

# Introduction

## Nonlinear wave equations

- Simplest Nonlinear

$$u_t + (1+u)u_x = 0$$

$$u(x,t) = f(x - (1+u)t)$$

Sharpens at leading and trailing edges (shock formation)

- Korteweg de Vries (KdV) Equation (1895)

$$u_t + (1+u)u_x + u_{xxx} = 0$$

$$u(x, t) = \frac{c}{2} \operatorname{sech}^2 \left( \frac{\sqrt{c}}{2} (x - ct - x_0) \right)$$

Solitary wave/soliton behaviour

Dispersion and tendency to shock formation in balance

# Nonlinear Wave Equations

**Yan Guo**



## **Nonlinear Wave Equations:**

**Nonlinear Wave Equations** Walter A. Strauss, 1990-01-12 The theory of nonlinear wave equations in the absence of shocks began in the 1960s Despite a great deal of recent activity in this area some major issues remain unsolved such as sharp conditions for the global existence of solutions with arbitrary initial data and the global phase portrait in the presence of periodic solutions and traveling waves This book based on lectures presented by the author at George Mason University in January 1989 seeks to present the sharpest results to date in this area The author surveys the fundamental qualitative properties of the solutions of nonlinear wave equations in the absence of boundaries and shocks These properties include the existence and regularity of global solutions strong and weak singularities asymptotic properties scattering theory and stability of solitary waves Wave equations of hyperbolic Schrodinger and KdV type are discussed as well as the Yang Mills and the Vlasov Maxwell equations The book offers readers a broad overview of the field and an understanding of the most recent developments as well as the status of some important unsolved problems Intended for mathematicians and physicists interested in nonlinear waves this book would be suitable as the basis for an advanced graduate level course Nonlinear Wave Equations Tatsien Li, Yi Zhou, 2017-11-23 This book focuses on nonlinear wave equations which are of considerable significance from both physical and theoretical perspectives It also presents complete results on the lower bound estimates of lifespan including the global existence which are established for classical solutions to the Cauchy problem of nonlinear wave equations with small initial data in all possible space dimensions and with all possible integer powers of nonlinear terms Further the book proposes the global iteration method which offers a unified and straightforward approach for treating these kinds of problems Purely based on the properties of solutions to the corresponding linear problems the method simply applies the contraction mapping principle Nonlinear Wave Equations Satyanad Kichenassamy, 1995-09-05 This work examines the mathematical aspects of nonlinear wave propagation emphasizing nonlinear hyperbolic problems It introduces the tools that are most effective for exploring the problems of local and global existence singularity formation and large time behaviour of solutions and for the study of perturbation methods **Nonlinear Wave Equations** Yan Guo, 2000 This volume presents original research papers and expository articles from the conference in honour of Walter A Strauss's 60th birthday held at Brown University in Providence Rhode Island The book offers a collection of original papers and expository articles mainly devoted to the study of nonlinear wave equations The articles cover a wide range of topics including scattering theory dispersive waves classical field theory mathematical fluid dynamics kinetic theory stability theory and variational methods The book offers a cross section of current trends and research directions in the study of nonlinear wave equations and related topics *Distributional Nonlinear Wave Equations* Khaled Zennir, Svetlin G. Georgiev, 2025-01-27 The book contains eleven chapters introduced by an introductory description Qualitative properties for the semilinear dissipative wave equations are discussed in Chapter 2 and Chapter 3 based on the solutions with compactly supported initial data The purpose

of Chapter 4 is to present results according to the well posedness and behavior of solutions the nonlinear viscoelastic wave equations in weighted spaces Elements of theory of Kirchhoff problem is introduced in Chapter 5 It is introduced same decay rate of second order evolution equations with density Chapter 6 is devoted on the original method for Well posedness and general decay for wave equation with logarithmic nonlinearities In Chapter 7 it is investigated the uniform stabilization of the Petrovsky Wave nonlinear coupled system The question of well posedness and general energy decay of solutions for a system of three wave equations with a nonlinear strong dissipation are investigated in chapter 8 using the weighted Insofar as Chapter 9 and chapter 10 are concerned with damped nonlinear wave problems in Fourier spaces The last Chapter 11 analysis the existence nonexistence of solutions for structural damped wave equations with nonlinear memory terms in  $\mathbb{R}^n$

