Computational Hydraulics Numerical Methods And Modelling

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Computational Hydraulics Numerical Methods And Modelling ***2023-11-13***

LEE JAIDEN

Computational Hydraulics Springer Nature
The expansion of unconventional petroleum resources in the recent decade and the rapid development of computational technology have provided the opportunity to develop and apply 3D numerical modeling technology to simulate the hydraulic fracturing of shale and tight sand formations. This book presents 3D numerical modeling technologies for hydraulic fracturing developed in recent years, and introduces solutions to various 3D geomechanical problems related to hydraulic fracturing. In the solution processes of the case studies included in the book, fully coupled multi-physics modeling has been adopted, along with innovative computational techniques, such as submodeling. In practice, hydraulic fracturing is an essential project component in shale gas/oil development and tight sand oil, and provides an essential measure in the process of drilling cuttings reinjection (CRI). It is also an essential measure for widened mud weight window (MWW) when drilling through naturally fractured formations; the process of hydraulic plugging is a typical application of hydraulic fracturing. 3D modeling and numerical analysis of hydraulic fracturing is essential for the successful development of tight oil/gas formations: it provides accurate solutions for optimized stage intervals in a multistage fracking job. It also provides optimized well-spacing for the design of zipper-frac wells. Numerical estimation of casing integrity under stimulation injection in the hydraulic fracturing process is one of major concerns in the successful development of unconventional resources. This topic is also investigated numerically in this book. Numerical solutions to several other typical geomechanics problems related to hydraulic fracturing, such as fluid migration caused by fault reactivation and seismic activities, are also presented. This book can be used as a reference textbook to petroleum, geotechnical and geothermal engineers, to senior undergraduate, graduate and postgraduate students, and to geologists, hydrogeologists, geophysicists and applied mathematicians working in this field. This book is also a synthetic compendium of both the fundamentals and some of the most advanced aspects of hydraulic fracturing technology.
Advances in Control and Automation of Water Systems Springer Science & Business Media
Hot Topics in Infection and Immunity II provides a current view from leading experts concerning the hottest topics of concern to clinicians caring for children with infections. The book brings together a collection of manuscripts from a faculty of authors of international standing who contributed to a course in Paediatric Infection and Immunity in Oxford, UK in June 2004.
Computational Algorithms for Shallow Water Equations SIAM
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.
Engineering Applications of Computational Hydraulics Butterworth-Heinemann
Now in its fifth edition, Hydraulics in Civil and Environmental Engineering combines thorough coverage of the basic principles of civil engineering hydraulics with wide-ranging treatment of practical, real-world applications. This classic text is carefully structured into two parts to address principles before moving on to more advanced topics. The first part focuses on fundamentals, including hydrostatics, hydrodynamics, pipe and open channel flow, wave theory, physical modeling, hydrology, and sediment transport. The second part illustrates the engineering applications of these fundamental principles to pipeline system design; hydraulic structures; and river, canal, and coastal engineering—including up-to-date environmental implications. A chapter on computational hydraulics demonstrates the application of computational simulation techniques to modern design in a variety of contexts. What’s New in This Edition Substantive revisions of the chapters on hydraulic machines, flood hydrology, and computational modeling New material added to the chapters on hydrostatics, principles of fluid flow, behavior of real fluids, open channel flow, pressure surge in pipelines, wave theory, sediment transport, river engineering, and coastal engineering The latest recommendations on climate change predictions, impacts, and adaptation measures Updated references Hydraulics in Civil and Environmental Engineering, Fifth Edition is an essential resource for students and practitioners of civil, environmental, and public health engineering and associated disciplines. It is comprehensive, fully illustrated, and contains many worked examples. Spreadsheets and useful links to other web pages are available on an accompanying website, and a solutions manual is available to lecturers.
Computational Methods in Water Resources John Wiley & Sons
Introduction to the Numerical Analysis of Incompressible Viscous Flows treats the numerical analysis of finite element computational fluid dynamics. Assuming minimal background, the text covers finite element methods; the derivation, behavior, analysis, and numerical analysis of Navier-Stokes equations; and turbulence and turbulence models used in simulations. Each chapter on theory is followed by a numerical analysis chapter that expands on the theory. This book provides the foundation for understanding the interconnection of the physics, mathematics, and numerics of the incompressible case, which is essential for progressing to the more complex flows not addressed in this book (e.g., viscoelasticity, plasmas, compressible flows, coating flows, flows of mixtures of fluids, and bubbly flows). With mathematical rigor and physical clarity, the book progresses from the mathematical preliminaries of energy and stress to finite element computational fluid dynamics in a format manageable in one semester. Audience: this unified treatment of fluid mechanics, analysis, and numerical analysis is intended for graduate students in mathematics, engineering, physics, and the sciences who are interested in understanding the foundations of methods commonly used for flow simulations.
Computational Hydraulics CRC Press
