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of the  
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Number 654

## The Riemann Problem for the Transportation Equations in Gas Dynamics

Wancheng Sheng  
Tong Zhang



January 1999 • Volume 137 • Number 654 (third of 6 numbers) • ISSN 0065-9266

American Mathematical Society

# Riemann Problem For The Transportation Equations In Gas Dynamics

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## **Riemann Problem For The Transportation Equations In Gas Dynamics:**

*The Riemann Problem for the Transportation Equations in Gas Dynamics* Wancheng Sheng, Tong Zhang, 1999 In this volume the one dimensional and two dimensional Riemann problems for the transportation equations in gas dynamics are solved constructively In either the 1 D or 2 D case there are only two kinds of solutions one involves Dirac delta waves and the other involves vacuums which has been merely discussed so far The generalized Rankine Hugoniot and entropy conditions for Dirac delta waves are clarified with viscous vanishing method All of the existence uniqueness and stability for viscous perturbations are proved analytically

**Riemann Problem for the Transportation Equations in Gas Dynamics** Wancheng Sheng, Tong Zhang, 2014-09-11 In this volume the one dimensional and two dimensional Riemann problems for the transportation equations in gas dynamics are solved constructively In either the 1 D or 2 D case there are only two kinds of solutions one involves Dirac delta waves and the other involves vacuums which has been merely discussed so far The generalized Rankine Hugoniot and entropy conditions for Dirac delta waves are clarified with viscous vanishing method All of the existence uniqueness and stability for viscous perturbations are proved analytically

**The Two-Dimensional Riemann Problem in Gas Dynamics** Jiequan Li, Tong Zhang, Shuli Yang, 2022-02-13 The Riemann problem is the most fundamental problem in the entire field of non linear hyperbolic conservation laws Since first posed and solved in 1860 great progress has been achieved in the one dimensional case However the two dimensional case is substantially different Although research interest in it has lasted more than a century it has yielded almost no analytical demonstration It remains a great challenge for mathematicians This volume presents work on the two dimensional Riemann problem carried out over the last 20 years by a Chinese group The authors explore four models scalar conservation laws compressible Euler equations zero pressure gas dynamics and pressure gradient equations They use the method of generalized characteristic analysis plus numerical experiments to demonstrate the elementary field interaction patterns of shocks rarefaction waves and slip lines They also discover a most interesting feature for zero pressure gas dynamics a new kind of elementary wave appearing in the interaction of slip lines a weighted Dirac delta shock of the density function The Two Dimensional Riemann Problem in Gas Dynamics establishes the rigorous mathematical theory of delta shocks and Mach reflection like patterns for zero pressure gas dynamics clarifies the boundaries of interaction of elementary waves demonstrates the interesting spatial interaction of slip lines and proposes a series of open problems With applications ranging from engineering to astrophysics and as the first book to examine the two dimensional Riemann problem this volume will prove fascinating to mathematicians and hold great interest for physicists and engineers

*Handbook of Differential Equations: Evolutionary Equations* C.M. Dafermos, Eduard Feireisl, 2005-10-05 The aim of this Handbook is to acquaint the reader with the current status of the theory of evolutionary partial differential equations and with some of its applications Evolutionary partial differential equations made their first appearance in the 18th century in the endeavor to understand the motion of fluids and other continuous media The active

research effort over the span of two centuries combined with the wide variety of physical phenomena that had to be explained has resulted in an enormous body of literature Any attempt to produce a comprehensive survey would be futile The aim here is to collect review articles written by leading experts which will highlight the present and expected future directions of development of the field The emphasis will be on nonlinear equations which pose the most challenging problems today Volume I of this Handbook does focus on the abstract theory of evolutionary equations Volume 2 considers more concrete problems relating to specific applications Together they provide a panorama of this amazingly complex and rapidly developing branch of mathematics

*Handbook of Mathematical Fluid Dynamics* S. Friedlander,D. Serre,2002-07-09 The Handbook of Mathematical Fluid Dynamics is a compendium of essays that provides a survey of the major topics in the subject Each article traces developments surveys the results of the past decade discusses the current state of knowledge and presents major future directions and open problems Extensive bibliographic material is provided The book is intended to be useful both to experts in the field and to mathematicians and other scientists who wish to learn about or begin research in mathematical fluid dynamics The Handbook illuminates an exciting subject that involves rigorous mathematical theory applied to an important physical problem namely the motion of fluids

