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Nonlinear Hyperbolic Equations, Spectral Theory, and Wavelet Transformations

A Volume of
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Hyperbolic Partial Differential Equations Nonlinear Theory

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Hyperbolic Partial Differential Equations Nonlinear Theory:

Hyperbolic Partial Differential Equations Matthew Witten, 2014-05-17 *Hyperbolic Partial Differential Equations* Volume 1 Population Reactors Tides and Waves Theory and Applications covers three general areas of hyperbolic partial differential equation applications These areas include problems related to the McKendrick Von Foerster population equations other hyperbolic form equations and the numerical solution This text is composed of 15 chapters and begins with surveys of age specific population interactions populations models of diffusion nonlinear age dependent population growth with harvesting local and global stability for the nonlinear renewal equation in the Von Foerster model and nonlinear age dependent population dynamics The next chapters deal with various applications of hyperbolic partial differential equations to such areas as age structured fish populations density dependent growth in a cell colony boll weevil cotton crop modeling age dependent predation and cannibalism parasite populations growth of microorganisms and stochastic perturbations in the Von Foerster model These topics are followed by discussions of bifurcation of time periodic solutions of the McKendrick equation the periodic solution of nonlinear hyperbolic problems and semigroup theory as applied to nonlinear age dependent population dynamics Other chapters explore the stability of biochemical reaction tanks an ADI model for the Laplace tidal equations the Carleman equation the nonequilibrium behavior of solids that transport heat by second sound and the nonlinear hyperbolic partial differential equations and dynamic programming The final chapters highlight two explicitly numerical applications a predictor convex corrector method and the Galerkin approximation in hyperbolic partial differential equations This book will prove useful to practicing engineers population researchers physicists and mathematicians

Lectures on Nonlinear Hyperbolic Differential Equations Lars Hörmander, 1997-07-17 In this introductory textbook a revised and extended version of well known lectures by L H rmander from 1986 four chapters are devoted to weak solutions of systems of conservation laws Apart from that the book only studies classical solutions Two chapters concern the existence of global solutions or estimates of the lifespan for solutions of nonlinear perturbations of the wave or Klein Gordon equation with small initial data Four chapters are devoted to microanalysis of the singularities of the solutions This part assumes some familiarity with pseudodifferential operators which are standard in the theory of linear differential operators but the extension to the more exotic classes of opertors needed in the nonlinear theory is presented in complete detail

Hyperbolic Partial Differential Equations Andreas Meister, Jens Struckmeier, 2012-12-06 The following chapters summarize lectures given in March 2001 during the summerschool on Hyperbolic Partial Differential Equations which took place at the Technical University of Hamburg Harburg in Germany This type of meeting is originally funded by the Volkswa genstiftung in Hannover Germany with the aim to bring together well known leading experts from special mathematical physical and engineering fields of interest with PhD students members of Scientific Research Institutes as well as people from Industry in order to learn and discuss modern theoretical and numerical developments Hyperbolic partial differential

equations play an important role in various applications from natural sciences and engineering Starting from the classical Euler equations in fluid dynamics several other hyperbolic equations arise in traffic flow problems acoustics radiation transfer crystal growth etc The main interest is concerned with nonlinear hyperbolic problems and the special structures which are characteristic for solutions of these equations like shock and rarefaction waves as well as entropy solutions As a consequence even numerical schemes for hyperbolic equations differ significantly from methods for elliptic and parabolic equations the transport of information runs along the characteristic curves of a hyperbolic equation and consequently the direction of transport is of constitutive importance This property leads to the construction of upwind schemes and the theory of Riemann solvers Both concepts are combined with explicit or implicit time stepping techniques whereby the chosen order of accuracy usually depends on the expected dynamic of the underlying solution

Nonlinear Hyperbolic Equations and Field Theory M K V Murthy, S Spagnolo, 1992-03-30 Contains the proceedings of a workshop on nonlinear hyperbolic equations held at Varenna Italy in June 1990

