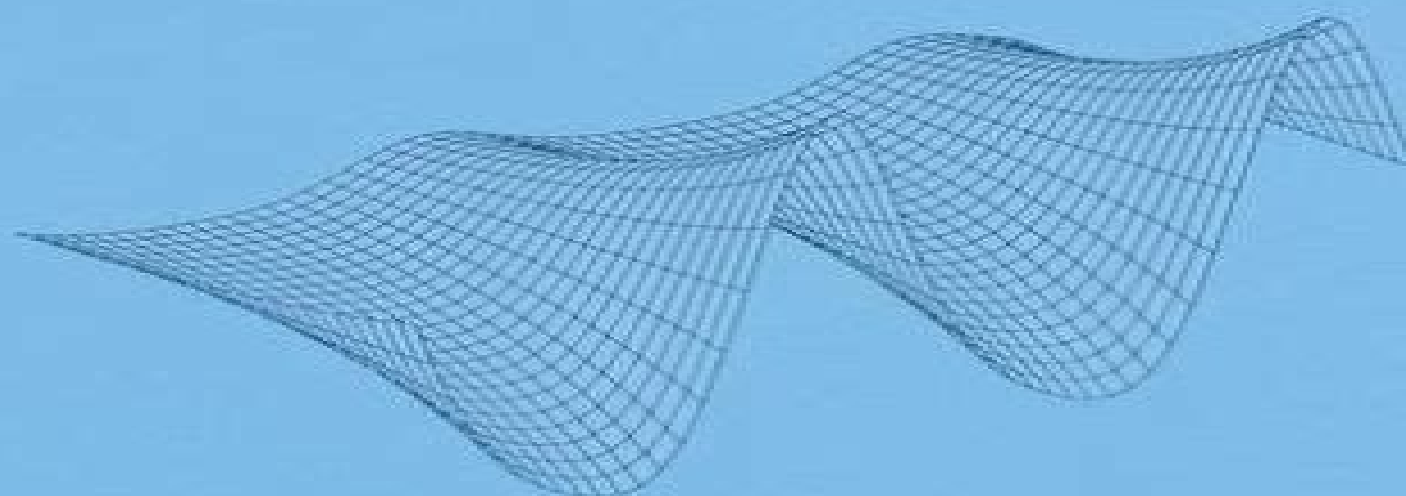


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NUMERICAL METHODS FOR SHALLOW-WATER FLOW

by

C. B. Vreugdenhil



Numerical Methods For Shallow Water Flow

Oscar Castro-Orgaz, Willi H. Hager



Numerical Methods For Shallow Water Flow:

Numerical Methods for Shallow-Water Flow C.B. Vreugdenhil, 1994-10-31 A wide variety of problems are associated with the flow of shallow water such as atmospheric flows tides storm surges river and coastal flows lake flows tsunamis Numerical simulation is an effective tool in solving them and a great variety of numerical methods are available The first part of the book summarizes the basic physics of shallow water flow needed to use numerical methods under various conditions The second part gives an overview of possible numerical methods together with their stability and accuracy properties as well as with an assessment of their performance under various conditions This enables the reader to select a method for particular applications Correct treatment of boundary conditions often neglected is emphasized The major part of the book is about two dimensional shallow water equations but a discussion of the 3 D form is included The book is intended for researchers and users of shallow water models in oceanographic and meteorological institutes hydraulic engineering and consulting It also provides a major source of information for applied and numerical mathematicians

Numerical Methods for Shallow-Water Flow C.B. Vreugdenhil, 2012-12-22 A wide variety of problems are associated with the flow of shallow water such as atmospheric flows tides storm surges river and coastal flows lake flows tsunamis Numerical simulation is an effective tool in solving them and a great variety of numerical methods are available The first part of the book summarizes the basic physics of shallow water flow needed to use numerical methods under various conditions The second part gives an overview of possible numerical methods together with their stability and accuracy properties as well as with an assessment of their performance under various conditions This enables the reader to select a method for particular applications Correct treatment of boundary conditions often neglected is emphasized The major part of the book is about two dimensional shallow water equations but a discussion of the 3 D form is included The book is intended for researchers and users of shallow water models in oceanographic and meteorological institutes hydraulic engineering and consulting It also provides a major source of information for applied and numerical mathematicians

