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read computing qualitatively correct approximations of balance laws exponential fit well balanced and asymptotic preserving by laurent gosse available from rakuten kobo substantial effort has been drawn for years onto the development of possibly high order numerical techniques for the s Computing Qualitatively Correct Approximations Of Balance Laws

This book book explores the ways that elaborate flux functions can be constructed, mainly in a one-dimensional context for hyperbolic systems admitting shock-type solutions and also for kinetic equations in the discrete-ordinate approximation.

Substantial effort has been drawn for years onto the development of (possibly high-order) numerical techniques for the scalar homogeneous conservation law, an equation which is strongly dissipative in L1 thanks to shock wave formation. Such a dissipation property is generally lost when considering hyperbolic systems of conservation laws, or simply inhomogeneous scalar balance laws involving accretive or space-dependent source terms, because of complex wave interactions. An overall weaker dissipation can reveal intrinsic numerical weaknesses through specific nonlinear mechanisms: Hugoniot curves being deformed by local averaging steps in Godunov-type schemes, low-order errors propagating along

expanding characteristics after having hit a discontinuity, exponential amplification of truncation errors in the presence of accretive source terms...
This book aims at presenting rigorous derivations of

different, sometimes called well-balanced, numerical schemes which succeed in reconciling high accuracy with a stronger robustness even in the aforementioned accretive contexts. It is divided into two parts: one dealing with hyperbolic systems of balance laws, such as arising from quasi-one dimensional nozzle flow computations, multiphase WKB approximation of linear Schrödinger equations, or gravitational Navier-Stokes systems. Stability results for viscosity solutions of onedimensional balance laws are sketched. The other being entirely devoted to the treatment of weakly nonlinear kinetic equations in the discrete ordinate

approximation, such as the ones of radiative transfer, chemotaxis dynamics, semiconductor conduction, spray dynamics or linearized Boltzmann models.
"Caseology" is one of the main techniques used in

these derivations. Lagrangian techniques for filtration equations are evoked too. Two-dimensional methods are studied in the context of non-degenerate semiconductor models.

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.

This volume gathers

contributions reflecting topics presented during an INDAM workshop held in Rome in May 2016. The event brought together many prominent researchers in both Mathematical Analysis and Numerical Computing, the goal being to promote interdisciplinary collaborations. Accordingly, the following thematic areas were developed: 1. Lagrangian discretizations and wavefront tracking for synchronization models; 2.

Astrophysics computations and post-Newtonian approximations; 3. Hyperbolic balance laws and corrugated isometric embeddings; 4. "Caseology" techniques for kinetic equations; 5. Tentative computations of compressible non-standard solutions; 6. Entropy dissipation, convergence rates and inverse design issues. Most of the articles are presented in a self-contained manner; some highlight new achievements, while others offer snapshots of the “state of the art” in certain fields. The book offers a unique resource, both for young researchers looking to quickly enter a given area of application, and for more experienced ones seeking comprehensive overviews and extensive bibliographic references.

This monograph presents, in an attractive and self-contained form, techniques based on the L1 stability theory derived at the end of the 1990s by A. Bressan, T.-P. Liu and T. Yang that yield original error estimates for so-called well-balanced numerical schemes solving 1D hyperbolic systems of balance laws. Rigorous error estimates are presented for both scalar balance laws and a position-dependent relaxation system, in inertial approximation. Such estimates shed light on why those algorithms based on source terms handled like "local scatterers" can outperform other, more standard, numerical schemes. Two-dimensional Riemann problems for the linear wave equation are also solved, with discussion of the issues raised relating to the treatment of 2D balance laws. All of the material provided in this book is highly relevant for the understanding of well-balanced schemes and will contribute to future improvements.

The proceedings of the 9th conference on "Finite Volumes for Complex Applications" (Bergen, June 2020) are structured in two volumes. The first volume collects the focused invited papers, as well as the reviewed contributions from internationally leading researchers in the field of analysis of finite volume and related methods. Topics covered include convergence and stability analysis, as well as investigations of these methods from the point of view of compatibility with physical principles. Altogether, a rather comprehensive overview is given on the state of the art in the field. The properties of the methods considered in the conference give them distinguished advantages for a number of applications. These include fluid dynamics, magnetohydrodynamics, structural analysis, nuclear physics, semiconductor theory, carbon capture utilization and storage, geothermal energy and further topics. The second volume covers reviewed contributions reporting successful applications of finite volume and related methods in these fields. The finite volume method in its various forms is a space discretization technique for partial differential equations based on the fundamental physical principle of conservation. Many finite volume methods preserve further qualitative or asymptotic properties, including maximum principles, dissipativity, monotone decay of free energy, and asymptotic stability, making the finite volume methods compatible discretization methods, which preserve qualitative properties of continuous problems at the discrete level. This structural approach to the discretization of partial differential equations becomes particularly important for multiphysics and multiscale applications. The book is a valuable resource for researchers, PhD and master's level students in numerical analysis, scientific computing and related fields such as partial differential equations, as well as engineers working in numerical modeling and simulations.

The first of two volumes, this edited proceedings book features research presented at the XVI International Conference on Hyperbolic Problems held in Aachen, Germany in summer 2016. It focuses on the theoretical, applied, and computational aspects of hyperbolic partial differential equations (systems of hyperbolic conservation laws, wave equations, etc.)

and of related mathematical models (PDEs of mixed type, kinetic equations, nonlocal or/and discrete models) found in the field of applied sciences.

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This monograph presents cutting-edge research on dispersive wave modelling, and the numerical methods used to simulate the propagation and generation of long surface water waves. Including both an overview of existing dispersive models, as well as recent breakthroughs, the authors maintain an ideal balance between theory and applications. From modelling tsunami waves to smaller scale coastal processes, this book will be an indispensable resource for those looking to be brought up-to-date in this active area of scientific research. Beginning with an introduction to various dispersive long wave models on the flat space, the authors establish a foundation on which readers can confidently approach more advanced mathematical models and numerical techniques. The first two chapters of the book cover modelling and numerical simulation over globally flat spaces, including adaptive moving grid methods along with the operator splitting approach, which was historically proposed at the Institute of Computational Technologies at Novosibirsk. Later chapters build on this to explore high-end mathematical modelling of the fluid flow over deformed and rotating spheres using the operator splitting approach. The appendices that follow further elaborate by providing valuable insight into long wave models based on the potential flow assumption, and modified intermediate weakly nonlinear weakly dispersive equations. Dispersive Shallow Water Waves will be a valuable resource for researchers studying theoretical or applied oceanography, nonlinear waves as well as those more broadly interested in free surface flow dynamics.

This book focuses on the

interplay between Eulerian and Lagrangian conservation laws for systems that admit physical motivation and originate from continuum mechanics. Ultimately, it highlights what is specific to and beneficial in the

Lagrangian approach and its numerical methods. The two first chapters present a selection of well-known features of conservation laws and prepare readers for the subsequent chapters, which are dedicated to the analysis and discretization of Lagrangian systems. The text is at the frontier of applied mathematics and scientific computing and appeals to students and researchers interested in Lagrangian-based computational fluid dynamics. It also serves as an introduction to the recent corner-based Lagrangian finite volume techniques.