The Cauchy Problem For Hyperbolic Operators Multiple Characteristics Micro Local Approach

The Hyperbolic Cauchy Problem-Kunihiko Kajitani 2006-11-15 The approach to the Cauchy problem taken here by the authors is based on theuse of Fourier integral operators with a complex-valued phase function, which is a time function chosen suitably according to the geometry of the multiple characteristics. The correctness of the Cauchy problem in the Gevrey classes for operators with hyperbolic principal part is shown in the first part. In the second part, the correctness of the Cauchy problem for effectively hyperbolic operators is proved with a precise estimate of the loss of derivatives. This method can be applied to other (non) hyperbolic problems. The text is based on a course of lectures given for graduate students but will be of interest to researchers interested in hyperbolic partial differential equations. In the latter part the reader is expected to be familiar with some theory of pseudo-differential operators.
The Cauchy Problem for Hyperbolic Operators-Karen Yagdjian 1997
Cauchy's Problem for Hyperbolic Equations-Lars Gårding 1958
Hyperbolic Systems of Conservation Laws-Alberto Bressan 2000 This book provides a self-contained introduction to the mathematical theory of hyperbolic systems of conservation laws, with particular emphasis on the study of discontinuous solutions, characterized by the appearance of shock waves. This area has experienced substantial progress in very recent years thanks to the introduction of new techniques, in particular the front tracking algorithm and the semigroup approach. These techniques provide a solution to the long standing open problems of uniqueness and stability of entropy weak solutions. This volume is the first to present a comprehensive account of these new, fundamental advances. It also includes a detailed analysis of the stability and convergence of the front tracking algorithm. A set of problems, with varying difficulty is given at the end of each chapter to verify and expand understanding of the concepts and techniques previously discussed. For researchers, this book will provide an indispensable reference to the state of the art in the field of hyperbolic systems of conservation laws.
Hyperbolic Systems with Analytic Coefficients-Tatsuo Nishitani 2013-11-19 This monograph focuses on the well-posedness of the Cauchy problem for linear hyperbolic systems with matrix coefficients. Mainly two questions are discussed: (A) Under which conditions on lower order terms is the Cauchy problem well posed? (B) When is the Cauchy problem well posed for any lower order term? For first order two by two systems with two independent variables with real analytic coefficients, we present complete answers for both (A) and (B). For first order systems with real analytic coefficients we prove general necessary conditions for question (B) in terms of minors of the principal symbols. With regard to sufficient conditions for (B), we introduce hyperbolic systems with nondegenerate characteristics, which contain strictly hyperbolic systems, and prove that the Cauchy problem for hyperbolic systems with nondegenerate characteristics is well posed for any lower order term. We also prove that any hyperbolic system which is close to a hyperbolic system with a nondegenerate characteristic of multiple order has a nondegenerate characteristic of the same order nearby.
Cauchy's Problem for Hyperbolic Differential Equations with Multiple Characteristics-Mehdi Shaghaghi Zarghamee 1968
Cauchy Problem for Differential Operators with Double Characteristics-Tatsuo Nishitani 2017-11-24 Combining geometrical and microlocal tools, this monograph gives detailed proofs of many well/ill-posed results related to the Cauchy problem for differential operators with non-effectively hyperbolic double characteristics. Previously scattered over numerous different publications, the results are presented from the viewpoint that the Hamilton map and the geometry of bicharacteristics completely characterizes the well/ill-posedness of the Cauchy problem. A doubly characteristic point of a differential operator P of order m (i.e. one where Pm = dPm = 0) is effectively hyperbolic if the Hamilton map FPm has real non-zero eigen values. When the characteristics are at most double and every double characteristic is effectively hyperbolic, the Cauchy problem for P can be solved for arbitrary lower order terms. If there is a non-effectively hyperbolic characteristic, solvability requires the subprincipal symbol of P to lie between −Pμj and Pμj , where iμj are the positive imaginary eigenvalues of FPm . Moreover, if 0 is an eigenvalue of FPm with corresponding 4 × 4 Jordan block, the spectral structure of FPm is insufficient to determine whether the Cauchy problem is well-posed and the behavior of bicharacteristics near the doubly characteristic manifold plays a crucial role.