Lattice Boltzmann Methods for Shallow Water Flows Jian Guo Zhou, 2013-03-14 The lattice Boltzmann method LBM is a modern numerical technique very efficient flexible to simulate different flows within complex varying geometries It is evolved from the lattice gas automata LGA in order to overcome the difficulties with the LGA The core equation in the LBM turns out to be a special discrete form of the continuum Boltzmann equation leading it to be self explanatory in statistical physics The method describes the microscopic picture of particles movement in an extremely simplified way and on the macroscopic level it gives a correct average description of a fluid The averaged particle velocities behave in time and space just as the flow velocities in a physical fluid showing a direct link between discrete microscopic and continuum macroscopic phenomena In contrast to the traditional computational fluid dynamics CFD based on a direct solution of flow equations the lattice Boltzmann method provides an indirect way for solution of the flow equations The method is characterized by simple calculation parallel process and easy implementation of boundary

conditions It is these features that make the lattice Boltzmann method a very promising computational method in different areas In recent years it receives extensive attentions and becomes a very potential research area in computational fluid dynamics However most published books are limited to the lattice Boltzmann methods for the Navier Stokes equations On the other hand shallow water flows exist in many practical situations such as tidal flows waves open channel flows and dam break flows

Shock-Capturing Methods for Free-Surface Shallow Flows E. F. Toro, 2001-03-30 The first of its kind in the field this title examines the use of modern shock capturing finite volume numerical methods in the solution of partial differential equations associated with free surface flows which satisfy the shallow water type assumption including shallow water flows dense gases and mixtures of materials as special samples Starting with a general presentation of the governing equations for free surface shallow flows and a discussion of their physical applicability the book goes on to analyse the mathematical properties of the equations in preparation for the presentation of the exact solution of the Riemann problem for wet and dry beds After a general introduction to the finite volume approach several chapters are then devoted to describing a variety of modern shock capturing finite volume numerical methods including Godunov methods of the upwind and centred type Approximate Riemann solvers following various approaches are studied in detail as is their use in the Godunov approach for constructing low and high order upwind TVD methods Centred TVD schemes are also presented Two chapters are then devoted to practical applications The book finishes with an overview of potential practical applications of the methods studied along with appropriate reference to sources of further information Features include Algorithmic and practical presentation of the methods Practical applications such as dam break modelling and the study of bore reflection patterns in two space dimensions Sample computer programs and accompanying numerical software details available at www.numeritek.com The book is suitable for teaching postgraduate students of civil mechanical hydraulic and environmental engineering meteorology oceanography fluid mechanics and applied mathematics Selected portions of the material may also be useful in teaching final year undergraduate students in the above disciplines The contents will also be of interest to research scientists and engineers in academia and research and consultancy laboratories

The Finite Element Method for Fluid Dynamics R. L. Taylor, P. Nithiarasu, 2024-11-20 The Finite Element Method for Fluid Dynamics provides a comprehensive introduction to the application of the finite element method in fluid dynamics The book begins with a useful summary of all relevant partial differential equations progressing to the discussion of convection stabilization procedures steady and transient state equations and numerical solution of fluid dynamic equations In this expanded eighth edition the book starts by explaining the character based split CBS scheme followed by an exploration of various other methods including SUPG PSPG space time and VMS methods Emphasising the fundamental knowledge mathematical and analytical tools necessary for successful implementation of computational fluid dynamics CFD The Finite Element Method for Fluid Dynamics stands as the authoritative introduction of choice for graduate level students researchers and professional engineers A proven keystone

