bona Roland Potthast K.I. Hopcraft Tuncay Aktosun Hiroshi Isozaki S. Novikov
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the purpose of this text is to present the theory and mathematics of inverse scattering in a simple way to the many researchers and professionals who use it in their everyday research while applications range across a broad spectrum of disciplines examples in this text will focus primarly but not exclusively on acoustics the text will be especially valuable for those applied workers who would like to delve more deeply into the fundamentally mathematical character of the subject matter practitioners in this field comprise applied physicists engineers and technologists whereas the theory is almost entirely in the domain of abstract mathematics this gulf between the two if bridged can only lead to improvement in the level of scholarship in this highly important discipline this is the book s primary focus

here is a clearly written introduction to three central areas of inverse problems inverse problems in electromagnetic scattering theory inverse spectral theory and inverse problems in quantum scattering theory inverse problems one of the most attractive parts of applied mathematics attempt to obtain information about structures by nondestructive measurements based on a series of lectures presented by three of the authors all experts in the field the book provides a quick and easy way for readers to become familiar with the area through a survey of recent developments in inverse spectral and inverse scattering problems

when in the spring of 1979 h p baltes presented me with the precursor of this vo 1 ume the book on inverse source problems in opti cs i expressed my gratitude in a short note 11hich in translation reads dear dr ba ltes the mere titl e of your unexpected gift evokes memori es of a period which in the terminology of your own contribution would be described as the stone age of the inverse problem

those were pleasant times walter kohn and i lived in a cave by ourselves drew pictures on the walls and nobody seemed to care now however inversion has become an industry which i contemplate with as much bewilderment as a surviving tasmanian aborigine gazing at a modern oil refinery with its towers its fl ares and the confus i ng maze of its tubes the present volume makes me feel even more aboriginal impossible for me to fathom its content what i can point out however is one of the forgotten origins of the inverse scattering problem of quantum mechanics werner heisenberg s s matrix theory of 1943 this grandiose scheme had the purpose of eliminating the notion of the hamiltonian in favour of the scattering operator if successful it would have done away once and for all with any kind of inverse problem

inverse problems in scattering and imaging is a collection of lectures from a nato advanced research workshop that integrates the expertise of physicists and mathematicians in different areas with a common interest in inverse problems covering a range of subjects from new developments on the applied mathematics mathematical physics side to many areas of application the book achieves a blend of research review and tutorial contributions it is of interest to researchers in the areas of applied mathematics and mathematical physics as well as those working in areas where inverse problems can be applied

inverse scattering theory is a major theme of applied mathematics and it has applications to such diverse areas as medical imaging geophysical exploration and nondestructive testing the inverse scattering problem is both nonlinear and ill posed thus presenting particular problems in the development of efficient inversion algorithms although linearized models continue to play an important role in many applications an increased need to focus on problems in which multiple scattering effects cannot be ignored has led to a central role for nonlinearity and the possibility of collecting large amounts of data over limited regions of space means that the ill posed nature of the inverse scattering problem has become a problem of central importance initial efforts to address the nonlinear and the ill posed nature of the inverse scattering problem focused on nonlinear optimization methods while efficient in many situations strong a priori information is necessary for their implementation this problem led to a qualitative approach to inverse scattering theory in which the amount of a priori information is drastically reduced although at the expense of only obtaining limited information about the values of the constitutive parameters this qualitative approach the linear sampling method the factorization method the theory of transmission eigenvalues etc is the theme of inverse scattering theory and transmission eigenvalues the authors begin with a basic introduction to the theory then proceed to more recent developments including a detailed discussion of the transmission eigenvalue problem present the new generalized linear sampling method in addition to the well known linear sampling and factorization methods and in order to achieve clarification of presentation focus on the inverse scattering problem for scalar homogeneous media