On the Cauchy Problem-Sigeru Mizohata 2014-05-10 Notes and Reports in Mathematics in Science and Engineering, Volume 3: On the Cauchy Problem focuses on the processes, methodologies, and mathematical approaches to Cauchy problems. The publication first elaborates on evolution equations, Lax-Mizohata theorem, and Cauchy problems in Gevrey class. Discussions focus on fundamental proposition, proof of theorem 4, Gevrey property in t of solutions, basic facts on pseudo-differential, and proof of theorem 3. The book then takes a look at micro-local analysis in Gevrey class, including proof and consequences of theorem 1. The manuscript examines Schrödinger type equations, as well as general view-points on evolution equations. Numerical representations and analyses are provided in the explanation of these type of equations. The book is a valuable reference for mathematicians and researchers interested in the Cauchy problem.
Cauchy's Problem for Hyperbolic Equations-Lars Gårding 1958
Hyperbolic Differential Operators And Related Problems-Vincenzo Ancona 2003-03-06 Presenting research from more than 30 international authorities, this reference provides a complete arsenal of tools and theorems to analyze systems of hyperbolic partial differential equations. The authors investigate a wide variety of problems in areas such as thermodynamics, electromagnetics, fluid dynamics, differential geometry, and topology. Renewing thought in the field of mathematical physics, Hyperbolic Differential Operators defines the notion of pseudosymmetry for matrix symbols of order zero as well as the notion of time function. Surpassing previously published material on the topic, this text is key for researchers and mathematicians specializing in hyperbolic, Schrödinger, Einstein, and partial differential equations; complex analysis; and mathematical physics.
The Hyperbolic Cauchy Problem-Kunihiko Kajitani 2014-01-15
Cauchy Problem for Nonlinear Hyperbolic Systems of Partial Differential Equations-Victoria Yasinovskaya 1983
On the Cauchy Problem for Quasilinear Hyperbolic System of Partial Differential Equations with a Retarded Argument-Zdzisław Kamont 1984
The Cauchy Problem for Hyperbolic Conservation Laws with Three Equations-Yun-Guang Lu 1995
The Cauchy Problem for Symmetric Hyperbolic Systems in Lp-Philip Brenner 1966
On the Cauchy Problem for Quasilinear Hyperbolic Systems of Partial Differential-functional Equations of the First Order-Tomasz Człapiński 1989
Boundary Value Problems for Hyperbolic Partial Differential Equations with Constant Coefficients-J. F. Heyda 1959
Global Solution of the Cauchy Problem for a Non-linear Hyperbolic Equation-A. Arosio 1982
The Cauchy problem for effectively hyperbolic equations-N. Iwasaki 1984
On the Cauchy Problem for a Class of Degenerate Hyperbolic Equations-Matthias Krüger 2018 In this thesis, a pseudodifferential calculus for a degenerate hyperbolic Cauchy problem is developed. The model for this problem originates from a certain observation in fluid mechanics, and is then extended to a more general class of hyperbolic Cauchy problems where the coefficients degenerate like a power of $t + |x|^2$ as $(t,x) \to (0,0)$. Symbol classes and pseudodifferential operators are introduced. In this process, it becomes apparent that exactly in the origin, these operators are of type (1,1). Although these operators are not L^2-continuous in general, a proof of continuity in...
The Singular Cauchy Problem for a Nonlinear Hyperbolic Equation-Seymour Singer 1969
On the Cauchy Problem for Quasilinear Hyperbolic Equations with Time Degeneration-Michael Reissig 1993
The Cauchy Problem for Semilinear Hyperbolic Equation with Characteristic Degeneration on the Initial Hyperplane- 2018
The Cauchy Problem for Degenerate Hyperbolic Darboux Equation-Kazuo Amano 1987
The Cauchy Problem for Quasi-linear Hyperbolic Evolution Problems with a Singularity in the Time-Clarissa Marie Claudel 1997
The Cauchy Problem in Abstract Gevrey Spaces for a Nonlinear Weakly Hyperbolic Equation of Second Order-Piero D'Ancona 1992
On the Degenerate Cauchy Problem for Linear Hyperbolic Equations of the Second Order-Chung-Lie Wang 1964
Plane Waves and Spherical Means-F. John 2013-12-01 The author would like to acknowledge his obligation to all his (;Olleagues and friends at the Institute of Mathematical Sciences of New York University for their stimulation and criticism which have contributed to the writing of this tract. The author also wishes to thank Aughtum S. Howard for permission to include results from her unpublished dissertation, Larkin Joyner for drawing the figures, Interscience Publishers for their cooperation and support, and particularly Lipman Bers, who suggested the publication in its present form. New Rochelle FRITZ JOHN September, 1955 [v] CONTENTS Introduction. . . . . 1 CHAPTER I Decomposition of an Arbitrary Function into Plane Waves Explanation of notation . . . . . 7 The spherical mean of a function of a single coordinate. 7 9 Representation of a function by its plane integrals . CHAPTER II Tbe Initial Value Problem for Hyperbolic Homogeneous Equations with Constant Coefficients Hyperbolic equations. . . . . 15 Geometry of the normal surface for a strictly hyperbolic equation. 16 Solution of the Cauchy problem for a strictly hyperbolic equation . 20 Expression of the kernel by an integral over the normal surface. 23 The domain of dependence . . . . . 29 The wave equation . . . . . 32 The initial value problem for hyperbolic equations with a normal surface having multiple points . . . . . 36 CHAPTER III The Fundamental Solution of a Linear Elliptic Differential Equation witL Analytic Coefficients Definition of a fundamental solution . . . . . 43 The Cauchy problem . . . . . 45 Solution of the inhomogeneous equation with a plane wave function as right hand side . . . . . 49 The fundamental solution. . . . . .