Hyperbolic Partial Differential Equations Serge Alinhac, 2009-06-17 The aim of this book is to present hyperbolic partial differential equations at an elementary level In fact the required mathematical background is only a third year university course on differential calculus for functions of several variables No functional analysis knowledge is needed nor any distribution theory with the exception of shock waves mentioned below

All solutions appearing in the text are piecewise classical C^1 solutions Beyond the simplifications it allows there are several reasons for this choice First we believe that all main features of hyperbolic partial differential equations PDE well posedness of the Cauchy problem finite speed of propagation domains of determination energy inequalities etc can be displayed in this context We hope that this book itself will prove our belief Second all properties solution formulas and inequalities established here in the context of smooth functions can be readily extended to more general situations solutions in Sobolev spaces or temperate distributions etc by simple standard procedures of functional analysis or distribution theory which are external to the theory of hyperbolic equations The deep mathematical content of the theorems is already to be found in the statements and proofs of this book The last reason is this We do hope that many readers of this book will eventually do research in the field that seems to us the natural continuation of the subject nonlinear hyperbolic systems compressible fluids general relativity theory etc

Nonlinear Hyperbolic Equations, Spectral Theory, and Wavelet Transformations Sergio Albeverio, Michael Demuth, Elmar Schrohe, Bert-Wolfgang Schulze, 2012-12-06 This volume focuses on recent developments in nonlinear and hyperbolic equations It will be a most valuable resource for researchers in applied mathematics the theory of wavelets and in mathematical and theoretical physics Nine up to date contributions have been written on invitation by experts in the respective fields The book is the third volume of the subseries *Advances in Partial Differential Equations*

Beyond Partial Differential Equations Horst Reinhard Beyer, 2007-04-10 This book introduces the treatment of linear and nonlinear quasi-linear abstract evolution equations by methods from the theory of strongly continuous semigroups The theoretical part is

accessible to graduate students with basic knowledge in functional analysis with only some examples requiring more specialized knowledge from the spectral theory of linear self adjoint operators in Hilbert spaces Emphasis is placed on equations of the hyperbolic type which are less often treated in the literature

Nonlinear Hyperbolic Equations, Spectral Theory, and Wavelet Transformations Sergio Albeverio, 2003

[An Introduction to Nonlinear Partial Differential Equations](#) J. David Logan, 2008-04-11 Praise for the First Edition This book is well conceived and well written The author has succeeded in producing a text on nonlinear PDEs that is not only quite readable but also accessible to students from diverse backgrounds SIAM Review A practical introduction to nonlinear PDEs and their real world applications Now in a Second Edition this popular book on nonlinear partial differential equations PDEs contains expanded coverage on the central topics of applied mathematics in an elementary highly readable format and is accessible to students and researchers in the field of pure and applied mathematics This book provides a new focus on the increasing use of mathematical applications in the life sciences while also addressing key topics such as linear PDEs first order nonlinear PDEs classical and weak solutions shocks hyperbolic systems nonlinear diffusion and elliptic equations Unlike comparable books that typically only use formal proofs and theory to demonstrate results An Introduction to Nonlinear Partial Differential Equations Second Edition takes a more practical approach to nonlinear PDEs by emphasizing how the results are used why they are important and how they are applied to real problems The intertwining relationship between mathematics and physical phenomena is discovered using detailed examples of applications across various areas such as biology combustion traffic flow heat transfer fluid mechanics quantum mechanics and the chemical reactor theory New features of the Second Edition also include Additional intermediate level exercises that facilitate the development of advanced problem solving skills New applications in the biological sciences including age structure pattern formation and the propagation of diseases An expanded bibliography that facilitates further investigation into specialized topics With individual self contained chapters and a broad scope of coverage that offers instructors the flexibility to design courses to meet specific objectives An Introduction to Nonlinear Partial Differential Equations Second Edition is an ideal text for applied mathematics courses at the upper undergraduate and graduate levels It also serves as a valuable resource for researchers and professionals in the fields of mathematics biology engineering and physics who would like to further their knowledge of PDEs