the inverse scattering transformation and the theory of solitons

inverse scattering problems and their application to nonlinear integrable equations is devoted to inverse scattering problems isps for differential equations and their application to nonlinear evolution equations nlees the book is suitable for anyone who has a mathematical background and interest in functional analysis partial differential equations equations of mathematical physics and functions of a complex variable this book is intended for a wide community working with inverse scattering problems and their applications in particular there is a traditional community in mathematical physics in this monograph the problems are solved step by step and detailed proofs are given for the problems to make the topics more accessible for students who are approaching them for the first time features the unique solvability of isps are proved the scattering data of the considered inverse scattering problems isps are described completely solving the associated initial value problem or initial boundary value problem for the nonlinear evolution equations nlees is carried out step by step namely the nlee can be written as the compatibility condition of two linear equations the unknown boundary values are calculated with the help of the lax generalized equation and then the time dependent scattering data sd are constructed from the initial and boundary conditions the potentials are recovered uniquely in terms of time dependent sd and the solution of the nlees is expressed uniquely in terms of the found solutions of the isp since the considered isps are solved well then the sps generated by two linear equations constitute the inverse scattering method ism the application of the ism to solving the nlees is consistent and is effectively embedded in the schema of the ism

a study by two of the major contributors to the theory of the inverse scattering transform and its application to problems of nonlinear

dispersive waves that arise in fluid dynamics plasma physics nonlinear optics particle physics crystal lattice theory nonlinear circuit theory and other areas a soliton is a localized pulse like nonlinear wave that possesses remarkable stability properties typically problems that admit soliton solutions are in the form of evolution equations that describe how some variable or set of variables evolve in time from a given state the equations may take a variety of forms for example pdes differential difference equations partial difference equations and integrodifferential equations as well as coupled odes of finite order what is surprising is that although these problems are nonlinear the general solution that evolves from almost arbitrary initial data may be obtained without approximation for such exactly solvable problems the inverse scattering transform provides the general solution of their initial value problems it is equally surprising that some of these exactly solvable problems arise naturally as models of physical phenomena simply put the inverse scattering transform is a nonlinear analog of the fourier transform used for linear problems its value lies in the fact that it allows certain nonlinear problems to be treated by what are essentially linear methods chapters 1 and 2 of the book describe in detail the theory of the inverse scattering transform chapter 3 discusses alternate methods for these exactly solvable problems and the interconnections among them physical applications are described in chapter 4 where for example similarities between deep water waves and nonlinear optics become evident because of the fundamental role of linear theory there is an extensive appendix that addresses the linear problems and their solutions

this book presents papers given at a conference on inverse scattering on the line held in june 1990 at the university of massachusetts amherst a wide variety of topics in inverse problems were covered inverse scattering problems on the line inverse problems in higher dimensions inverse conductivity problems and numerical methods in addition problems from statistical physics were covered including monodromy problems quantum inverse scattering and the bethe ansatz one of the aims of the conference was to bring together researchers in a variety of areas of inverse problems which have seen intensive activity in recent years scattering

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swift progress and new applications characterize the area of solitons and the inverse scattering transform there are rapid developments in current nonlinear optical technology larger intensities are more available pulse widths are smaller relaxation times and damping rates are less significant in keeping with these advancements exactly integrable soliton equations such as 3 wave resonant interactions and second harmonic generation are becoming more and more relevant inexperimental applications techniques are now being developed for using these interactions to frequency convert high intensity sources into frequency regimes where there are no lasers other experiments involve using these interactions to develop intense variable frequency sources opening up even morepossibilities this volume contains new developments and state of the art research arising from the conference on the legacy of the inverse scattering transform held at mount holyoke college south hadley ma unique to this volume is the opening section reviews this part of the book provides reviews of major research results in the inverse scattering transform ist on the application of ist to classical problems in differential geometry on algebraic and analytic aspects ofsoliton type equations on a new method for studying boundary value problems for integrable partial differential equations pdes in two dimensions on chaos in pdes on advances in multi soliton complexes and on a unified approach to integrable systems via painleve analysis this conference provided aforum for general exposition and discussion of recent developments in nonlinear waves and related areas with potential applications to other fields the book will be of interest to graduate students and researchers interested in mathematics physics and engineering