Hyperbolic Equations and Related Topics-Sigeru Mizohata 2014-05-10 Hyperbolic Equations and Related Topics covers the proceedings of the Taniguchi International Symposium, held in Katata, Japan on August 27-31, 1984 and in Kyoto, Japan on September 3-5, 1984. The book focuses on the mathematical analyses involved in hyperbolic equations. The selection first elaborates on complex vector fields; holomorphic extension of CR functions and related problems; second microlocalization and propagation of singularities for semi-linear hyperbolic equations; and scattering matrix for two convex obstacles. Discussions focus on the construction of asymptotic solutions, singular vector fields and Leibniz formula, second microlocalization along a Lagrangean submanifold, and hypo-analytic structures. The text then ponders on the Cauchy problem for effectively hyperbolic equations and for uniformly diagonalizable hyperbolic systems in Gevrey classes. The book takes a look at generalized Hamilton flows and singularities of solutions of the hyperbolic Cauchy problem and analytic and Gevrey well-posedness of the Cauchy problem for second order weakly hyperbolic equations with coefficients irregular in time. The selection is a dependable reference for researchers interested in hyperbolic equations.
The Solution of Cauchy's Problem for a Third Order Linear Hyperbolic Differential Equations by Means of Riesz Integrals-Stanford University. Department of Mathematics 1953
Asymptotic Gevrey Classes and the Cauchy Problem for Non-strictly Hyperbolic Linear Differential Equations-Edward Newberger 1969 The notion of asymptotic Gevrey classes alpha, alpha> 1 is introduced. These classes are related to but distinct from the Gevrey classes used by J. Leray and Y. Ohya in connection with the Cauchy problem for a nonstrictly hyperbolic equation defined on a strip X in R sub (l+1), l = or> 1. A characterization of an asymptotic Gevrey class alpha is given in terms of conditions on the determining sequence of the class. To this end, the work of S. Mandelbrojt on classes of infinitely differentiable functions is extended to strips X and to the norms associated with these strips. Asymptotic Gevrey classes are then applied to a study of the Cauchy problem for a non-strictly hyperbolic linear differential equation on X. It is proved that if the coefficients of the differential operator, the non-homogeneous term, and the Cauchy data belong to certain asymptotic Gevrey classes alpha, then a solution exists on X which belongs to an appropriate Gevrey class alpha. (Author).
Lectures on Cauchy's Problem in Linear Partial Differential Equations-Jacques Hadamard 2014-08-25 Would well repay study by most theoretical physicists." — Physics Today "An overwhelming influence on subsequent work on the wave equation." — Science Progress "One of the classical treatises on hyperbolic equations." — Royal Naval Scientific Service Delivered at Columbia University and the Universities of Rome and Zürich, these lectures represent a pioneering investigation. Jacques Hadamard based his research on prior studies by Riemann, Kirchhoff, and Volterra. He extended and improved Volterra's work, applying its theories relating to spherical and cylindrical waves to all normal hyperbolic equations instead of only to one. Topics include the general properties of Cauchy's problem, the fundamental formula and the elementary solution, equations with an odd number of independent variables, and equations with an even number of independent variables and the method of descent.