reference in the library for engineers seeking to grasp and implement the finite element method in fluid dynamics Founded by a prominent pioneer in the field this eighth edition has been updated by distinguished academics who worked closely with Olgierd C Zienkiewicz Includes new chapters on data driven computational fluid dynamics and independent adaptive mesh and buoyancy driven flow chapters *Shallow Water Hydrodynamics* W.Y. Tan,1992-08-17 Within this monograph a comprehensive and systematic knowledge on shallow water hydrodynamics is presented A two dimensional system of shallow water equations is analyzed including the mathematical and mechanical backgrounds the properties of the system and its solution Also featured is a new mathematical simulation of shallow water flows by compressible plane flows of a special virtual perfect gas as well as practical algorithms such as FDM FEM and FVM Some of these algorithms have been utilized in solving the system while others have been utilized in various applied fields An emphasis has been placed on several classes of high performance difference schemes and boundary procedures which have found wide uses recently for solving the Euler equations of gas dynamics in aeronautical and aerospace engineering This book is constructed so that it may serve as a handbook for practitioners It will be of interest to scientists designers teachers postgraduates and professionals in hydraulic marine and environmental engineering especially those involved in the mathematical modelling of shallow water bodies

Numerical Methods for the Three-dimensional Shallow Water Equations on Supercomputers E. D. de Goede,1993 Holl Zusammenfass *Dispersive Shallow Water Waves* Gayaz Khakimzyanov,Denys Dutykh,Zinaida Fedotova,Oleg Gusev,2020-09-15 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 **Non-Hydrostatic Free Surface Flows** Oscar Castro-Orgaz,Willi H. Hager,2017-03-27 This book provides essential information on the higher mathematical level of

approximation over the gradually varied flow theory also referred to as the Boussinesq type theory In this context it presents higher order flow equations together with their applications in a broad range of pertinent engineering and environmental problems including open channel groundwater and granular material flows Computational Algorithms for Shallow Water Equations Eleuterio F. Toro,2024-08-01 This book is a thoroughly revised and enlarged version of Shock capturing methods for free surface shallow flows first published by Wiley and Sons 2001 The book describes mathematically free surface flows through partial differential equations and includes modern shock capturing methods to solve them with strong emphasis on finite volume upwind and centred methods Such equations and methods are fundamental in simulating shallow water flows but also atmospheric flows dispersion of dense gases and the dynamics of mixtures of materials The book is accompanied by numerical software in the form of sample computer programs as supplementary material In this new edition additional sections have been introduced to existing chapters Also new chapters have been included one contains a review of the mathematics of hyperbolic partial differential equations another introduces the numerical analysis of partial differential equations and another one deals with advanced very high order numerical methods in the finite volume and discontinuous Galerkin frameworks Furthermore comprehensive modifications and corrections have been made throughout various sections of the text and numerous figures depicting numerical results have been enhanced This book is primarily intended for environmental scientists applied mathematicians and engineers in academia research laboratories industry and consultancy organisations Senior undergraduate and postgraduate students involved with mathematical modelling and computational methods for environmental problems will benefit from studying this book Lecturers could use most of the material for courses on numerical methods for wave propagation problems in hydraulics oceanography atmospheric and other geophysical fluid dynamics contexts *Numerical Solution of the Shallow-water Equations* F. W. Wubs,1988 **Shallow Flows** Gerhard H. Jirka,Wim S.J. Uijttewaai,2004-09-15 This text presents the key findings of the International Symposium held in Delft in 2003 which explored the process of shallow flows Shallow flows are found in lowland rivers lakes estuaries bays coastal areas and in density stratified atmospheres and may be observed in puddles as in oceans They impact on the life and work of a wide variety of readers who are here provided with a clear overview of the subject Shallow flows are intrinsically turbulent On one hand there are strongly three dimensional small scale turbulent motions and on the other hand large scale quasi two dimensional turbulence This book explains and examines these differences and their effects with sections on transport processes in shallow flows shallow jets wakes and mixing layers stratified and rotating flows in ocean and atmosphere river and channel flows and numerical modelling and turbulence closure techniques The reader is provided with the pick of current studies and a fresh approach to the subject with expert examination of a fascinating and crucial phenomenon of our world s water systems **Coanda Effect** Noor A Ahmed,2019-08-28 Coanda effect is a complex fluid flow phenomenon enabling the production of vertical take off landing aircraft Other applications range from helicopters to