New Trends in the Theory of Hyperbolic Equations Michael Reissig, Bert-Wolfgang Schulze, 2006-03-21 Presenting several developments in the theory of hyperbolic equations this book's contributions deal with questions of low regularity critical growth ill posedness decay estimates for solutions of different non linear hyperbolic models and introduce new approaches based on microlocal methods

Partial Differential Equations Lawrence C. Evans, 2022-03-22 This is the second edition of the now definitive text on partial differential equations PDE It offers a comprehensive survey of modern techniques in the theoretical study of PDE with particular emphasis on nonlinear equations Its wide scope and clear exposition make it a great text for a graduate course in PDE For this edition the author

has made numerous changes including a new chapter on nonlinear wave equations more than 80 new exercises several new sections a significantly expanded bibliography About the First Edition I have used this book for both regular PDE and topics courses It has a wonderful combination of insight and technical detail Evans book is evidence of his mastering of the field and the clarity of presentation Luis Caffarelli University of Texas It is fun to teach from Evans book It explains many of the essential ideas and techniques of partial differential equations Every graduate student in analysis should read it David Jerison MIT I use Partial Differential Equations to prepare my students for their Topic exam which is a requirement before starting working on their dissertation The book provides an excellent account of PDE s I am very happy with the preparation it provides my students Carlos Kenig University of Chicago Evans book has already attained the status of a classic It is a clear choice for students just learning the subject as well as for experts who wish to broaden their knowledge An outstanding reference for many aspects of the field Rafe Mazzeo Stanford University [Nonlinear Hyperbolic Waves in Multidimensions](#) Phoolan Prasad, 2001-05-18 The propagation of curved nonlinear wavefronts and shock fronts are very complex phenomena Since the 1993 publication of his work Propagation of a Curved Shock and Nonlinear Ray Theory author Phoolan Prasad and his research group have made significant advances in the underlying theory of these phenomena This volume presents their results and pr *Oscillation Theory of Partial Differential Equations* Norio Yoshida, 2008 This unique book is designed to provide the reader with an exposition of interesting aspects encompassing both rudimentary and advanced knowledge of oscillation theory of partial differential equations which dates back to the publication in 1955 of a paper by Ph Hartman and A Wintner The objective of oscillation theory is to acquire as much information as possible about the qualitative properties of solutions of differential equations through the analysis of laws governing the distribution of zeros of solutions as well as the asymptotic behavior of solutions of differential equations under consideration This textbook on oscillation theory of partial differential equations is useful for both specialists and graduate students working in the field of differential equations The book will also help to stimulate further progress in the study of oscillation theory and related subjects **Nonlinear Partial Differential Equations and Related Analysis** Gui-Qiang Chen, George Gasper, Joseph W. Jerome, 2005 The Emphasis Year on Nonlinear Partial Differential Equations and Related Analysis at Northwestern University produced this fine collection of original research and survey articles Many well known mathematicians attended the events and submitted their contributions for this volume Eighteen papers comprise this work representing the most significant advances and current trends in nonlinear PDEs and their applications Topics covered include elliptic and parabolic equations Navier-Stokes equations and hyperbolic conservation laws Important applications are presented from incompressible and compressible fluid mechanics combustion and electromagnetism Also included are articles on recent advances in statistical reliability in modeling simulation level set methods for image processing shock waves free boundaries boundary layers errors in numerical solutions stability instability and singular limits The volume is suitable for researchers and graduate students interested in partial