The Cauchy Problem and the Mixed Boundary Value Problem for a Non-linear Hyperbolic Partial Differential Equation in Two Independent Variables-James Conlan 1958
On the Cauchy Problem of a 2 X 2 System of Nonstrictly Hyperbolic Conservation Laws-Pui Tak Kan 1989
Hyperbolic Problems and Regularity Questions-Mariarosaria Padula 2007-01-21 This book discusses new challenges in the quickly developing field of hyperbolic problems. Particular emphasis lies on the interaction between nonlinear partial differential equations, functional analysis and applied analysis as well as mechanics. The book originates from a recent conference focusing on hyperbolic problems and regularity questions. It is intended for researchers in functional analysis, PDE, fluid dynamics and differential geometry.
Well-posedness of Linear Hyperbolic Problems-Aleksandr Mikhaĭlovich Blokhin 2006 "This book will be useful for students and specialists of partial differential equations and the mathematical sciences because it clarifies crucial points of Kreiss' symmetrizer technique. The Kreiss technique was developed by H.O. Kreiss for initial boundary value problems for linear hyperbolic systems. This technique is important because it involves equations that are used in many of the applied sciences. The research presented in this book takes unique approaches to exploring the Kreiss technique that will add insight and new perspectives to linear hyperbolic problems"--Publ. web site.
Hyperbolic Equations and General Relativity-Marica Minucci 2019 This work is divided into three parts. In the first part, the hyperbolic equations' theory is analysed, the second part concerns the Cauchy problem in General Relativity, whereas the third part gives a modern perspective of General Relativity. In the first part, the study of systems of partial differential equations allows the introduction of the concept of wave-like propagation and the definition of hyperbolic equation is given. Thus, once the definition of Riemann kernel is given, Riemann's method to solve a hyperbolic equation in two variables is shown. The discussion moves on the fundamental solutions and its relation to Riemann kernel is pointed out. Therefore, the study of the fundamental solutions concludes by showing how to build them providing some examples of solution with odd and even number of variables. Moreover, the fundamental solution of the scalar wave equation with smooth initial conditions is studied. In the second part, following the work of FourÃ¯s-Bruhat, the problem of finding a solution to the Cauchy problem for Einstein field equations in vacuum with non-analytic initial data is presented by first studying under which assumptions second-order systems of partial differential equations, linear and hyperbolic, with n functions and four variables admit a solution. Hence, it is shown how to turn non-linear systems of partial differential equations into linear systems of the same type for which the previous results hold. These considerations allow us to prove the existence and uniqueness of the solution to the Cauchy problem for Einstein's vacuum field equations with non-analytic initial data. Eventually, the causal structure of space-time is studied. The definitions of strong causality, stable causality and global hyperbolicity are given and the relation between the property of global hyperbolicity and the existence of Cauchy surfaces is stressed. In the third part, Riemann's method is used to study the news function describing the gravitational radiation produced in axisymmetric black hole collisions at the speed of light. More precisely, since the perturbative field equations may be reduced to equations in two independent variables, as was proved by D'Eath and Payne, the Green function can be analysed by studying the corresponding second-order hyperbolic operator with variable coefficients. Thus, an integral representation of the solution in terms of the Riemann kernel function can be given.
Multi-dimensional hyperbolic partial differential equations-Sylvie Benzoni-Gavage 2006-11-23 Authored by leading scholars, this comprehensive, self-contained text presents a view of the state of the art in multi-dimensional hyperbolic partial differential equations, with a particular emphasis on problems in which modern tools of analysis have proved useful. Ordered in sections of gradually increasing degrees of difficulty, the text first covers linear Cauchy problems and linear initial boundary value problems, before moving on to nonlinear problems, including shock waves. The book finishes with a discussion of the application of hyperbolic PDEs to gas dynamics, culminating with the shock wave analysis for real fluids. With an extensive bibliography including classical and recent papers both in PDE analysis and in applications (mainly to gas dynamics), this text will be valuable to graduates and researchers in both hyperbolic PDEs and compressible fluid dynamics.
A Singular Cauchy Problem for a Quasilinear Hyperbolic Equation-Robin Edward Textor 1972
Partial Differential Equations in Classical Mathematical Physics-Isaak Rubinstein 1998-04-28 The book's combination of mathematical comprehensiveness and natural scientific motivation represents a step forward in the presentation of the classical theory of PDEs.

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