This handbook covers computational fluid dynamics from fundamentals to applications. This text provides a well documented critical survey of numerical methods for fluid mechanics, and gives a state-of-the-art description of computational fluid mechanics, considering numerical analysis, computer technology, and visualization tools. The chapters in this book are invaluable tools for reaching a deeper understanding of the problems associated with the calculation of fluid motion in various situations: inviscid and viscous, incompressible and compressible, steady and unsteady, laminar and turbulent flows, as well as simple and complex geometries. Each chapter includes a related bibliography Covers fundamentals and applications Provides a deeper understanding of the problems associated with the calculation of fluid motion
Engineeing applications to computational hydraulics CRC Press
There has been an explosive growth of methods in recent years for learning (or estimating dependency) from data, where data refers to known samples that are combinations of inputs and corresponding outputs of a given physical system. The main subject addressed in this thesis is model induction from data for the simulation of hydrodynamic processes in the aquatic environment. Firstly, some currently popular artificial neural network architectures are introduced, and it is then argued that these devices can be regarded as domain knowledge incapsulators by applying the method to the generation of wave equations from hydraulic data and showing how the equations of numerical-hydraulic models can, in their turn, be recaptured using artificial neural networks. The book also demonstrates how artificial neural networks can be used to generate numerical operators on non-structured grids for the simulation of hydrodynamic processes in two-dimensional flow systems and a methodology has been derived for developing generic hydrodynamic models using artificial neural network. The book also highlights one other model induction technique, namely that of support vector machine, as an emerging new method with a potential to provide more robust models.
Numerical Methods for Shallow-Water Flow Routledge
"This book delves into the increasing role of computers, particularly personal computers, in solving hydraulic problems across various engineering disciplines, with a specific focus on civil engineering's hydraulics and water resources aspects. By leveraging Microsoft Excel, readers can easily grasp hydraulic principles and apply them to numerous problems without the need for complex software codes. The content has been refined through years of teaching Computational Hydraulics at the master's level and based on the theses of numerous doctoral and graduate students. It is designed for undergraduate and graduate students who have completed prerequisite courses in fluid mechanics, hydraulics, and differential equations. The book can be studied over two semesters and is also valuable for engineers seeking insights into this subject. Throughout the book, theoretical concepts are reinforced with a wealth of examples solved at the end of each chapter. These examples comprehensively address practical complexities, enhancing the reader's understanding. Moreover, the book covers not only "computer hydraulics" but also touches on "computational fluid dynamics" to provide a broader perspective on the subject, incorporating examples from environmental and structural engineering. The book introduces the finite differences method, a valuable tool for solving common partial differential equations used in fluid mechanics and hydraulics. It also presents alternative solution methods for three types of partial differential equations: elliptic, parabolic, and hyperbolic, supplemented with real-world applications and thorough solutions. Recommended primarily for third and fourth-year undergraduate and graduate students, the book caters to those interested in numerical modeling, including software developers working on finite difference numerical methods. In summary, the book is a comprehensive resource for those in the fields of civil and environmental engineering, offering practical problem-solving skills for real-world applications and serving as a guide for software developers creating programs related to finite difference numerical methods"--
Elements of Computational Hydraulics Syrawood Publishing House
Control and automation of water systems in one of the branches of fluid mechanics and hydraulics that uses numerical methods and algorithms to solve and analyze problems that involve fluid flows. Computers are used to perform the millions of calculations required to simulate the interaction of liquids and gases with surfaces defined by boundary conditions. Advances in Control and Automation of Water Systems presents topical research in the study of control and automation of water systems. The editors use the simulation of a water hammer (or fluid hammer) as the basis for demonstrating computational techniques used for the processing and automation of water systems. The simulation shows and explains a variety of data analysis techniques and complex calculations that involve many elements of water systems, such as flow minimum and maximum pressure automation heat and mass transfer predicting failure and more. This book provides a broad understanding of the main computational techniques used for processing control and automation of water systems. The theoretical background to a number of techniques is introduced, and general data analysis techniques and examining the application of techniques in an industrial setting, including current practices and current research, are considered. The book also provides practical experience of commercially available systems and includes a small-scale water systems related projects. This book provides innovative chapters on the growth of educational, scientific, and industrial research activities among mechanical engineers and international academia in the water industry. New methods and novel applications of existing methods are discussed that further

the understanding of the structural behavior of new and advanced systems. This book presents significant research reporting new methodologies and important applications in the fields of automation and control as well as the latest coverage of chemical databases and the development of new computational methods and efficient algorithms for hydraulic software and mechanical engineering. The research and development presented in the book will have significant potential applications in several disciplines of hydraulic and mechanical engineering.