road vehicles from flow mixing to combustion from noise reduction to pollution control from power generation to robot operation and so forth Book starts with description of the effect its history and general formulation of governing equations simplifications used in different applications Further it gives an account of this effect s lift boosting potential on a wing and in non flying vehicles including industrial applications Finally occurrence of the same in human body and associated adverse medical conditions are explained

Hydrobiological Modelling Brian J. Williams,2006 The book describes models of aquatic ecosystems ranging from lakes to estuaries to the deep ocean It provides a background in the physical and biological processes numerical methods and elementary ecosystem models It describes two of the most widely used hydrodynamic models and presents a number of case studies The practice of modelling in management is discussed Numerical Solution of the Shallow Water Equations David L. Whitfield,1996 Hydrodynamics : Theory and Applications A. T. Chwang,Joseph H. W. Lee,D. Y. C. Leung,1996

Advances in Fluid Mechanics Dia Zeidan,Lucy T. Zhang,Eric Goncalves Da Silva,Jochen Merker,2022-06-06 This edited book provides invited and reviewed contributions in mathematical physical and experimental modelling and simulations in all fluid mechanics branches Contributions explore the emerging and state of the art tools in the field authored by well established researchers to derive improved performance of modelling and simulations Serving the multidisciplinary fluid mechanics community this book aims to publish new research work that enhances the prediction and understanding of fluid mechanics and balances from academic theory to practical applications through modelling numerical studies algorithms and simulation The book offers researchers students and practitioners significant insights on modelling and simulations in fluid mechanics It offers readers a range of academic contributions on fluid mechanics by researchers that have become leaders in their field The research work presented in this book will add values to the existing literature in terms of what needs to be done better to direct modelling and simulations towards a growing and rapidly developing field

Informatics, Networking and Intelligent Computing Jiaying Zhang,2015-05-06 This proceedings volume contains selected papers presented at the 2014 International Conference on Informatics Networking and Intelligent Computing held in Shenzhen China Contributions cover the latest developments and advances in the field of Informatics Networking and Intelligent Computing Computational Fluid Dynamics Paul D. Bates,Stuart N. Lane,Robert I. Ferguson,2005-08-05

Uniquely outlines CFD theory in a manner relevant to environmental applications This book addresses the basic topics in CFD modelling in a thematic manner to provided the necessary theoretical background as well as providing global cases studies showing how CFD models can be used in practice demonstrating how good practice can be achieved with reference to both established and new applications First book to apply CFD to the environmental sciences Written at a level suitable for non mathematicians **Parallel Computational Fluid Dynamics '98** Chiao-ling Lin,P. Fox,A. Ecer,N. Satofuka,Jacques Periaux,1999-05-26 This book contains the papers presented at the Parallel Computational Fluid Dynamics 1998 Conference The book is focused on new developments and applications of parallel technology Key topics are introduced through

contributed papers and invited lectures. These include typical algorithmic developments such as distributed computing, domain decomposition, and parallel algorithms. Some of the papers address the evaluations of software and machine performance and software tool environments. The application of parallel computers to complex fluid dynamics problems are also conveyed through sessions such as DNS, LES, combustion, and reacting flows, industrial applications, water resources, and environmental flows. The editors believe this book will provide many researchers much beyond those contributing to this volume with fresh information and reference.

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