*Advances in Differential Equations and Mathematical Physics* Yulia E. Karpeshina,2003 This volume presents the proceedings of the 9th International Conference on Differential Equations and Mathematical Physics It contains 29 research and survey papers contributed by conference participants The conference provided researchers a forum to present and discuss their recent results in a broad range of areas encompassing the theory of differential equations and their applications in mathematical physics Papers in this volume represent some of the most interesting results and the major areas of research that were covered including spectral theory with applications to non relativistic and relativistic quantum mechanics including time dependent and random potential resonances many body systems pseudodifferential operators and quantum dynamics inverse spectral and scattering problems the theory of linear and nonlinear partial differential equations with applications in fluid dynamics conservation laws and numerical simulations as well as equilibrium and nonequilibrium statistical mechanics The volume is intended for graduate students and researchers interested in mathematical physics

*Continuum Mechanics, Applied Mathematics and Scientific Computing: Godunov's Legacy* Gennadii V. Demidenko,Evgeniy Romenski,Eleuterio Toro,Michael Dumbser,2020-04-03 This book is a liber amicorum to Professor Sergei Konstantinovich Godunov and gathers contributions by renowned scientists in honor of his 90th birthday The contributions address those fields that Professor Godunov is most famous for differential and difference equations partial differential equations equations of mathematical physics mathematical modeling difference schemes advanced computational methods for hyperbolic equations computational methods for linear algebra and mathematical problems in continuum mechanics

*Nonlinear Conservation Laws and Applications* Alberto Bressan,Gui-Qiang G. Chen,Marta Lewicka,Dehua Wang,2011-04-19 This volume contains the proceedings of the Summer

Program on Nonlinear Conservation Laws and Applications held at the IMA on July 13-31 2009 Hyperbolic conservation laws is a classical subject which has experienced vigorous growth in recent years The present collection provides a timely survey of the state of the art in this exciting field and a comprehensive outlook on open problems Contributions of more theoretical nature cover the following topics global existence and uniqueness theory of one dimensional systems multidimensional conservation laws in several space variables and approximations of their solutions mathematical analysis of fluid motion stability and dynamics of viscous shock waves singular limits for viscous systems basic principles in the modeling of turbulent mixing transonic flows past an obstacle and a fluid dynamic approach for isometric embedding in geometry models of nonlinear elasticity the Monge problem and transport equations with rough coefficients In addition there are a number of papers devoted to applications These include models of blood flow self gravitating compressible fluids granular flow charge transport in fluids and the modeling and control of traffic flow on networks

**Generalizations of the Perron-Frobenius Theorem for Nonlinear Maps** Roger D. Nussbaum, Sjoerd M. Verduyn Lunel, 1999 The classical Frobenius Perron Theorem establishes the existence of periodic points of certain linear maps in  $\mathbb{R}^n$  The authors present

generalizations of this theorem to nonlinear **Rational  $S^1$ -Equivariant Stable Homotopy Theory** John Patrick Campbell Greenlees, 1999 The memoir presents a systematic study of rational  $S^1$  equivariant cohomology theories and a complete algebraic model for them It provides a classification of such cohomology theories in simple algebraic terms and a practical means of calculation The power of the model is illustrated by analysis of the Segal conjecture the behaviour of the Atiyah Hirzebruch spectral sequence the structure of  $S^1$  equivariant K theory and the rational behaviour of cyclotomic spectra and the topological cyclic homology construction Inverse Invariant Theory and Steenrod Operations Mara D.

Neusel, 2000 This book is intended for researchers and graduate students in commutative algebra algebraic topology and invariant theory Control and Relaxation over the Circle Bruce Hughes, Stratos Prassidis, 2000 This work formulates and proves a geometric version of the fundamental theorem of algebraic K theory which relates the K theory of the Laurent polynomial extension of a ring to the K theory of the ring The geometric version relates the higher simple homotopy theory of the product of a finite complex and a circle with that of the complex By using methods of controlled topology we also obtain a geometric version of the fundamental theorem of lower algebraic K theory The main new innovation is a geometrically defined nil space *Matching of Orbital Integrals on  $GL(4)$  and  $GSp(2)$*  Yuval Zvi Flicker, 1999 The trace formula is the

most powerful tool currently available to establish liftings of automorphic forms as predicted by Langlands principle of functionality The geometric part of the trace formula consists of orbital integrals and the lifting is based on the fundamental lemma The latter is an identity of the relevant orbital integrals for the unit elements of the Hecke algebras This volume concerns a proof of the fundamental lemma in the classically most interesting case of Siegel modular forms namely the symplectic group  $Sp(2)$  These orbital integrals are compared with those on  $GL(4)$  twisted by the transpose inverse involution

The technique of proof is elementary Compact elements are decomposed into their absolutely semi simple and topologically unipotent parts also in the twisted case a double coset decomposition of the form  $H G K$  where  $H$  is a subgroup containing the centralizer plays a key role

**Caustics for Dissipative Semilinear Oscillations** Jean-Luc Joly, Guy Métivier, Jeffrey Rauch, 2000 This book is intended for graduate students and research mathematicians interested in partial differential equations