Wave Propagation in Fluids CRC Press

Hydraulic engineering is a branch of civil engineering that deals with the flow of fluid, typically water and sewage, through conduits and makes use of gravity for the movement of fluid. It involves designing structures with the capacity to remove or divert water from the roadways and pass the collected water from under the roadway. Hydraulic engineering is also concerned with the technical challenges involved in sewerage design and water infrastructure. It is used for creating bridges, sewers, dams, canals, etc. The computational aspects of hydraulics with respect to civil engineering problems are dealt with under the discipline of computational hydraulics, which contains methods and techniques for numerical simulation of water flows in natural or manmade systems with the aid of computers. In such systems, flow and transport is modeled using computer tools such as computer graphics, statistical analysis methods, electronic databases, and spreadsheets. This book contains some path-breaking studies related to computation, analysis, and modeling within hydraulic engineering. It will serve as a valuable source of reference for graduate and postgraduate students.

Open Channel Flow Butterworth-Heinemann

What is the progress in hydraulic research? What are the new methods used in modeling of transport of momentum, matter and heat in both open and conduit channels? What new experimental methods, instruments, measurement techniques, and data analysis routines are used in top class laboratory and field hydro-environment studies? How to link novel findings in fundamental hydraulics with the investigations of environmental issues? The consecutive 32nd International School of Hydraulics that took place in Łochów, Poland brought together eminent modelers, theoreticians and experimentalists as well as beginners in the field of hydraulics to consider these and other questions about the recent advances in hydraulic research all over the world. This volume reports key findings of the scientists that took part in the meeting. Both state of the art papers as well as detailed reports from various recent investigations are included in the book

Advances in Hydroscience CRC Press

A comprehensive treatment of open channel flow, Open Channel Flow: Numerical Methods and Computer Applications starts with basic principles and gradually advances to complete problems involving systems of channels with branches, controls, and outflows/ inflows that require the simultaneous solutions of systems of nonlinear algebraic equations coupled with differential equations. The book includes downloadable resources that contain a program that solves all types of simple open channel flow problems, the source programs described in the text, the executable elements of these programs, the TK-Solver and MathCad programs, and the equivalent MATLAB® scripts and functions. The book provides applied numerical methods in an appendix and also incorporates them as an integral component of the methodology in setting up and solving the governing equations. Packed with examples, the book includes problems at the end of each chapter that give readers experience in applying the principles and often expand upon the methodologies use in the text. The author uses Fortran as the software to supply the computer instruction but covers math software packages such as MathCad, TK-Solver, MATLAB, and spreadsheets so that readers can use the instruments with which they are the most familiar. He emphasizes the basic principles of conservation of mass, energy, and momentum, helping readers achieve true mastery of this important subject, rather than just learn routine techniques. With the enhanced understanding of the fundamental principles of fluid mechanics provided by this book, readers can then apply these principles to the solution of complex real-world problems. The book supplies the knowledge tools necessary to analyze and design economical and properly performing conveyance systems. Thus not only is the book useful for graduate students, but it also provides professional engineers the expertise and knowledge to design well performing and economical channel systems.

Elements of Computational Hydraulics Springer Science & Business Media

This is the updated new edition from the founder and inventor of the subject. It provides an account of the principles and a survey of modelling in hydraulic, coastal and offshore engineering.

Introduction to the Numerical Analysis of Incompressible Viscous Flows Springer Science & Business Media

What is Computational Hydraulics? Computational hydraulics is one of the many fields of science in which the application of computers gives rise to a new way of working, which is intermediate between purely theoretical and experimental. It is concerned with simulation ofthe flow of water, together with its consequences, using numerical methods on com puters. There is not a great deal of difference with computational hydrodynamics or computational fluid dynamics, but these terms are too much restricted to the fluid as such. It seems to be typical of practical problems in hydraulics that they are rarely directed to the flow by itself, but rather to some consequence of it, such as forces on obstacles, transport of heat, sedimentation of a channel or decay of a pollutant. All these subjects require very similar numerical methods and this is why they are treated together in this book. Therefore, I have preferred to use the term computational hydraulics. Accordingly, I have attempted to show the wide field of application by giving examples of a great variety of such practical problems. Purpose of the Book It is getting a normal situation that an engineer is required to solve some engineering problem involving fluid flow, using standard and general-purpose computer programs available in many organizations. In many instances, the software has been designed with the claim that no numerical or computer-science expertise is needed in using them.