differential equations **Partial Differential Equations: Nonlinear equations** Michael E. Taylor, 2011 This text provides an introduction to the theory of partial differential equations It introduces basic examples of partial differential equations arising in continuum mechanics electromagnetism complex analysis and other areas and develops a number of tools for their solution including particularly Fourier analysis distribution theory and Sobolev spaces These tools are applied to the treatment of basic problems in linear PDE including the Laplace equation heat equation and wave equation as well as more general elliptic parabolic and hyperbolic equations Companion texts which take the theory of partial differential equations further are AMS volume 116 treating more advanced topics in linear PDE and AMS volume 117 treating problems in nonlinear PDE **Pseudodifferential Operators and Nonlinear PDE** Michael Taylor, 1991-11-01 For the past 25 years the theory of pseudodifferential operators has played an important role in many exciting and deep investigations into linear PDE Over the past decade this tool has also begun to yield interesting results in nonlinear PDE This book is devoted to a summary and reconsideration of some used of pseudodifferential operator techniques in nonlinear PDE The book should be of interest to graduate students instructors and researchers interested in partial differential equations nonlinear analysis in classical mathematical physics and differential geometry and in harmonic analysis *Nonlinear Partial Differential Equations and Hyperbolic Wave Phenomena* Norske videnskaps-akademi. Research Program on Nonlinear Partial Differential Equations, 2010-10-01 This volume presents the state of the art in several directions of research conducted by renowned mathematicians who participated in the research program on Nonlinear Partial Differential Equations at the Centre for Advanced Study at the Norwegian Academy of Science and Letters Oslo Norway during the academic year 2008 09 The main theme of the volume is nonlinear partial differential equations that model a wide variety of wave phenomena Topics discussed include systems of conservation laws compressible Navier Stokes equations Navier Stokes Korteweg type systems in models for phase transitions nonlinear evolution equations degenerate mixed type equations in fluid mechanics and differential geometry nonlinear dispersive wave equations Korteweg de Vries Camassa Holm type etc and Poisson interface problems and level set formulations **Analytical Approaches to Multidimensional Balance Laws** Olga S. Rozanova, 2006 It is difficult to overestimate the importance of mathematical investigation of balance laws They arise in many areas of physics mechanics chemistry biology social sciences In this collective book we concentrate in particular on the equations of continuous medium and related to them As a rule they are very complicated in their primitive form An important feature of such equations is a possible formation of singularities even in initially smooth solution within a finite time The structure of the singularities can be very complex A natural step in the approach to this problem is the transition despite the three dimensionality of our world to spatially one dimensional model Significant progress has been achieved in this direction Unfortunately the methods of the one dimensional theory as usual cannot be adapted to a case of many spatial variables However there are many attempts to deal with multidimensional problems We would like to present some of them All of the

papers are written by outstanding experts representing various schools in mathematics and mechanics Each paper is organised as follows it contains an elementary as far as it is possible introduction to a problem a brief review of previously published results and then original results of the authors are presented

Exact Solutions and Invariant Subspaces of Nonlinear Partial Differential Equations in Mechanics and Physics Victor A. Galaktionov, Sergey R. Svirshchevskii, 2006-11-02

Exact Solutions and Invariant Subspaces of Nonlinear Partial Differential Equations in Mechanics and Physics is the first book to provide a systematic construction of exact solutions via linear invariant subspaces for nonlinear differential operators Acting as a guide to nonlinear evolution equations and models from physics and mechanics the book

Approximation Theory and Analytic Inequalities Themistocles M. Rassias, 2021-07-21

This contributed volume focuses on various important areas of mathematics in which approximation methods play an essential role It features cutting edge research on a wide spectrum of analytic inequalities with emphasis on differential and integral inequalities in the spirit of functional analysis operator theory nonlinear analysis variational calculus featuring a plethora of applications making this work a valuable resource The reader will be exposed to convexity theory polynomial inequalities extremal problems prediction theory fixed point theory for operators PDEs fractional integral inequalities multidimensional numerical integration Gauss Jacobi and Hermite Hadamard type inequalities Hilbert type inequalities and Ulam s stability of functional equations Contributions have been written by eminent researchers providing up to date information and several results which may be useful to a wide readership including graduate students and researchers working in mathematics physics economics operational research and their interconnections

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