**Algebraic and Strong Splittings of Extensions of Banach Algebras** William G. Bade, Harold G. Dales, Zinaida Alexandrovna Lykova, 1999 In this volume the authors address the following Let  $A$  be a Banach algebra and let  $0 \rightarrow I \rightarrow \text{frak } A \rightarrow \text{frak } A/I \rightarrow 0$  be an extension of  $A$  where  $\text{frak } A$  is a Banach algebra and  $I$  is a closed ideal in  $\text{frak } A$  The extension splits algebraically respectively splits strongly if there is a homomorphism respectively continuous homomorphism  $\theta: A \rightarrow \text{frak } A$  such that  $\pi \circ \theta$  is the identity on  $A/I$  Consider first for which Banach algebras  $A$  it is true that every extension of  $A$  in a particular class of extensions splits either algebraically or strongly and second for which Banach algebras it is true that every extension of  $A$  in a particular class which splits algebraically also splits strongly These questions are closely related to the question when the algebra  $\text{frak } A$  has a strong Wedderburn decomposition The main technique for resolving these questions involves the Banach cohomology group  $H^2(A, E)$  for a Banach  $A$  bimodule  $E$  and related cohomology groups Later chapters are particularly concerned with the case where the ideal  $I$  is finite dimensional Results are obtained for many of the standard Banach algebras  $A$

**Splitting Theorems for Certain Equivariant Spectra** L. Gaunce Lewis, 2000 This book is intended for graduate students and research mathematicians interested in algebraic topology

*Uniform Rectifiability and Quasiminimizing Sets of Arbitrary Codimension* Guy David, Stephen Semmes, 2000 This book is intended for graduate students and research mathematicians interested in calculus of variations and optimal control optimization

Sobolev Met Poincare Piotr Hajłasz, Pekka Koskela, 2000 There are several generalizations of the classical theory of Sobolev spaces as they are necessary for the applications to Carnot Caratheodory spaces subelliptic equations quasiconformal mappings on Carnot groups and more general Loewner spaces analysis on topological manifolds potential theory on infinite graphs analysis on fractals and the theory of Dirichlet forms The aim of this paper is to present a unified approach to the theory of Sobolev spaces that covers applications to many of those areas The variety of different areas of applications forces a very general setting We are given a metric space  $X$  equipped with a doubling measure  $\mu$  A generalization of a Sobolev function and its gradient is a pair  $u \in L^1_{\text{loc}}(X)$   $0 \leq g \in L^p(X)$  such that for every ball  $B \subset X$  the Poincare type inequality  $\int_B |u - \int_B u| d\mu \leq C r \int_B g d\mu$  holds where  $r$  is the radius of  $B$  and  $\sigma \geq 1$   $C \geq 0$  are fixed constants Working in the above setting we show that basically all relevant results from the classical theory have their counterparts in our general setting These include Sobolev Poincare type embeddings Rellich Kondrachov compact embedding theorem and even a version of the Sobolev embedding theorem on spheres The second part of the paper is devoted to examples and applications in the above

mentioned areas      *Cutting Brownian Paths* Richard F. Bass, Krzysztof Burdzy, 1999 A long open problem in probability theory has been the following Can the graph of planar Brownian motion be split by a straight line In this volume the authors provide a solution discuss related works and present a number of open problems      Special Groups M. A. Dickmann, Francisco Miraglia, 2000 This monograph presents a systematic study of Special Groups a first order universal existential axiomatization of the theory of quadratic forms which comprises the usual theory over fields of characteristic different from 2 and is dual to the theory of abstract order spaces The heart of our theory begins in Chapter 4 with the result that Boolean algebras have a natural structure of reduced special group More deeply every such group is canonically and functorially embedded in a certain Boolean algebra its Boolean hull This hull contains a wealth of information about the structure of the given special group and much of the later work consists in unveiling it Thus in Chapter 7 we introduce two series of invariants living in the Boolean hull which characterize the isometry of forms in any reduced special group While the multiplicative series expressed in terms of meet and symmetric difference constitutes a Boolean version of the Stiefel Whitney invariants the additive series expressed in terms of meet and join which we call Horn Tarski invariants does not have a known analog in the field case however the latter have a considerably more regular behaviour We give explicit formulas connecting both series and compute explicitly the invariants for Pfister forms and their linear combinations In Chapter 9 we combine Boolean theoretic methods with techniques from Galois cohomology and a result of Voevodsky to obtain an affirmative solution to a long standing conjecture of Marshall concerning quadratic forms over formally real Pythagorean fields Boolean methods are put to work in Chapter 10 to obtain information about categories of special groups reduced or not And again in Chapter 11 to initiate the model theoretic study of the first order theory of reduced special groups where amongst other things we determine its model companion The first order approach is also present in the study of some outstanding classes of morphisms carried out in Chapter 5 e g the pure embeddings of special groups Chapter 6 is devoted to the study of special groups of continuous functions

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