Hydraulic Engineering: Computation, Analysis and Modeling CRC Press

This book presents the theory and computation of open channel flows, using detailed analytical, numerical and experimental results. The fundamental equations of open channel flows are derived by means of a rigorous vertical integration of the RANS equations for turbulent flow. In turn, the hydrostatic pressure hypothesis, which forms the core of many shallow water hydraulic models, is scrutinized by analyzing its underlying assumptions. The book’s main focus is on one-dimensional models, including detailed treatments of unsteady and steady flows. The use of modern shock capturing finite difference and finite volume methods is described in detail, and the quality of solutions is carefully assessed on the basis of analytical and experimental results. The book’s unique features include: • Rigorous derivation of the hydrostatic-based shallow water hydraulic models • Detailed treatment of steady open channel flows, including the computation of transcritical flow profiles • General analysis of gate maneuvers as the solution of a Riemann problem • Presents modern shock capturing finite volume methods for the computation of unsteady free surface flows • Introduces readers to movable bed and sediment transport in shallow water models • Includes numerical solutions of shallow water hydraulic models for non-hydrostatic steady and unsteady free surface flows This book is suitable for both undergraduate and graduate level students, given that the theory and numerical methods are progressively introduced starting with the basics. As supporting material, a collection of source codes written in Visual Basic and inserted as macros in Microsoft Excel® is available. The theory is implemented step-by-step in the codes, and the resulting programs are used throughout the book to produce the respective solutions.

Computational Hydraulics Pitman Advanced Publishing Program

An account of principles and survey modelling in hydraulic, coastal and offshore engineering. Amongst the topics covered are discrete forms of conservation laws, numerical methods, the foundations of computational hydraulics, and applications of computational hydraulics.

Model Induction from Data CRC Press

Advances in Hydroscience, Volume 14-1986 covers topics on the frontiers of hydroscience, including urban hydrology, remote sensing, sewer hydraulics, and computational hydraulics. The book presents articles on state-of-the-art theory and practice in sewer hydraulics and the passive microwave remote sensing of soil moisture. An article on the numerical modeling of unsteady open-channel flow is also encompassed. Hydraulic engineers, hydrologists, earth scientists, agricultural engineers, soil scientists, environmental engineers, and urban designers and planners will find the text invaluable.

Computational hydraulics Springer Nature

An introduction to the Large-Eddy-Simulation (LES) method, geared primarily toward hydraulic and environmental engineers, the book covers special features of flows in water bodies and summarizes the experience gained with LES for calculating such flows. It can also be a valuable entry to the subject of LES for researchers and students in all fields of fluids engineering, and the applications part will be useful to researchers interested in the physics of flows governed by the dynamics of coherent structures.

Computational Hydraulics IWA Publishing

Open channel hydraulics has always been a very interesting domain of scienti c and engineering activity because of the great importance of water for human l- ing. The free surface ow, which takes place in the oceans, seas and rivers, can be still regarded as one of the most complex physical processes in the environment. The rst source of dif culties is the proper recognition of physical ow processes and their mathematical description. The second one is related to the solution of the derived equations. The equations arising in hydrodynamics are rather comp- cated and, except some much idealized cases, their solution requires application of the numerical methods. For this reason the great progress in open channel ow modeling that took place during last 40 years paralleled the progress in computer technique, informatics and numerical methods. It is well known that even ty- cal hydraulic engineering problems need applications of computer codes. Thus, we witness a rapid development of ready-made packages, which are widely d- seminated and offered for engineers. However, it seems necessary for their users to be familiar with some fundamentals of numerical methods and computational techniques applied for solving the problems of interest. This is helpful for many r- sons. The ready-made packages can be effectively and safely applied on condition that the users know their possibilities and limitations. For instance, such knowledge is indispensable to distinguish in the obtained solutions the effects coming from the considered physical processes and those caused by numerical artifacts.

Numerical Modeling in Open Channel Hydraulics Pitman Advanced Publishing Program

Computational Hydraulics provides an introduction to computational techniques for hydraulic and fluid flow engineers. It combines classical hydraulics with new methods such as finite elements and boundary elements, which are both presented in a matrix formulation. The most interesting feature of the book is the integrated treatment given to the theoretical and computing aspects of numerical methods. The format presents a series of complete computer programs, for linear and non-linear pipe network analysis, depth flow computations, and finite and boundary elements for Laplace equations. The programs, which are written in standard FORTRAN, are self-contained and easy to implement in any computer. The book is the product of several years' experience in teaching and research at undergraduate and post-graduate level and can be used to offer a self-contained course on Computational Hydraulics for final year or M.Sc. Engineering students. The authors hope that this book will make practicing hydraulic engineers more aware of modern computer techniques and be useful in teaching them to the next generation.