over the last twenty years the growing availability of computing power has had an enormous impact on the classical fields of direct and inverse scattering the study of inverse scattering in particular has developed rapidly with the ability to perform computational

simulations of scattering processes and led to remarkable advances in a range of

with the advent of the comparatively new disciplines of remote sensing and non destructive evaluation of materials the topic of inverse scattering has broadened from its origins in elementary particle physics to encompass a diversity of applications one such area which is of increasing importance in inverse scattering within the context of electromagnetism and this text aims to serve as an introduction to that particular speciality the subject s development has progressed at the hands of engineers mathematicians and physicists alike with an inevitable disparity of emphasis and notation one of the main objectives of this text is to distill the essence of the subject and to present it in the form of a graduated and coherent development of ideas and techniques the text provides a physical approach to inverse scattering solutions emphasizing the applied aspects rather than the mathematical rigour the authors teaching and research backgrounds in physics electrical engineering and applied mathematics enable them to explore and stress the cross disciplinary nature of the subject this treatment will be of use to anyone embarking on a theoretical or practical study of inverse electromagnetic scattering

authored by two experts in the field who have been long time collaborators this monograph treats the scattering and inverse scattering problems for the matrix schr□ dinger equation on the half line with the general selfadjoint boundary condition the existence uniqueness construction and characterization aspects are treated with mathematical rigor and physical insight is provided to make the material accessible to mathematicians physicists engineers and applied scientists with an interest in scattering and inverse scattering the material presented is expected to be useful to beginners as well as experts in the field the subject matter covered is expected to be interesting to a wide range of researchers including those working in quantum graphs and scattering on graphs the theory presented is illustrated with various explicit examples to improve the understanding of scattering and inverse scattering problems the monograph introduces a specific class of input data sets consisting of a potential and a boundary condition and a specific class of scattering data sets consisting of a scattering matrix and bound state information the important problem of the characterization is solved by establishing a one to one correspondence between the two aforementioned classes the characterization result is formulated in various equivalent forms providing insight and allowing a comparison of different techniques used to solve the inverse scattering problem the past literature treated the type of boundary condition as a part of the scattering data used as input to recover the potential this monograph provides a proper formulation of the inverse scattering problem where the type of boundary condition is no longer a part of the scattering data set but rather both the potential and the type of boundary condition are recovered from the scattering data set

the aim of this book is to provide basic knowledge of the inverse problems arising in various areas in mathematics physics engineering and medical science these practical problems boil down to the mathematical question in which one tries to recover the operator coefficients or the domain manifolds from spectral data the characteristic properties of the operators in question are often reduced to those of schr□ dinger operators we start from the 1 dimensional theory to observe the main features of inverse spectral problems and then proceed to multi dimensions the first milestone is the borg levinson theorem in the inverse dirichlet problem in a bounded domain elucidating basic motivation of the inverse problem as well as the difference between 1 dimension and multi dimension the main theme is the inverse scattering in which the spectral data is heisenberg s s matrix defined through the observation of the asymptotic behavior at infinity of solutions significant progress has been made in the past 30 years by using the faddeev green function or the complex geometrical optics solution by sylvester and uhlmann which made it possible to reconstruct the potential from the s matrix of one fixed energy one can also prove the equivalence of the knowledge of s matrix and that of the dirichlet to neumann map for boundary value problems in bounded domains we apply this idea also to the dirac equation the maxwell equation and discrete schr□ dinger operators on perturbed lattices our final topic is the boundary control method introduced by belishev and kurylev which is for the moment the only systematic method for the reconstruction of the riemannian metric from the boundary observation which we apply to the inverse scattering on non compact manifolds we stress that this book focuses on the lucid exposition of these problems and mathematical backgrounds by explaining the basic knowledge of functional analysis and spectral theory omitting the technical details in order to make the book accessible to graduate students as an introduction to partial differential equations pdes and functional analysis

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