**Nonlinear Wave Equations** Daqian Li, Yi Zhou, 2017      Nonlinear Waves in Inhomogeneous and Hereditary Media Aleksandr Aleksandrovich Lokshin, Elena Arturovna Sagomonyan, 1992      **Solitons and Nonlinear Wave Equations** Dobb RK., 1982      **Solitons and Nonlinear Wave Equations** Roger K. Dodd, 1982      *Nonlinear Wave Equations* Walter A. Strauss, 1989 The theory of nonlinear wave equations in the absence of shocks began in the 1960s Despite a great deal of recent activity in this area some major issues remain unsolved such as sharp conditions for the global existence of solutions with arbitrary initial data and the global phase portrait in the presence of periodic solutions and traveling waves This book based on lectures presented by the author at George Mason University in January 1989 seeks to present the sharpest results to date in this area The author surveys the fundamental qualitative properties of the solutions of nonlinear wave      *Lectures on the Energy Critical Nonlinear Wave Equation* Carlos E. Kenig, 2015-04-14 This monograph deals with recent advances in the study of the long time asymptotics of large solutions to critical nonlinear dispersive equations The first part of the monograph describes in the context of the energy critical wave equation the concentration compactness rigidity theorem method introduced by C Kenig and F Merle This approach has become the canonical method for the study of the global regularity and well posedness conjecture defocusing case and the ground state conjecture focusing case in critical dispersive problems The second part of the monograph describes the channel of energy method introduced by T Duyckaerts C Kenig and F Merle to study soliton resolution for nonlinear wave equations This culminates in a presentation of the proof of the soliton resolution conjecture for the three dimensional radial focusing energy critical wave equation It is the intent that the results described in this book will be a model for what to strive for in the study of other nonlinear dispersive equations A co publication of the AMS and CBMS      **Nonlinear Waves in Inhomogeneous and Hereditary Media** Alexandr A. Lokshin, Elena A. Sagomonyan, 1992 This booklet presents a study of one dimensional waves in solids which can be modelled by nonlinear wave equations of different types The factorization method is the main tool in this analysis It allows for an exact or at least asymptotic decomposition of the waves under consideration in terms of first order multipliers Chapter 1 provides a general introduction It presents some well known results on characteristics Riemann invariants simple waves etc The main result of

Chap 1 is Theorem 1.3.2 Sect 1.3.2 which establishes the possibility of exact factorization of the nonlinear wave equation  $E_{tt} + u_x^2$  with constant coefficients. This theorem permits one to construct further factorizations of more complicated wave equations which the reader will meet in the following chapters. Chapter 2 is devoted to short wave processes in inhomogeneous media, the main result being the uniform asymptotic factorization of nonlinear wave equations with variable coefficients and the description of corresponding single wave processes without the usual assumption of a small wave amplitude.

*Nonlinear Wave Equations* Walter A. Strauss, 1989

[Linear And Nonlinear Wave Propagation](#) Spencer P. Kuo, 2021-04-16

Waves are essential phenomena in most scientific and engineering disciplines such as electromagnetism and optics and different mechanics including fluid, solid, structural, quantum, etc. They appear in linear and nonlinear systems. Some can be observed directly and others are not. The features of the waves are usually described by solutions to either linear or nonlinear partial differential equations which are fundamental to the students and researchers. Generic equations describing wave and pulse propagation in linear and nonlinear systems are introduced and analyzed as initial boundary value problems. These systems cover the general properties of non-dispersive and dispersive, uniform and non-uniform, with and without dissipation. Methods of analyses are introduced and illustrated with analytical solutions. Wave-wave and wave-particle interactions ascribed to the nonlinearity of media such as plasma are discussed in the final chapter. This interdisciplinary textbook is essential reading for anyone in the above mentioned disciplines. It was prepared to provide students with an understanding of waves and methods of solving wave propagation problems. The presentation is self-contained and should be read without difficulty by those who have adequate preparation in classic mechanics. The selection of topics and the focus given to each provide essential materials for a lecturer to cover the bases in a linear/nonlinear wave course.

[Lectures on Non-linear Wave Equations](#) Christopher Donald Sogge, 2008

Presents an account of the basic facts concerning the linear wave equation and the methods from harmonic analysis that are necessary when studying nonlinear hyperbolic differential equations. This book examines quasilinear equations with small data where the Klainerman-Sobolev inequalities and weighted space-time estimates are introduced.

[Nonlinear Wave Equations, Formation of Singularities](#) Fritz John, 2019

**Nonlinear Waves** Lokenath Debnath, 2009-01-08

The outcome of a conference held in East Carolina University in June 1982, this book provides an account of developments in the theory and application of nonlinear waves in both fluids and plasmas. Twenty-two contributors from eight countries here cover all the main fields of research including nonlinear water waves, KdV equations, solitons and inverse scattering transforms, stability of solitary waves, resonant wave interactions, nonlinear evolution equations, nonlinear wave phenomena in plasmas, recurrence phenomena in nonlinear wave systems, and the structure and dynamics of envelope solitons in plasmas.

**Global Existence and Blow-up of Solutions for Nonlinear Wave Equations** Hengli Jiao, 1996

**Harmonic Analysis And Wave Equations** Jean-michel Coron, Tatsien Li, Wei-min Wang, 2019-08-19

This book is a collection of lecture notes for the LIAFMA School and Workshop on Harmonic

Analysis and Wave Equations which was held on May 8 18 2017 at Fudan University in Shanghai China The aim of the LIASFMA School and Workshop is to bring together Chinese and French experts to discuss and dissect recent progress in these related fields and to disseminate state of art new knowledge and new concepts to graduate students and junior researchers The book provides the readers with a unique and valuable opportunity to learn from and communicate with leading experts in nonlinear wave type equations The readers will witness the major development with the introduction of modern harmonic analysis and related techniques      Nonlinear Wave Equations Oana Pascu,2002

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algo básico para conseguir aprender y memorizar algo es hacer que esta información entre en nuestra mente en varias ocasiones con una sola presentación es muy complejo mantener algo en la memoria a menos que tenga un profundo impacto emocional el repaso y la repetición sirven para ir reforzando la see more

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limitarse a leer un texto y esperar a que este acabe grabándose en la memoria puede ser un proceso lento y poco eficiente resulta recomendable a la hora de acelerarlo realizar [see more](#)

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